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Research Article

Consumer Behavior of Potato Donuts in Malang, Indonesia: An Extended Theory of Planned Behavior (ETPB) Approach

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ARTICLE INFO	ABSTRACT
	The potato donut industry has experienced a decline in revenue, compounded by consumer complaints regarding service quality post-COVID-19. Understanding consumer behavior and seller service standards is crucial for enhancing purchasing decisions. This study aims to investigate the influence of attitude towards behavior, subjective norms, perceived behavioral control, and service quality on purchase intention for potato donuts, as well as the impact of service quality and behavioral control on purchase decisions, and the pivotal role of purchase intention therein. A sample of 70 respondents aged 15-55 participated, with primary data collection conducted via online questionnaires distributed through Google Forms in November 2023. Structural equation modeling (SEM) analysis performed using WarpPLS 8.0 software revealed that attitudes towards behavior, subjective norms, and perceived behavioral control positively and significantly influenced purchase intention for potato donuts, while service quality yielded no significant effect. Neither perceived behavioral control nor service quality exerted influence on purchase decisions for potato donuts. Notably, purchase intention emerged as a highly significant determinant of purchase decisions.

INTRODUCTION

The advancement of agribusiness in Indonesia is typified by the proliferation of agriculturally based processed food. The ongoing expansion of processed food products continues to underpin the local economy due to its swift progression. Entrepreneurs are drawn to the promising prospects within the processed food sector. Consequently, this phenomenon is regarded as an avenue for transitioning household industry commodities into broader-scale food industry products, thereby fostering community autonomy (Putri et al., 2020). Notably, among these products are processed foods derived from potatoes.

Potatoes (Solanum tuberosum L.) represent a crop of significant economic importance (Yuminarti et al., 2021) and are readily amenable to processing. The production volume of potatoes has seen an increase, rising from 1.36 million metric tons in 2021 to 1.5 million in 2022. Notably, the highest production levels were recorded in East Java, amounting to 3.8 tons (BPS, 2023). Concurrently, in Malang, the production volume

surged from 3.1 metric tons in 2019 to 3.2 metric tons in 2020 (BPS Kabupaten Malang, 2020). The substantial potato production in East Java, particularly in Malang, presents opportunities for augmenting the economic value of potatoes through their processing into value-added foods.

In Malang, the production rate of processed foods derived from potatoes reached 26.9% in 2014, a figure that has since experienced a sustained rise alongside the growing popularity of fast food consumption among the local populace. Particularly, potato-based products such as potato donuts have emerged as a significant source of income for Malang residents (Nugroho Wicaksono & Soelistyo, 2022).

One of the renowned potato donut brands in Malang is "Donat Kentang Malang," operating as a substantial micro, small, and medium enterprise (MSME) situated in Penanggungan, Klojen, Malang (KIMGERABAH, 2022). Presently, this MSME operates three branches located on Tlogomas street, Sigura-gura Dam, and Tirto Utomo. Established in 2012, it has amassed over a decade of operational experience, witnessing a remarkable surge in revenue of 3000-4000% by 2022. This empirical observation finds corroboration in the research conducted by Putri et al. (2020), which yielded congruent findings in the sales report of "Mama Syifa's Potato Donuts" in Medan. Over a 14-year span, sales escalated by up to 4800%. It can be inferred from the study by Haq and Wulandari (2020) that potato-based food entrepreneurs with greater business experience possess enhanced knowledge and expertise, thereby enabling them to adeptly navigate challenges compared to their less experienced counterparts.

The COVID-19 pandemic led to a decline in revenue for "Donut Kentang Malang," attributed to the implementation of the PPKM policy. Concurrently, numerous consumers expressed dissatisfaction regarding inadequate service quality across various social media platforms. Given these challenges, elucidating the intentions and behaviors of potato donut consumers, along with discerning their service quality preferences, becomes imperative for enhancing purchasing decisions. The conceptual framework of consumer behavior encompasses attitudes, subjective norms, and behavioral control, all of which wield influence over purchase intentions and decisions.

Service quality variables are integrated as predictive factors to evaluate purchase intentions and decisions in response to observed phenomena in the field, particularly customer concerns regarding service delivery by staff and provided facilities. Within the construct of service quality, this study focuses on five indicators, including tangibility, reliability, responsiveness, assurance, and empathy (Ponnaiyan et al., 2021)

Hence, it is imperative to investigate purchasing behavior and service quality. The research questions posed are as follows: How do attitude towards behavior, subjective norms, perceived behavioral control, and service quality affect the purchase intentions of potato donut consumers? How do perceived behavioral control and service quality impact the purchasing decisions regarding potato donuts? How do purchase intention affect the decision-making process of purchasing potato donuts?

This study employs the Theory of Planned Behavior (TPB) and incorporates service quality variables to comprehend consumer behavior concerning potato donuts. The TPB framework is utilized to elucidate the factors influencing consumer behavior in product purchasing decisions (Ajzen, 2015). Notably, TPB has been effectively applied across various scientific domains, including food consumption choices (Ajzen, 2015). This theory furnishes accurate predictions regarding intentions related to food consumption, encompassing intentions to consume soft drinks, fish, and dairy products (Ajzen, 2015). Furthermore, findings from research conducted by Divayana et al. (2022) indicate that the utilization of attitude variables and subjective norms positively and significantly influences purchase intentions in the context of acquiring Shirataki instant noodle products. Specifically, subjective norms, attitudes towards behavior, and purchase intentions are examined using the Extended Theory of Planned Behavior (ETPB).

Meanwhile, Lim & An's (2021) research findings demonstrate that perceived behavioral control significantly and positively impacts the purchase intention of Yak-sun Korean healthy food products when employing the Theory of Planned Behavior (TPB). Similarly, Oscar & Keni (2019) study reveals a positive correlation between service quality and purchase intentions and decisions. In contrast, Xiao et al. (2019) report divergent results, indicating a negative relationship between service quality and the purchase intention of Generation Y students in Malaysia. Conducting this study is imperative to prompt potato donut business stakeholders to enhance service quality, potentially stimulating consumer demand for potato donuts. Such initiatives are essential for ensuring the continued survival and growth of "Donat Kentang Malang" amid the escalating competition from similar enterprises in Malang.

The preceding studies generally focus on research conducted within the domains of fast-food establishments, organic food venues, and establishments offering healthy food options. A notable deviation from these research lies in the current study, which centers on processed agricultural food products, specifically

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potato donuts. Whereas previous research typically examined establishments providing on-site dining facilities, the present study of "Donut Kentang Malang" does not feature such amenities. This divergence highlights a research gap concerning the variables considered, as well as disparities in conditions, circumstances, and locales. Consequently, there exists a disparity between the current study and previous research, underscoring the importance of conducting this study to underscore its novelty. Motivated by the aforementioned research context, there arises a necessity to explore the impact of service quality on purchasing interest and decisions regarding processed products at "Donat Kentang Malang," grounded in the Theory of Planned Behavior.

The novelty of this study, in comparison to prior research, lies in its utilization of the Theory of Planned Behavior (TPB) to elucidate and forecast the behaviors of potato donut consumers in distinct situations, with the integration of service quality variables to augment TPB. Previous research has primarily focused on conventional donut purchasing behaviors, manufacturing processes, and marketing strategies for potato donuts. This study aims to ascertain the influence of attitude towards behavior, subjective norms, perceived behavioral control, and service quality on potato donut purchase intentions, as well as the impact of service quality and behavioral control on purchase decisions, alongside the role of purchase intentions in influencing potato donut purchase decisions.

METHOD

This study adopts a quantitative research approach aimed at describing and empirically testing the formulated hypotheses. Site selection for this research followed a purposive sampling method, which involves selecting a site based on specific criteria and objectives to ensure the resulting data's representativeness (Sugiyono, 2018). The research site chosen for this study is situated in Malang, selected due to its notable consumption rates among Malang residents, given its economic significance and relatively high population density. Specifically, the "Donut Kentang Malang" establishment was selected for its strategic location in proximity to educational institutions, workplaces, and residential areas, rendering it frequented by students, employees, and housewives alike.

The sampling technique employed in this study is purposive sampling, selected based on specific considerations (Sugiyono, 2018). Criteria for selecting respondents as samples include individuals who have made purchases at least once from the central outlet of "Donat Kentang Malang" located at Jl. Mayjend Panjaitan No. 5A, Malang, within the age range of 15-55 years. The determination of the sample size in this study adhered to the rule of thumb prescribed by SEM-PLS, which recommends a sample size of 10 times the number of structural paths. Given that this study entailed 7 structural paths, the sample size comprised 70 respondents (Solimun et al., 2022).

This study employed online distribution of questionnaires through Google Forms to collect primary data. The distribution took place via social media platforms throughout November 2023. The variables under investigation were assessed using a Likert scale, specifically a 5-point Likert scale ranging from 1 to 5, wherein 1 represents "Strongly Disagree" (SD); 2 represents "Disagree" (D); 3 represents "Neutral" (N); 4 represents "Agree" (S); and 5 represents "Strongly Agree" (SA) (Azwar, 2013). Data analysis was conducted utilizing Structural Equation Modeling (SEM) analysis through WarpPLS software. This analytical approach enabled the examination of relationships between latent variables and their indicators. The structural equation model (SEM) utilizing WarpPLS 8.0 software was utilized to predict the magnitude of these relationships. A graphical representation of the conceptual model can be observed in Figure 1.
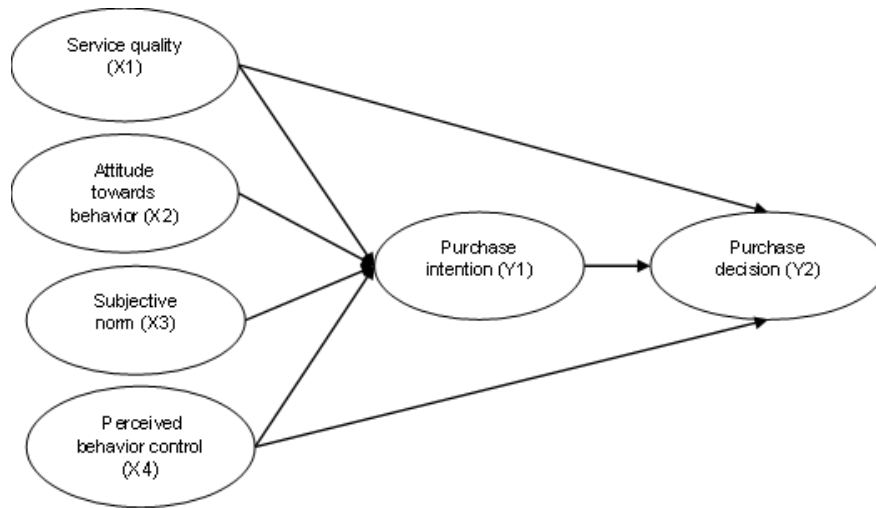
Figure 1. Conceptual research model

RESULTS AND DISCUSSION

Evaluation of partial least squares-structural equation modeling (PLS-SEM) results

Evaluation of this study model uses reflective indicators.

a. Outer Model Structural Model Analysis

The assessment of the reflective model measurement encompasses evaluating composite reliability to measure internal consistency and individual indicator reliability to assess convergent validity. Convergent validity is established when there is a high correlation between the scores obtained from two distinct instruments measuring the same construct (Abdillah & Hartono, 2015).

Tabel 1. Loading and Cross Loading

Indicator	X1	X2	X3	X4	Y1	Y2	Explanation
X1.1	**(0.578)**	-0.539	0.101	-0.282	0.069	0.190	Valid
X1.2	**(0.634)**	0.457	-0.657	-0.405	0.456	-0.181	Valid
X1.3	**(0.841)**	0.128	-0.040	0.182	-0.036	-0.134	Valid
X1.4	**(0.800)**	0.175	0.022	0.001	-0.077	0.155	Valid
X1.5	**(0.722)**	-0.313	0.518	0.368	-0.328	-0.010	Valid
X2.1	0.024	**(0.877)**	-0.085	-0.096	-0.096	0.155	Valid
X2.2	0.045	**(0.832)**	0.274	-0.075	-0.019	-0.104	Valid
X2.3	-0.267	**(0.730)**	-0.155	-0.231	0.604	-0.014	Valid
X2.4	0.011	**(0.743)**	-0.024	0.085	-0.341	0.070	Valid
X2.5	0.155	**(0.828)**	-0.027	0.303	-0.106	-0.111	Valid
X3.1	0.115	0.512	**(0.821)**	-0.328	-0.085	0.259	Valid
X3.2	0.148	0.102	**(0.896)**	-0.264	0.134	-0.019	Valid
X3.3	0.165	0.030	**(0.828)**	0.134	-0.231	0.190	Valid
X3.4	-0.220	-0.419	**(0.801)**	0.367	-0.081	-0.095	Valid
X3.5	-0.302	-0.323	**(0.622)**	0.162	0.331	-0.444	Valid
X4.1	0.029	0.451	-0.305	**(0.712)**	0.063	0.027	Valid
X4.2	-0.145	0.014	-0.095	**(0.806)**	0.159	0.168	Valid
X4.3	-0.197	0.057	0.314	**(0.736)**	0.133	-0.183	Valid
X4.4	0.203	-0.632	0.136	**(0.777)**	0.053	-0.321	Valid
X4.5	0.099	0.141	-0.052	**(0.838)**	-0.372	0.274	Valid
Y1.1	0.115	0.134	-0.323	0.103	**(0.765)**	-0.107	Valid
Y1.2	0.215	-0.435	0.319	-0.096	**(0.774)**	-0.203	Valid
Y1.3	-0.291	-0.050	0.189	0.094	**(0.810)**	0.173	Valid
Y1.4	-0.025	0.360	-0.201	-0.106	**(0.762)**	0.130	Valid
Y2.1	-0.055	-0.006	0.104	-0.024	0.071	**(0.919)**	Valid
Y2.2	-0.008	0.142	0.092	-0.263	0.060	**(0.927)**	Valid
Y2.3	0.076	-0.167	-0.238	0.350	-0.160	**(0.758)**	Valid

Source: Primary Data Processed (2023)

The evaluation of reflective measurement models encompasses the assessment of discriminant validity, which can be quantified by scrutinizing the average variance extracted (AVE) for all items within each indicator. Discriminant validity denotes the degree to which a construct genuinely differs from other constructs according to empirical criteria, where a construct is deemed unique and captures phenomena not accounted for by other constructs in the model.

Tabel 2. Composite Reliability and Cronbach Alpha

	X1	X2	X3	X4	Y1	Y2
Composite reliability	0.842	0.901	0.897	0.882	0.860	0.904
Cronbach alpha	0.763	0.862	0.854	0.832	0.783	0.838

Source: Primary data processed (2023)

Tabel 3. Square Root of AVE (AVEs) Discriminant Validity Test Results

Variable	X1	X2	X3	X4	Y1	Y2
Service Quality (X1)	**(0.722)**	0.698	0.633	0.571	0.559	0.478
Attitude towards behavior (X2)	0.698	**(0.804)**	0.606	0.663	0.536	0.409
Subjective Norm (X3)	0.633	0.606	**(0.799)**	0.496	0.638	0.587
Perceived behavior control (X4)	0.571	0.663	0.496	**(0.775)**	0.751	0.544
Purchase Intention (Y1)	0.559	0.536	0.638	0.751	**(0.778)**	0.735
Purchase Decision (Y2)	0.478	0.409	0.587	0.544	0.735	**(0.872)**

Source: Primary data processed (2023)

1. Assessment of Indicator Loadings (Factor Loading).

Table 1 reveals that the loading factor values for all indicators are ≥ 0.5, indicating that each indicator meets the criteria for convergent validity, as suggested by Hair (2014) who considers a factor loading value meaningful if ≥ 0.5.

2. Assessment of Internal Consistency Reliability.

Table 2 illustrates that the Composite Reliability (CR) values for all variables range from 0.70 to 0.9, indicating that all variables meet the criteria for composite reliability, with values ranging from good to satisfactory, as noted by Hair et al. (2019). Additionally, the Cronbach's alpha value for all variables exceeds 0.6, demonstrating that the questionnaire meets the criteria for internal consistency reliability across all variables (Solimun et al., 2022).

3. Assessment of Discriminant Validity.

Table 1 demonstrates that the loading factor values for each designated variable exceed the cross-loading values with other variables, thereby confirming the presence of discriminant validity for all indicators (Hair et al., 2019). Moreover, Table 3 indicates that the Average Variance Extracted (AVE) for all latent variables (highlighted in bold) surpasses that of all other indicator model variants (not in bold), underscoring the validity of all indicators in the questionnaire (Hair et al., 2019).

From the analysis presented in Tables 1, 2, and 3, it is evident that all indicator criteria and questionnaire items meet the specified standards, thus affirming the validity and reliability of the construct.

b. Inner Model Structural Model Analysis

Table 4 reveals that the Average Path Coefficient (APC), Average R-squared (ARS), and Average Adjusted R-squared (AARS) each exhibit a p-value < 0.001, indicating significance at the $p < 0.05$ level, thus confirming the fulfillment of model fit requirements (Solimun et al., 2022). The average block Variance Inflation Factor (VIF) registers at 2.154, while the average full collinearity VIF (AFVIF) stands at 2.774, both falling within the ideal range, thereby signifying the absence of collinearity issues within the model (Solimun et al., 2022). Specifically, the AVIF, an indicator of multicollinearity, must be below 5. Additionally, the Goodness of Fit (GoF) value of 0.670 indicates satisfactory model fit criteria. The Sympson's Paradox Ratio (SPR) value of 1 signifies ideal fit criteria, suggesting the absence of Sympson's Paradox issues within the model. Moreover, the R-squared Contribution Ratio (RSCR) value of 1 denotes optimal fit criteria, indicating no negative R-squared contribution to the model. The Statistical Suppression Ratio (SSR) and Nonlinear Bivariate Causality Direction Ratio (NBCDR) values of 1 signify model acceptance.

Tabel 4. Model fit and quality indices

Criteria	Criteria Fit	Analysis Result	Explanation
Average Path Coefficient (APC)	P< 0.05	0.296, P=0.002	Qualify model fit
Average R-squared (ARS)	P< 0.05	0.715, P<0.001	Qualify model fit
Average adjusted R-squared (AARS)	P< 0.05	0.701, P<0.001	Qualify model fit
Average block VIF (AVIF)	Accepted if ≤ 5, ideally ≤ 3.3	2.154	Ideally
Average full collinearity VIF (AFVIF)	Accepted if ≤ 5, ideally ≤ 3.3	2.774	Ideally
Goodness of Fit (GoF)	Small≥ 0.1, Medium≥ 0.25, Big ≥ 0.36	0.670	Big
Sympson's paradox ratio (SPR)	Accepted if ≥ 0.7, ideal ≥1	1	Ideally
R- squared contribution ratio (RSCR)	Accepted if ≥ 0.9, ideal ≥1	1	Ideally
Statistical suppression ratio (SSR)	Accepted if ≥ 0.7	1	Accepted
Nonlinear bivariate causality direction ratio (NLBCDR)	Accepted if ≥ 0.7	1	Accepted

Source: Primary data processed (2023)

Drawing from the comprehensive analysis results presented in the table, it is evident that all model fit criteria have been satisfactorily met. This observation aligns with the assertion by Solimun et al., (2022), who contend that when the goodness of fit criteria are met consistently, the research model is deemed sound and viable.

Hypothesis Testing

Hypothesis testing is conducted to assess the proposed hypotheses' overall impact. As depicted in Figure 2, the R2 value for the purchase intention variable (Y1) is 0.84, indicating that service quality variables, behavioral attitudes, subjective norms, and behavioral control collectively account for 84% of the variance in purchase intention, with the remaining 16% attributed to external variables beyond the model. Regarding the purchasing decision variable (Y2), the R2 value stands at 0.59, signifying that service quality, behavioral attitudes, subjective norms, perceived behavioral control, and purchase intentions collectively influence 59% of purchasing decisions, while 41% of the variance is influenced by external variables not included in the model. The positive R-squared value indicates a favorable influence of the exogenous variable on the endogenous variable in this study.
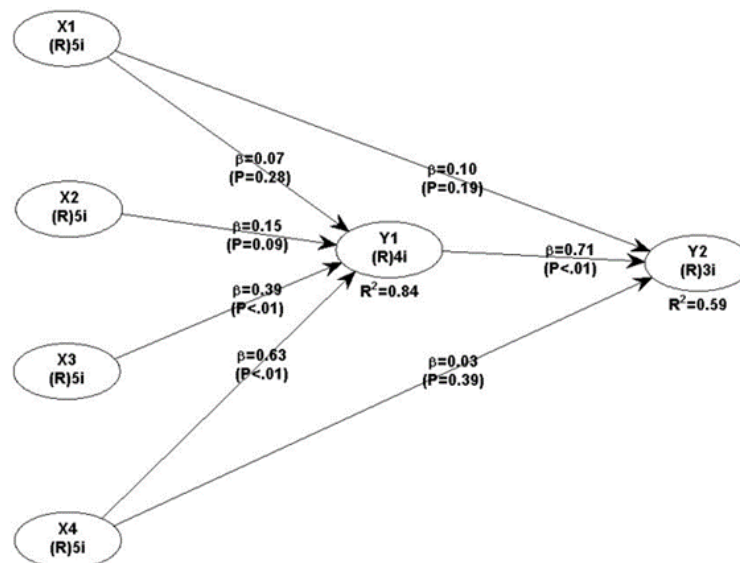
Figure 2. Model Path
(Source: Primary data processed, 2023)

In this study, direct hypothesis testing was conducted employing the t-test. The decision to assess the hypotheses adheres to established criteria: if the P value is < 0.10 (α 10%), it signifies low significance; if the P value is < 0.05 (α 5%), it denotes moderate significance; and if the P value is < 0.01 (α 1%), it indicates high significance. A P value ranging from < 0.01 to 0.10 implies hypothesis acceptance, while a P value exceeding

0.10 signifies hypothesis rejection (Solimun et al., 2022). Hypothesis testing aims to scrutinize the impact of explanatory variables on response variables. The resampling method was employed using WarpPLS 8.0 Stable 3 software, in accordance with software recommendations, and utilizing the t-test. The findings of hypothesis testing in this study are detailed in Table 5.

Table 5. Hypothesis test results

Path	Path Coefficient	P value	Explanation
Service Quality (X1) ➜ Purchase Decision (Y2)	0.100	0.194	Rejected
Service Quality (X1) ➜ Purchase Intention (Y1)	0.067	0.284	Rejected
Attitude towards behavior (X2) ➜ Purchase Intention (Y1)	0.151	0.095	Accepted
Subjective Norm (X3) ➜ Purchase Intention (Y1)	0.392	< 0.01	Accepted
Perceived behavior control (X4) ➜ Purchase Intention (Y1)	0.625	<0.001	Accepted
Perceived behavior control (X4) ➜ Purchase Decision (Y2)	0.034	0.388	Rejected
Purchase Intention (Y1) ➜ Purchase Decision (Y2)	0,705	<0.001	Accepted

Source: Primary data processed (2023)

Table 5 presents the outcomes of direct hypothesis testing as follows:

1. The influence of service quality variables on purchasing decisions yields an effect value of 0.10 with a P-value of 0.19. This indicates a positive yet insignificant impact of service quality on purchasing decisions, hence H1 is rejected.
2. The influence of service quality variables on purchase intentions indicates an effect value of 0.08 with a P-value of 0.28. This suggests a positive yet insignificant influence of service quality on purchase intentions, hence H2 is rejected.
3. The impact of the attitude towards behavior variable on purchase intentions manifests an effect value of 0.15 with a P-value of 0.01. This signifies a positive and moderately significant influence of attitude towards behavior on purchase intention, hence H3 is Accepted.
4. The effect of the subjective norm variable on purchase intention reveals an effect value of 0.39 with a P-value of 0.01. This suggests a positive and highly significant impact of norms on purchase intention, hence H4 is Accepted.
5. The influence of the perceived behavioral control variable on purchase intention exhibits an effect value of 0.63 with a P-value < 0.01. This indicates a positive and highly significant effect of perceived behavioral control on purchase intention, hence H5 is Accepted.
6. The impact of the perceived behavioral control variable on purchasing decisions presents an effect value of 0.03 with a P-value of 0.39. This indicates a positive yet insignificant effect of perceived behavioral control on purchasing intentions, hence H6 is rejected.
7. The influence of purchasing intentions on purchasing decisions demonstrates an effect value of 0.70 with a P-value of 0.01. This suggests a very positive and highly significant effect of purchasing intentions on purchasing decisions, hence H7 is Accepted.

The Effect of Attitude Toward Behavior on Purchase Intention

The results of the hypothesis testing reveal that the attitude towards behavior exerts a positive fairly significant influence on purchase intention. This finding diverges from the findings of Divayana et al. (2022), suggesting that consumer knowledge pertaining to processing techniques and nutritional content significantly shapes attitudes and consequently influences purchasing intentions towards products. In the current study, while consumer attitudes towards product quality, price relative to quality, halal labeling on product packaging, and the gratification associated with purchase contribute positively to shaping purchase intentions, this influence is comparatively weaker than that of subjective norm variables and behavioral control. The majority of participants in this study, predominantly married individuals with families comprising 3–4 members and belonging to the lower middle-income bracket, prioritize affordability over product attributes to facilitate bulk purchases for their families. Additionally, they rely on recommendations from friends and family regarding product quality rather than seeking this information themselves. Moreover, a significant proportion of busy

private employees among the consumers prefer potato donuts due to their ready-to-eat nature, eliminating the need for advance ordering.

The Effect of Subjective Norm on Purchase Intention

The results of hypothesis testing reveal a notable finding: subjective norms exert a positive and significant effect on consumers' purchase intentions. Recommendations from family and friends advocating the purchase of potato donuts over conventional ones, alongside prevailing consumption trends within the local community, emerge as pivotal factors shaping consumer purchasing intentions. The majority of respondents, who are primarily private employees and married individuals with families averaging 3–4 members, underscore the considerable influence of suggestions from colleagues, family members, and community consumption patterns on purchasing intentions. These findings are consistent with the research conducted by Al-Swidi et al. (2014), which similarly demonstrates that subjective norms wield a direct and significant influence on purchase intentions, highlighting their substantial role in shaping consumer behavior.

The Effect of Perceived Behavior Control on Purchase Intention

The results of hypothesis testing reveal a substantial finding: the path coefficient value of the perceived behavioral control variable on purchase intention stands at 0.625, with a P-value of <0.001. Notably, the path coefficient value of behavioral control surpasses that of other variables, suggesting that consumers' purchasing intentions are significantly influenced by their ability to make purchases owing to affordability and product availability. The predominant demographic among respondents comprises early adults aged 36–45 years, married with families, and employed in the private sector with moderate incomes. These demographic characteristics influence respondents' self-control in opting for cost-effective purchases to cater to their families and ensuring product availability to streamline the shopping process. These findings align with those of Divayana et al. (2022), indicating that respondents' confidence in controlling their purchases is driven by their financial capacity and accessibility, thereby shaping their intention to purchase instant shirataki noodles.

The Effect of Service Quality on Purchase Intention

The results of the hypothesis test indicate that service quality does not have effect on purchase intention. A notable demographic characteristic of the majority of respondents, predominantly private sector employees with moderate to low incomes, suggests that affordability holds greater sway in shaping purchase intentions than the level of service quality experienced. These outcomes find support in a study by Xiao et al. (2019) conducted at a fast-food restaurant in Malaysia. Their research similarly demonstrated that service quality lacked significant impact on purchase intentions, as the majority of respondents, mainly students with limited financial resources, prioritized cost-effectiveness over service quality.

The Effect of Service Quality on Purchase Decision

The results of the hypothesis testing indicate that service quality does have an effect on purchasing decisions. Similar findings were observed in a study by Santoso (2016) concerning fast food restaurants, where service quality exhibited no significant impact on purchasing decisions. In the context of this study, consumers' decisions to purchase potato donuts are primarily driven by factors other than service quality; this aligns with Santoso's (2016) findings, wherein consumers, predominantly students with limited financial means, prioritized factors such as affordability and convenient campus locations over the quality of service and ambience. Conversely, consumers in this study placed emphasis on the product's quality, affordability, halal certification, and appealing packaging, along with their intention to recommend it to others, mirroring the endorsements provided by friends and family who favored potato donuts over traditional ones.

The Effect of Perceived Behavior Control on Purchase Decision

The results of the hypothesis testing reveal that purchasing decisions are not impacted by perceived behavioral control. This finding is consistent with the research conducted by Al-Swidi et al. (2014), which concluded that Pakistani consumers exhibit a relatively low level of self-regulatory control concerning the

adoption of new products. Instead, they tend to rely heavily on social validation to mitigate the risks associated with uncertain behaviors. This phenomenon aligns with Ajzen's (2015) explanation of the Theory of Planned Behavior in the context of food consumption, wherein consumers are presumed to engage in habitual purchasing patterns without extensively deliberating on their beliefs each time they make a decision. Thus, routine food purchases are often executed without significant conscious consideration.

The Effect of Purchase Intention on Purchase Decision

The significant impact of purchase intention on purchasing decisions is evident, as indicated by a path coefficient value of 0.705 and a P-value < 0.001. This signifies a positive correlation between the purchase intention variable and the purchase decision, with each unit increase in purchase intention resulting in a 0.705 increase in the purchase decision. These findings confirm the acceptance of hypothesis 7 (H7). They align with the conclusions of Fleseriu et al. (2020), who observed a substantial influence of consumer purchase intentions on organic food purchasing decisions in Romania. This supports the Theory of Planned Behavior proposed by Ajzen (1991), which posits that stronger behavioral intentions correlate with a higher likelihood of actual performance. In the context of this study, it elucidates that heightened purchase intentions correspond to stronger consumer inclinations to buy potato donuts.

The results of this study offer insights into the determinants impacting consumer purchasing behavior concerning potato donuts. Findings reveal that stronger attitudes towards behavior, subjective norms, and perceived behavioral control correlate with heightened consumer intentions to purchase potato donuts. Conversely, service quality exhibits no influence on purchase intentions or decisions, indicating that psychological factors and consumer behavior wield greater significance in shaping purchasing inclinations and decisions than service quality. The Theory of Planned Behavior, as postulated by Ajzen (2008), is substantiated, asserting that the amalgamation of favorable attitudes, subjective norms, and perceived behavioral control culminates in behavioral intentions. This aligns assertion that cultural, social, personal, and psychological factors are paramount in shaping consumer behavior, corroborated assertion that consumer behavior encompasses thoughts, feelings, and actions within the consumption process, alongside environmental influences.

The implications of this study are profound for both the business sector and policymakers in Indonesia's food industry. It underscores the necessity of comprehending consumer behavior and its determinants on purchase intentions and decisions. Effective marketing strategies should be devised to target consumers' attitudes, subjective norms, and perceived behavioral control. Given the prevalence of psychological factors and consumer behavior in influencing purchase intentions and decisions over service quality, businesses must prioritize these factors in marketing strategies and product development for potato donuts. Ensuring affordability and product availability is vital, particularly considering that the majority of consumers are middle-aged women, married, with families, working in the private sector, leading busy lives. Word-of-mouth marketing strategies and social media promotions should be further enhanced to bolster the popularity of potato donuts and expand the consumer base.

Furthermore, this study underscores the considerable potential of processed potato products in Indonesia's agricultural product processing industry. Elevating the value-added of processed potato products can augment farmers' and communities' incomes in potato production areas. In the long run, sustainable development in agribusiness and agricultural product processing can enhance the welfare of farmers and rural communities, while diminishing reliance on imported food products. These insights also underscore the prospect of potato processing in advancing agribusiness in Indonesia, fostering productivity, and contributing to the nation's economic advancement. Consequently, these findings offer valuable insights for crafting enhanced strategies and policies to propel the growth of agribusiness and the agricultural product processing sector in Indonesia.

CONCLUSION

The research findings indicate that attitudes towards behavior, subjective norms, and perceived behavioral control have a positive and significant effect on the intention to purchase potato donuts. Conversely, service quality has no effect on the intention to buy potato donuts. Furthermore, perceived behavioral control and service quality have no effect on the decision to purchase potato donuts. Notably, purchase intention has a highly significant effect on the purchase decision of potato donuts.

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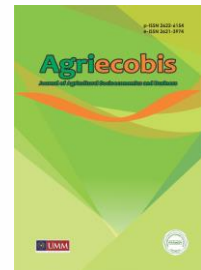
Research Article

Utilizing Analytical Hierarchy Process for Evaluating the Performance of Straw Mushroom (Volvariella spp.) Farmers in North-Eastern Region of Karawang, West Java, Indonesia

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ABSTRACT

Producers of Straw Mushroom (Volvariella spp.) in the North-Eastern region of Karawang, West Java, Indonesia predominantly operate within the sub-districts of Cilamaya Kulon, Cilamaya Wetan, and Banyusari. A noticeable decline in Straw Mushroom cultivation has been observed in this region, which can be ascribed to various factors including suboptimal farming practices, diminished seed quality, and erratic weather conditions impacting production outcomes. It is imperative to enhance the efficiency of mushroom farming across multiple stages encompassing planning, procurement of raw materials, processing, Maintenance, harvesting, marketing, shipping, handling returns, and ensuring consumer satisfaction. This study aims to evaluate the productivity of mushroom farmers, with a specific focus on the top-performing farmers in the North-Eastern region of Karawang. Proportionate stratified random sampling was employed as the sampling technique, and data were collected through structured interviews utilizing a questionnaire. Quantitative analysis, employing the Analytical Hierarchy Process method, was utilized for data analysis. The findings reveal that planning criteria hold the highest priority value of 0.306, whereas satisfaction criteria have the lowest priority value of 0.018. The top-performing farmers achieved a score of 2.08, while the lowest performing farmers attained a score of 1.10.

INTRODUCTION

The agricultural sector assumes a dual function within the economy, acting as both a direct supplier of sustenance and income, and as a substantial driver of economic advancement and societal well-being (Rompas et al., 2015). It holds pivotal importance in propelling Indonesia's economic trajectory (Shodiq, 2022), providing sustenance for a substantial portion of the populace and offering avenues for income generation through various agricultural commodities (Indraningsih & Swastika, 2022). Among the agricultural sub-sectors, horticulture is presently garnering notable focus and investment within Indonesia (Sebagai et al., 2019).

Horticulture stands as a pivotal element in agricultural progress, encompassing various categories of vegetables, fruits, ornamental, and medicinal plants. These commodities often hold considerable economic significance, thereby constituting a vital income source for farmers and facilitating labor absorption. Among horticultural commodities, mushrooms are acknowledged for their substantial economic value (Ufairoh, 2022).

Mushrooms have gained increasing popularity among consumers in Indonesia (Pertanian & Padjadjaran, 2021), establishing themselves as highly coveted horticultural commodities (Lestari et al., 2018).Volvariella spp., commonly referred to as Straw Mushroom, is extensively cultivated and represents one of the most prevalent mushroom varieties. BPS (2021) reveals that mushroom production in Indonesia reached a total of 900,420 quintals in 2021. The majority of mushroom produce is marketed in its fresh form, with a particular focus on urban areas. Straw Mushroom (Volvariella spp.) holds widespread consumption appeal and is frequently incorporated as an ingredient in various culinary preparations (Dilla, 2019). West Java is emerging as a prominent hub for the cultivation of Straw Mushroom (Volvariella spp.) within Indonesia.

In 2021, data from the BPS of West Java revealed that mushroom production in the region totaled 216,257 quintals, with a cultivated area spanning 135,567 square meters. The predominant cultivated species of edible fungus is Volvariella spp., commonly known as Straw Mushroom. Production of Straw Mushroom (Volvariella spp.) is gaining prominence across various districts in West Java, including Karawang, Bandung, West Bandung, Bogor, Subang, and Majalengka. Commonly cultivated crops in these regions encompass Straw Mushroom (Volvariella spp.), long beans, cucumber, eggplant, Choy sum (Chinese flowering cabbage), water spinach, spinach, and red or cayenne pepper.

Karawang, situated in West Java, is widely acknowledged as a significant hub for Straw Mushroom (Volvariella spp.) production, as evidenced by Sasmita et al. (2022) and Widiyanto et al. (2021). Consequently, the preeminence of Straw Mushroom (Volvariella spp.) as a commodity in Karawang is not unexpected (Suhaeni et al., 2022). According to the BPS of Karawang in 2022, Straw Mushroom (Volvariella spp.) accounted for the highest seasonal vegetable production, reaching 1,176,964 quintals in 2021. The primary production regions for Straw Mushroom (Volvariella spp.) are the sub-districts of Cilamaya Kulon, Cilamaya Wetan, and Banyusari in the North-Eastern Region of Karawang. However, in 2022, the output of Straw Mushroom (Volvariella spp.) declined to 833,606 quintals, as reported by the coordinator of the Horticulture section of the Agriculture Office in Karawang (2023).

In the North-eastern Region of Karawang, farmers engage in the cultivation of Straw Mushroom (Volvariella spp.) primarily in the sub-districts of Cilamaya Kulon, Cilamaya Wetan, and Banyusari. A decrease in Straw Mushroom (Volvariella spp.) cultivation has been observed across these three sub-districts. Table 1 presents data on mushroom production in Cilamaya Kulon, Cilamaya Wetan, and Banyusari sub-districts, sourced from the Agriculture Office in Karawang in 2023.

Table 1. Production of Straw Mushroom (Volvariella spp.) in the sub-districts of Cilamaya Kulon, Cilamaya Wetan, and Banyusari

Sub-districts	Production of Straw Mushroom (Volvariella spp.) (in quintals)	
	2021	2022
Cilamaya Kulon	1,094.94	114
Cilamaya Wetan	2,346.65	146.5
Banyusari	860.6	510.28

Source : Agriculture Office in Karawang (2023)

The decline in Straw Mushroom (Volvariella spp.) production can be attributed to various factors such as farmers' suboptimal performance in the cultivation process, deteriorating seed quality, and unpredictable weather conditions, all of which directly influence overall production outcomes (Saikia & Bora, 2023). Cultivation of Straw Mushroom (Volvariella spp.) holds promise as a lucrative venture due to its short growth cycle and relatively high market value (Dewi, 2023; Utami, 2023), presenting significant cash generation potential (Suhaeni et al., 2021).

Farmers persistently strive to improve Straw Mushroom (Volvariella spp.) quality to enhance yields. Optimizing cultivation processes is paramount for boosting production. This entails improving performance across all stages, including planning, procurement, processing, maintenance, harvesting, marketing, shipping, material return, and ensuring farmer satisfaction.

This study aims to assess the performance of Straw Mushroom (Volvariella spp.) farmers in the North-Eastern Region of Karawang and analyze the top-performing farmers' performance within the same region. The Analytical Hierarchy Process methodology is employed to facilitate decision-making based on multiple criteria.

METHOD

Research Method

The study employs quantitative and descriptive qualitative analysis methodologies to evaluate the performance of mushroom farmers. Quantitative analysis assesses farmers' performance, while descriptive qualitative analysis provides additional insights into farmers with the highest and lowest scores. Performance indicators were developed using the Analytical Hierarchy Process methodology to evaluate mushroom farmers' performance optimally.

Situated in the North-Eastern Region of Karawang, specifically in the sub-districts of Cilamaya Kulon, Cilamaya Wetan, and Banyusari, this study's research site was chosen due to its prominence in mushroom production and the absence of prior research on mushroom growers' performance in the area. Data collection occurred during April and May 2023.

Sampling Technique

This study employs proportionate stratified random sampling as its sampling method, which is commonly used when dealing with heterogeneous populations (Swarjana & Ketut, 2012). This approach divides the population into strata based on various characteristics such as age, location, gender, education level, and income.

In this research, the proportionate stratified random sampling technique was applied to select a sample of Straw Mushroom (Volvariella spp.) farmers in the North-Eastern Region of Karawang, specifically in Cilamaya Kulon District, Cilamaya Wetan District, and Banyusari District. Each district has a different number of mushroom farmers: Cilamaya Kulon has 43, Cilamaya Wetan has 19, and Banyusari has 8, totaling 70 mushroom farmers in the region.

The determination of the sample size of mushroom producers followed the formula used in proportionate stratified random sampling. The formula:

$$n_i = \frac{N_i}{N} \; x \; n \tag{1}$$

Where:
n_i : number of samples by strata/level
n : total number of samples
N_i : number of populations by strata/level
N : total number of populations

➢ Sub-district of *Cilamaya Kulon*
  For the sample of Straw Mushroom (Volvariella spp.) farmers in Cilamaya Kulon are:
n = $\frac{43}{70}$ x 60
n = 36,85 (rounded up by the researcher to 37)
➢ Sub-district of *Cilamaya Wetan*
  For the sample of Straw Mushroom (Volvariella spp.) farmers in Cilamaya Wetan are:
n = $\frac{19}{70}$ x 60
n = 16,28 (rounded down by the researcher to 16)

➢ Sub-district of *Banyusari*
  For the sample of Straw Mushroom (Volvariella spp.) farmers in Banyusari are:
n = $\frac{8}{70}$ x 60
n = 6,85 (rounded up by the researcher to 7)
The sample size for Straw Mushroom (Volvariella spp.) farmers in Cilamaya Kulon, Cilamaya Wetan, and Banyusari was determined to be 37, 16, and 7 farmers, respectively, resulting in a total sample of 60 farmers for this study.

Data Collection Technique

This study included both primary and secondary data sources. The researcher collected primary data by conducting interviews with farmers who cultivate Straw Mushroom (Volvariella spp.) in the north-eastern region of Karawang. The interviews were carried out using a questionnaire designed by the researcher. The secondary data was acquired through an extensive review of literature, including data from reputable government entities and institutions such as the Indonesian Statistics (BPS), the Agriculture Office, and relevant academic publications.

Data Analysis Method

The study adopted a quantitative analysis approach, employing the Analytical Hierarchy Process (AHP) method. Developed by Thomas L. Saaty, the AHP is a decision support methodology aimed at decomposing multifaceted situations involving multiple factors or criteria into a hierarchical structure (Supriadi et al., 2018). This methodology facilitates decision-making by organizing complex situations into a hierarchical framework of components and criteria. The study utilized the following criteria: K-1 for planning, K-2 for procurement, K-3 for processing, K-4 for maintenance, K-5 for harvesting, K-6 for marketing, K-7 for delivery, K-8 for return, and K-9 for satisfaction.

Advantages and disadvantages of AHP (Supriadi et al., 2018) The Analytic Hierarchy Process (AHP) encompasses various advantages and disadvantages within its analytical framework. Its advantages include:

1. Unity: AHP transforms broad and unstructured problems into a flexible and comprehensible model.
2. Complexity: AHP addresses complex problems through a systems approach and deductive integration.
3. Interdependence: AHP is applicable to system elements that are independent of each other and do not necessitate linear relationships.
4. Hierarchy structuring: AHP reflects natural thought processes by categorizing system elements into hierarchical levels, with each level containing similar elements.
5. Measurement: AHP offers a measurement scale and a methodology for deriving priorities.
6. Consistency: AHP considers logical consistency in judgments used to establish priorities.
7. Synthesis: AHP generates an overall estimate of the desirability of each alternative.
8. Trade-off: AHP assesses the relative priority of factors within the system, allowing individuals to select the best alternative based on their objectives.
9. Judgment and consensus: While not mandating consensus, AHP combines the outcomes of various assessments.
10. Process repetition: AHP enables individuals to refine problem definitions and enhance judgment and understanding through iterative processes.

The Analytic Hierarchy Process (AHP) presents several disadvantages:

1. Dependency on subjective expert input: The AHP model relies heavily on subjective impressions provided by experts. Consequently, the accuracy of the model hinges on the expert's assessment, making it vulnerable to errors if the assessment is incorrect.
2. Lack of statistical testing: As a purely mathematical technique, the AHP does not incorporate statistical testing. Thus, there is no means to ascertain the level of confidence in the accuracy of the model generated.

The steps involved in determining criteria weights through the Analytical Hierarchy Process approach are as follows:

1. Problem Identification:
   The initial step in utilizing the AHP technique involves defining the primary objective, criteria, and alternatives to be considered.
2. Development of a Hierarchical System, Beginning with the Main Goal:
   Figure 1 provides a visual representation of the hierarchical structure typically employed in this process.
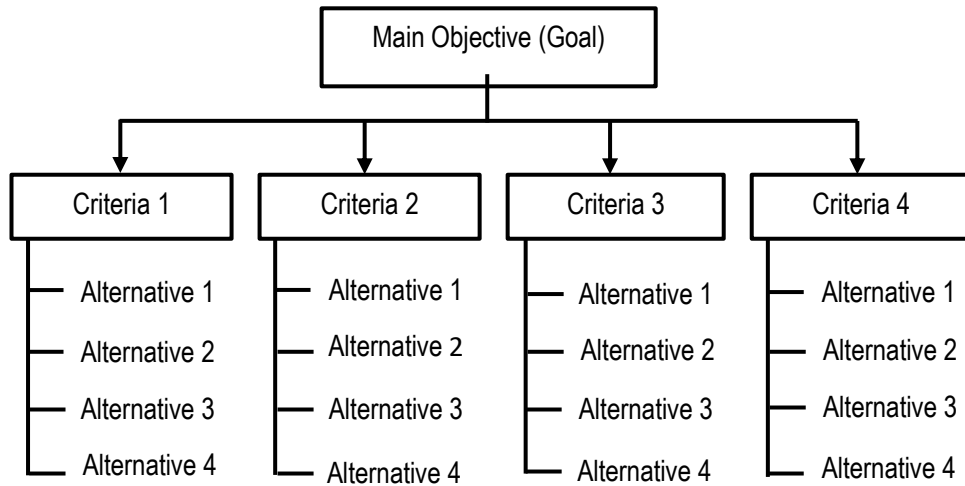
Source: (Munthafa et al., 2017)

Figure 1. Hierarchical Structure of AHP

1. Creating a pairwise comparison matrix illustrating the relative contribution or effect of each element to the objective or criterion level above it.

Table 2. Pairwise Comparison Matrix

	Criteria -1	Criteria -2	Criteria -3	….	Criteria-n
Criteria -1	K11	K12	K13	….	K1n
Criteria -2	K21	K22	K23	….	K2n
Criteria -3	K31	K32	K33	….	K3n
…	…	…	…	…	…
Criteria-n	Kn1	Kn2	Kn3	….	Knn

Source: (Suhaeri & Yunita, 2023)

The pairwise comparison matrix is calculated using the following formula

$$A = \left[a_{ij} \right](n \times n) = \begin{bmatrix} 1 & a_{12} & ... & a_{1j} & ... & a_{1n} \\ 1/a_{12} & 1 & ... & a_{2j} & ... & a_{2n} \\ ... & ... & ... & ... & ... & ... \\ 1/a_{1j} & 1/a_{2j} & ... & 1 & ... & a_{jn} \\ ... & ... & ... & ... & ... & ... \\ 1/a_{1n} & 1/a_{2n} & ... & 1/a_{jn} & ... & 1 \end{bmatrix} \tag{2}$$

where:
A   : square matrix for pairwise comparisons
a_{ij} : value of i-th row and j-th column
If $a_{ij} = a$ then $a_{ji} = \frac{1}{a}$ (reciprocal value)

The sum value of each j-th column is calculated by:

$$a_{.j} = \sum_{i=1}^{n} a_{ij} \tag{3}$$

where:

$a_{.j}$: the sum value of the j-th column
j   : the number of columns 1, 2, ..., n
I   : the number of rows
N   : the number of columns or rows

Therefore, the row matrix of the sum result is obtained as follows.

$$\begin{bmatrix} a_{.1} & a_{.2} & a_{.3} & ... & a_{.j} & ... & a_{.n} \end{bmatrix} \tag{4}$$

Define pairwise comparisons so that there is a total of n x [(n-1)/2] judgments, where n is the number of elements being compared.

Table 3. Rating Scale of Pairwise Comparison

Intensity of Importance	Description
1	Both elements are equally important
3	One element is slightly more important than the other
5	One element is more important than the other
7	One element is significantly more important than the other
9	One element is absolutely more important than the other
2,4,6,8	Values between two adjacent consideration values
Reverse	If activity i gets one number compared to activity j, then j has the opposite value compared to i.

Source : (Metode et al., 2023)

2. Determining the normalization matrix of the pairwise comparison matrix, using the following formula.

$$K = \begin{bmatrix} k_{ij} \end{bmatrix}(n \times n) = \frac{A(n \times n)}{\begin{bmatrix} a_{.j} \end{bmatrix}} = \begin{bmatrix} \frac{1}{a_{.1}} & \frac{a_{12}}{a_{.2}} & ... & \frac{a_{1j}}{a_{.j}} & ... & \frac{a_{1n}}{a_{.n}} \\ \frac{1/a_{12}}{a_{.1}} & \frac{1}{a_{.2}} & ... & \frac{a_{2j}}{a_{.j}} & ... & \frac{a_{2n}}{a_{.n}} \\ ... & ... & ... & ... & ... & ... \\ \frac{1/a_{1j}}{a_{.1}} & \frac{1/a_{2j}}{a_{.2}} & ... & \frac{1}{a_{.j}} & ... & \frac{a_{jn}}{a_{.n}} \\ ... & ... & ... & ... & ... & ... \\ \frac{1/a_{1n}}{a_{.1}} & \frac{1/a_{2n}}{a_{.2}} & ... & \frac{1/a_{jn}}{a_{.j}} & ... & \frac{1}{a_{.n}} \end{bmatrix} = \begin{bmatrix} k_{11} & k_{12} & ... & k_{1j} & ... & k_{1n} \\ k_{21} & k_{22} & ... & k_{2j} & ... & k_{2n} \\ ... & ... & ... & ... & ... & ... \\ k_{i1} & k_{i2} & ... & k_{ij} & ... & k_{in} \\ ... & ... & ... & ... & ... & ... \\ k_{n1} & k_{n2} & ... & k_{nj} & ... & k_{nn} \end{bmatrix} \tag{5}$$

where:
k_{ij} : the value of the i-th criterion and the j-th column of the normalization matrix result of matrix A
j   : the number of columns 1, 2, ..., n
n   : the number of columns or rows

Sum the values of the j-th column based on the i-th row with the following formula:

$$k_{i.} = \frac{\sum_{j=1}^{n} k_{ij}}{n} \tag{6}$$

where:
$k_{i.}$: criterion value of summing the value of the i-th row in normalization matrix
j   : the number of columns
i   : the number of rows 1, 2, ..., n
n   : the number of columns or rows

Therefore, the matrix result of the priority column is as follows.

$$K_{prioritas} = \begin{bmatrix} k_{1.} \\ k_{2.} \\ k_{3.} \\ ... \\ k_{i.} \\ ... \\ k_{n.} \end{bmatrix} \tag{7}$$

where:
$k_{prioritas}$: priority value for each criterion
$k_{i.}$: criterion value of summing the value of the i-th row in normalization matrix

3. Calculating eigenvalues criteria
The eigenvalue criteria are calculated by multiplying the comparison matrix (A) multiplied by the priority matrix.

$$A(n \times n) \times K_{prioritas}(n \times 1) = \begin{bmatrix} 1 & a_{12} & ... & a_{1j} & ... & a_{1n} \\ 1/a_{12} & 1 & ... & a_{2j} & ... & a_{2n} \\ ... & ... & ... & ... & ... & ... \\ 1/a_{1j} & 1/a_{2j} & ... & 1 & ... & a_{jn} \\ ... & ... & ... & ... & ... & ... \\ 1/a_{1n} & 1/a_{2n} & ... & 1/a_{jn} & ... & 1 \end{bmatrix} \times \begin{bmatrix} k_{1.} \\ k_{2.} \\ k_{3.} \\ ... \\ k_{i.} \\ ... \\ k_{n.} \end{bmatrix} = \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ ... \\ e_i \\ ... \\ e_n \end{bmatrix} \tag{8}$$

where:
$e_{i.}$: criteria values of the 1st, 2nd, 3rd, i and n-th rows
A : square matrix of pairwise comparisons
$k_{prioritas}$: priority value for each criterion
$k_{i.}$: criterion value of summing the value of the i-th row in normalization matrix
n : the number of columns or rows

4. Calculating hierarchy consistency
To calculate the consistency of the hierarchy, what is needed is to calculate the value λ_{max} (characteristic value) consisting of n (number of criteria), e_i (i-th eigenvalue), and k_i (number of priority values in the i-th row). Then calculate the consistency index (CI) value consisting of λ_{max} (characteristic value) and n (number of criteria). Then calculate the consistency ratio (CR) value consisting of CI (consistency index value) and RI (random consistency index value).

a. Calculating the value of λ_{max}
The calculation of λ_max involves multiplying 1 divided by the number of criteria by the sum of the i-th eigenvalue divided by the i-th priority value, as depicted in the following formula.

$$\lambda_{max} = \frac{1}{n}\left(\sum_{i=1}^{n} \frac{e_i}{k_i}\right) \tag{9}$$

where:
λ_{max} : characteristic value
n : the number of criteria
e_i : the i-th eigenvalue
k_i : the number of priority values in the i-th row

b. Calculating the value of the consistency index as follows.

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{10}$$

where:
CI : the value of the consistency index
λ_{max} : characteristic value
n : the number of criteria

c. Calculating the value of the consistency ratio as follows.

$$CR = \frac{CI}{RI} \tag{11}$$

where:
CR : the value of the consistency ratio
CI : the value of the consistency index
RI : the value of the random consistency index

Table 4. Random Consistency Index

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48	1,56	1,57	1,59

Source: Saputra and Nugraha (2020)

If the consistency ratio (CR) is ≤ 0.1 (10%), the assessment results are deemed acceptable and valid (Susetyo et al., 2019), signifying consistency in the evaluation process (Rasyid & Wagola, 2021).

RESULTS AND DISCUSSION

Hierarchical Structure

The issue under examination is subdivided into various components, specifically criteria and alternatives, organized hierarchically. In this study, a total of nine criteria were utilized, including planning (K-1), procurement (K-2), processing (K-3), maintenance (K-4), harvesting (K-5), marketing (K-6), delivery (K-7), return (K-8), and satisfaction (K-9). These criteria are derived from the performance of farmers, encompassing their planning, production, and overall satisfaction in carrying out agricultural tasks. The study involved a spectrum of options, represented by farmers numbered from 1 to 60.
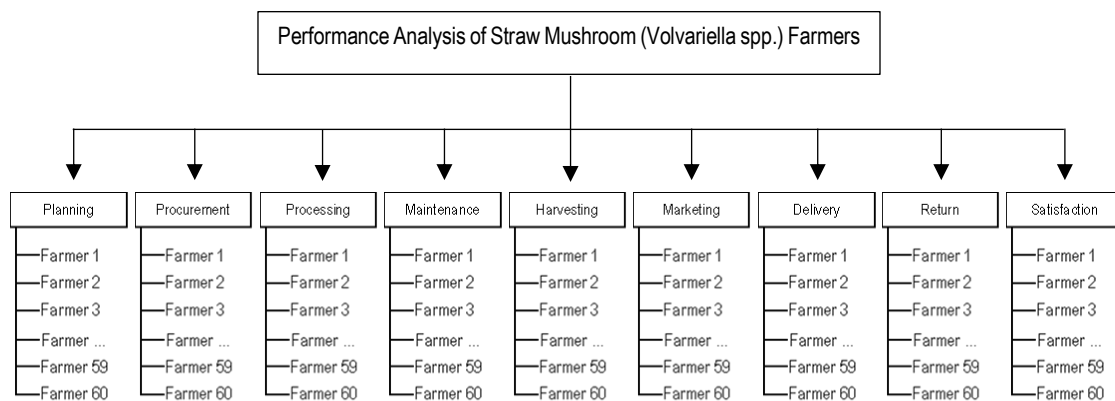
Figure 2. Hierarchical Structure of Performance Analysis of Straw Mushroom (Volvariella spp.) Farmers in North-Eastern Region of Karawang

Pairwise Comparison Matrix

At this stage, a comparative assessment is conducted between each criterion and every other criterion, resulting in a 9x9 matrix.

Table 5. Pairwise Comparison Matrix on the Performance of Straw Mushroom (Volvariella spp.) Farmers in North-Eastern Region of Karawang

Criteria	K-1	K-2	K-3	K-4	K-5	K-6	K-7	K-8	K-9
K-1	1	3	3	3	5	5	7	9	9
K-2	0.33	1	3	3	3	5	5	7	9
K-3	0.33	0.33	1	3	3	3	5	5	7
K-4	0.33	0.33	0.33	1	3	3	3	5	5
K-5	0.20	0.33	0.33	0.33	1	3	3	3	5
K-6	0.20	0.20	0.33	0.33	0.33	1	3	3	3
K-7	0.14	0.20	0.20	0.33	0.33	0.33	1	3	3
K-8	0.11	0.14	0.20	0.20	0.33	0.33	0.33	1	3
K-9	0.11	0.11	0.14	0.20	0.20	0.33	0.33	0.33	1

The data in Table 5 of the pairwise comparison matrix delineate the performance of Straw Mushroom (Volvariella spp.) Farmers in the North-Eastern Region of Karawang as follows:

a. The value of 1 in the planning criterion column and row signifies equal importance between the two elements.
b. The value of 3 in the procurement criteria column of the planning criteria row suggests a slightly higher level of importance for the planning criteria compared to procurement aspects.
c. The value of 5 in the harvesting criteria column of the planning criteria row indicates greater significance for the planning criteria element over the harvesting criteria element.
d. The value of 7 in the shipping criteria column of the planning criteria row indicates the higher importance of the planning criteria element relative to the shipping criteria element.
e. The value of 9 in the return criteria column of the planning criteria row underscores the substantial significance of the planning criteria element over the return criteria element.
f. The value of $\frac{1}{3}$ or 0.33 in the planning criteria column of the procurement criteria row represents the inverse of the value in the procurement criteria column of the planning criteria row.
g. The value of $\frac{1}{5}$ or 0.20 in the planning criteria column of the harvesting criteria row is the reciprocal of the value in the harvesting criteria column of the planning criteria row.
h. The value of $\frac{1}{7}$ or 0.14 in the planning criteria column for the delivery criteria row inversely corresponds to the value in the delivery criteria column for the planning criteria row.
i. The value of $\frac{1}{9}$ or 0.11 in the planning criteria column of the return criteria row represents the inverse of the value in the return criteria column of the planning criteria row.

The summation results for each column of criteria in the row matrix are as follows:

$$a_{.j} = [2{,}77 \quad 5{,}65 \quad 8{,}54 \quad 11{,}40 \quad 16{,}20 \quad 21{,}00 \quad 27{,}67 \quad 36{,}33 \quad 45{,}00]$$

Normalizing a Matrix

Normalizing a matrix aims to standardize each element within the matrix, ensuring uniformity across its values (Aini et al., 2022). In the normalized matrix, the criterion value in each criterion column equals 1. The summation of criterion values in the i-th row of the normalized matrix is obtained by totaling the values within that row, yielding the following outcomes:

$$k_{i.} = \begin{bmatrix} 2,75 \\ 1,91 \\ 1,36 \\ 0,99 \\ 0,71 \\ 0,50 \\ 0,36 \\ 0,25 \\ 0,17 \end{bmatrix}$$

The priority value of the i-th row of normalized matrix is calculated by dividing the sum of the i-th row by the number of criteria, so that the following results are obtained.

$$K_{prioritas} = \begin{bmatrix} 0,306 \\ 0,212 \\ 0,151 \\ 0,110 \\ 0,078 \\ 0,056 \\ 0,040 \\ 0,028 \\ 0,018 \end{bmatrix}$$

Eigenvalue of Criteria

The eigenvalue of each criterion is determined by normalizing the comparison value and then multiplying it by the priority value. This calculation is performed using the Microsoft Excel program, yielding the following outcomes. The eigenvalue of each criterion is derived from the multiplication of the values in the pairwise comparison matrix by the corresponding values in the priority matrix.

$$e_{i.} = \begin{bmatrix} 3,094 \\ 2,173 \\ 1,525 \\ 1,087 \\ 0,760 \\ 0,531 \\ 0,376 \\ 0,258 \\ 0,177 \end{bmatrix}$$

Hierarchy Consistency

Ensuring consistency in decision-making is crucial to avoid decisions based on inconsistent considerations. The level of hierarchy consistency is determined through the calculation of λ_{max}, the consistency index value, and the consistency ratio value.

a. The value of λ_{max}

$$\lambda_{max} = \frac{1}{n} \left(\sum_{i=1}^{n} \frac{e_i}{k_i} \right)$$

$$\lambda_{max} = \frac{1}{9} \left(\frac{3,094}{0,306} + \frac{2,173}{0,212} + \frac{1,525}{0,151} + \frac{1,087}{0,110} + \frac{0,760}{0,078} + \frac{0,531}{0,056} + \frac{0,376}{0,040} + \frac{0,258}{0,028} + \frac{0,177}{0,018} \right) = 9,754$$

b. The value of the Consistency Index (CI)

$$CI = \frac{\lambda_{max} - n}{n-1} = \frac{9,754 - 9}{9-1} = \frac{0,754}{8} = 0,094$$

c. The value of Consistency Ratio (CR)

$$CR = \frac{CI}{RI} = \frac{0,094}{1,45} = 0,065$$

After doing calculations, the resultant ratio value is less than 0.1. Therefore, it can be inferred that the assessment findings are acceptable and consistent with the respondents' evaluation. The calculation can proceed accordingly (Handoko et al., 2023).

The Alternative Value of Criteria on Straw Mushroom (Volvariella spp.) Farmers

The value of this criterion was derived from interviews conducted with farmers cultivating Straw Mushroom (Volvariella spp.) in the north-eastern region of Karawang. The result of row matrix $a_{.j}$ is derived from the interview findings as follows.

$$a_{.j} = [217 \quad 175 \quad 215 \quad 300 \quad 199 \quad 193 \quad 187 \quad 300 \quad 115]$$

Alternative Normalizing Matrix on Straw Mushroom (Volvariella spp.) Farmers

The alternative value in each column of the alternative normalizing matrix criteria has a uniform value of 1. The alternative value of the summation of the normalizing matrix value of the i-th row is obtained as follows.

$$k_{i.} = \begin{bmatrix} 0,165 \\ 0,155 \\ 0,132 \\ 0,161 \\ 0,141 \\ \dots \\ 0,165 \\ 0,170 \\ 0,124 \\ 0,124 \\ 0,165 \end{bmatrix}$$

Alternative Eigenvalue

The alternative eigenvalue for Straw Mushroom (Volvariella spp.) farmers is computed by determining the eigenvalue for each farmer based on the priorities assigned to each criterion. These alternative values are derived from normalized criteria. The resulting alternative eigenvalues are as follows.

$$e_{a1} = \begin{bmatrix} 0,0056 \\ 0,0056 \\ 0,0056 \\ 0,0042 \\ 0,0056 \\ \dots \\ 0,0056 \\ 0,0056 \\ 0,0042 \\ 0,0042 \\ 0,0056 \end{bmatrix} \quad e_{a2} = \begin{bmatrix} 0,0036 \\ 0,0036 \\ 0,0024 \\ 0,0036 \\ 0,0024 \\ \dots \\ 0,0036 \\ 0,0036 \\ 0,0036 \\ 0,0036 \\ 0,0036 \end{bmatrix} \quad e_{a3} = \begin{bmatrix} 0,0028 \\ 0,0028 \\ 0,0028 \\ 0,0028 \\ 0,0028 \\ \dots \\ 0,0028 \\ 0,0028 \\ 0,0014 \\ 0,0014 \\ 0,0028 \end{bmatrix}$$

$$e_{a4} = \begin{bmatrix} 0,0018 \\ 0,0018 \\ 0,0018 \\ 0,0018 \\ 0,0018 \\ \dots \\ 0,0018 \\ 0,0018 \\ 0,0018 \\ 0,0018 \\ 0,0018 \end{bmatrix} \quad e_{a5} = \begin{bmatrix} 0,0012 \\ 0,0008 \\ 0,0008 \\ 0,0008 \\ 0,0008 \\ \dots \\ 0,0016 \\ 0,0020 \\ 0,0008 \\ 0,0008 \\ 0,0016 \end{bmatrix} \quad e_{a6} = \begin{bmatrix} 0,0012 \\ 0,0009 \\ 0,0009 \\ 0,0012 \\ 0,0009 \\ \dots \\ 0,0009 \\ 0,0009 \\ 0,0009 \\ 0,0009 \\ 0,0009 \end{bmatrix}$$

$$
e_{a7} = \begin{bmatrix} 0,0006 \\ 0,0006 \\ 0,0006 \\ 0,0009 \\ 0,0006 \\ \dots \\ 0,0006 \\ 0,0006 \\ 0,0006 \\ 0,0006 \\ 0,0006 \end{bmatrix}
\qquad
e_{a8} = \begin{bmatrix} 0,0005 \\ 0,0005 \\ 0,0005 \\ 0,0005 \\ 0,0005 \\ \dots \\ 0,0005 \\ 0,0005 \\ 0,0005 \\ 0,0005 \\ 0,0005 \end{bmatrix}
\qquad
e_{a9} = \begin{bmatrix} 0,0005 \\ 0,0005 \\ 0,0002 \\ 0,0005 \\ 0,0003 \\ \dots \\ 0,0005 \\ 0,0005 \\ 0,0002 \\ 0,0002 \\ 0,0005 \end{bmatrix}
$$

where:

e_{a1} : alternative eigenvalue on K-1 planning

e_{a2} : alternative eigenvalue on K-2 procurement

e_{a3} : alternative eigenvalue on K-3 processing

e_{a4} : alternative eigenvalue on K-4 maintenance

e_{a5} : alternative eigenvalue on K-5 harvesting

e_{a6} : alternative eigenvalue on K-6 marketing

e_{a7} : alternative eigenvalue on K-7 delivery

e_{a8} : alternative eigenvalue on K-8 return

e_{a9} : alternative eigenvalue on K-9 satisfaction

Results of Final Assessment

The results of the final assessment are calculated by summing the results of the calculation of the alternatives eigenvalue - the criteria are then multiplied by 100. So that the results of the final assessment of Straw Mushroom (Volvariella spp.) farmers with the name Mr. Ahmad Baihaqi were obtained:

Final Assessment = (0,0071 + 0,0036 + 0,0035 + 0,0018 + 0,0020 + 0,0012 + 0,0006 + 0,0005 + 0,0005) (100)

= (0,0208) (100) = 2,08

Perform the same procedure for each farmer. Subsequently, conduct ranking utilizing the Microsoft Excel program to identify the top 5 farmers and the bottom 5 farmers based on their respective values, as illustrated in Table 6 below.

Table 6. Results of the Final Assessment of the Performance of St raw Mushroom (Volvariella spp.) Farmers in 2023

No	Nama	Results of the Final Assessment	Description
1	Ahmad Baihaqi	2,08	Best (Highest)
2	Katim	1,96	Best (Highest)
3	Sarwiyan	1,87	Best (Highest)
4	Karna	1,84	Best (Highest)
5	Kisel	1,82	Best (Highest)
56	Sayidi	1,47	Lowest
57	Datam	1,40	Lowest
58	Sarim	1,29	Lowest
59	Dulkarim	1,28	Lowest
60	Podil	1,10	Lowest

The analysis of Straw Mushroom (Volvariella spp.) farmers' performance in the North-Eastern Region of Karawang reveals that the planning criteria exhibit the highest significance among the evaluated criteria. Among the performance indicators for mushroom farmers, planning holds the utmost priority, with a priority value of 0.306. Following this, the procurement criteria rank second in importance, with a value of 0.212, while processing criteria occupy the third position at 0.151. Maintenance criteria are fourth in priority, scoring 0.110, whereas harvesting criteria rank fifth with a value of 0.078. Marketing criteria hold the sixth position, achieving a value of 0.056. Subsequently, delivery criteria are seventh in priority at 0.040, while return criteria follow closely behind at 0.028. Lastly, satisfaction criteria represent the least priority, with a value of 0.018.

The top-performing farmer is the one who achieves the highest score. From the pool of 60 respondents consisting of Straw Mushroom (Volvariella spp.) farmers, the analysis identifies 5 farmers with the most exemplary performance. The leading farmer exhibits the highest score of 2.08, followed by the second-best

performer at 1.96. The third-best performance scores 1.87, while the fourth and fifth best performances yield values of 1.84 and 1.82, respectively.

The advantages of top-performance among Straw Mushroom (Volvariella spp.) farmers in the North and North Eastern Region of Karawang are as follows:

- Diligently participating in mushroom counseling and training activities.
- Innovating patterns of making mushroom barns, such as elongating them beyond normal sizes.
- Making innovations in media processing.
- Making innovations in spraying mushroom seedlings, such as using sugar water, jelly, and stimulating drugs.
- Producing their own mushroom seedlings.
- Regulating the room temperature in the mushroom barn.

The disadvantages of the lowest-performance among Straw Mushroom (Volvariella spp.) farmers in the North and North Eastern Region of Karawang are:

- The condition of the mushroom barn is not suitable for use.
- Lack of innovation.
- Absence of a specialized mushroom farmer group.
- Lack of a temperature measuring device, resulting in temperature setting estimations.
- Relatively few mushroom barns, failing to meet the minimum requirement of at least three units.

CONCLUSION

The performance analysis of Straw Mushroom (Volvariella spp.) farmers in the North-Eastern Region of Karawang indicates that among the nine performance criteria evaluated, planning emerges as the most pivotal aspect. Planning exhibits the highest priority value of 0.306, followed by procurement with a value of 0.212, processing with 0.151, and maintenance with 0.110. Among the 60 respondents, five farmers demonstrated the most exemplary performance. The highest-ranking farmer achieved a final score of 2.08, followed by the second, third, fourth, and fifth best performers with final scores of 1.96, 1.87, 1.84, and 1.82, respectively.

Policy interventions by the government should encompass capital allocation, training sessions, counseling, mentoring programs, and comparative studies tailored to Straw Mushroom farmers. These initiatives aim to enhance farmers' self-sufficiency, particularly in seed production. Furthermore, farmers are encouraged to maintain more than one mushroom barn, ideally a minimum of three, and to innovate in barn construction patterns, media processing techniques, mushroom seed spraying methods, and proper regulation of barn temperatures.
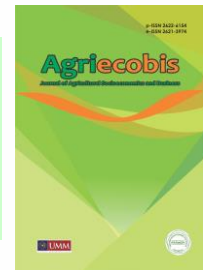
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Research Article

Analysis on Farmers' Decision-Making Processes Regarding Sustainable Agricultural Practices: A Case Study in Kademangan, Pagelaran, Malang, Indonesia

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ARTICLE INFO	ABSTRACT
	Pagelaran, located in Malang, is among the seven key rice-producing regions, encompassing an agricultural expanse of 2,592 hectares. Despite this, a notable scarcity persists in the adoption of sustainable agricultural practices among local farmers, such as the utilization of organic fertilizers and integrated pest and disease management within their agricultural enterprises. The investigation centered on Kademangan, Pagelaran, Malang, Indonesia. Employing a purposive sampling approach, the study engaged 66 respondents. Data synthesis encompassed primary and secondary sources. Methodologies encompassed descriptive analysis, Structural Equation Model (SEM), and Analytical Hierarchy Process (AHP). Outcomes underscored the significant impact of innovation characteristics on farmers' attitudes, intentions, and decisions. Additionally, attitudes and moral norms emerged as influential determinants of farmers' intentions and decisions. Perceived behavioral control and intentions were pivotal in shaping farmers' decisions. Notably, strategies aimed at enhancing farmer capacity pertaining to sustainable agriculture emerged as paramount in augmenting its implementation, as per the study's findings.

INTRODUCTION

The escalation of food production endeavors is driven by the imperative to satisfy burgeoning population demands. Nonetheless, such intensification endeavors are paralleled by a surge in the utilization of chemical inputs, posing adverse repercussions on agricultural ecosystems. Empirical evidence underscores humanity's substantial role in exacerbating climate change and environmental degradation within agricultural domains (Chen, 2016). The persistence of these practices harbors the potential to precipitate heightened and irreversible harm in forthcoming epochs. In response, sustainable agricultural innovations have been cultivated as a proactive measure to mitigate these deleterious effects.

Sustainable agriculture embodies a holistic agricultural framework prioritizing economic, social, and ecological dimensions (Wahyudi et al., 2017). It entails the integration of agricultural practices while minimizing or ceasing activities detrimental to the environment. This paradigm offers a viable approach to fostering robust, secure agriculture, sustainable food production, and environmental stewardship. Evidence from various Asian and Latin American nations underscores the efficacy of sustainable agriculture in enhancing agricultural sector

productivity and ameliorating food insecurity and poverty (Zeweld et al., 2017). Despite Indonesia's introduction of sustainable agricultural systems since the 21st century, their actual implementation remains suboptimal, as evidenced in locales like Pagelaran. Government initiatives aimed at bolstering sustainable agriculture, such as fertilizer subsidy programs, fall short in eliciting the desired behavioral shifts among farmers.

Multiple studies (Nguyen & Drakou, 2021; Zamasiya et al., 2017; Yanakittkul & Aungvaravong, 2020) underscore the significance of integrating socio-psychological factors within the Theory of Planned Behavior (TPB) framework to forecast farmers' decision-making processes. These factors encompass attitudes, subjective norms, and perceived behavioral control, alongside innovation characteristics including relative advantage, compatibility, complexity, triability, and observability (Sholahuddin, 2017). Moreover, this inquiry extends the discourse by incorporating moral norms as an additional predictor of environmentally friendly behavior (Maleksaeidi & Keshavarz, 2019). Motivated by the aforementioned challenges, this study endeavors to elucidate farmers' decision-making processes in sustainable agriculture implementation. Accordingly, the study aims to (1) describe the characteristics of farmers, (2) analyze the effect of innovation characteristics, attitudes, subjective norms, perceived behavioral control, and moral norms on farmers' intention to implement sustainable agriculture, (3) analyze the effect of innovation characteristics, attitudes, subjective norms, perceived behavioral control, and moral norms on farmers' decisions through farmers' intention to implement sustainable agriculture, and (4) analyze strategies to improve the implementation of sustainable agriculture.

METHOD

This study adopts a quantitative research approach, which entails examining specific representative populations or samples, collecting data through research instruments, conducting statistical/quantitative data analysis, and testing predetermined hypotheses (Sugiyono, 2012).

Research Setting (Location and Time)

The study was purposively conducted in Kademangan, Pagelaran, Malang, Indonesia, encompassing local rice farmers. Data collection occurred during the planting season in October 2023. The offline distribution of questionnaires was chosen by the researcher to ensure accuracy, facilitating effective and systematic interviews for obtaining valid data from the researcher-developed questionnaire.

Sampling Technique

The analysis employed Structural Equation Models (SEM), utilizing non-probability sampling to encompass every member of the population. Specifically, purposive sampling was employed, with careful consideration given to respondents residing in Kademangan engaged in rice farming, ensuring data collection aligned with desired characteristics. Sample size determination followed Cohen's guidelines, aiming for a Statistical Power of 80% at a significance level of 5% ($\alpha = 0.05$), with a minimum R^2 of 0.50 and 8 arrows pointing to construct formation. Consequently, 62 respondents were included in the SEM analysis.

For the Analytical Hierarchy Process (AHP) analysis, purposive sampling was also utilized. Selection of respondents to complete the AHP questionnaire was based on their expertise, credibility, and extensive knowledge of rice farming activities. Specifically, four respondents were chosen, including the Coordinator and Counselor of Agricultural Extension of Pagelaran, as well as the Heads of Farmers Association (GAPOKTAN) "Mekar Sari II" and "Mekar Sari." These individuals played an integral role in providing agricultural insights and assisting in questionnaire completion.

Data collection

This study employs both primary and secondary data sources. Primary data, as delineated by Sugiyono (2012), is directly gathered through questionnaires. Secondary data sources, conversely, are obtained indirectly from various sources such as the Department of Food Crops Horticulture and Plantations, Indonesia Statistics (BPS), Agricultural Extension Center of Pagelaran, as well as from literature sources including books, journals, and online repositories. The first offline questionnaire utilizes a 5-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree. Similarly, the second offline questionnaire employs an importance scale: 1 = equal relative importance, 3 = Moderately more important, 5 = Strongly important, 7 = Very Strongly more important, 9 = Extremely important, with intermediary values assigned scores of 2, 4, 6, and 8.

Data analysis

This study employs descriptive analysis, Structural Equation Model (SEM) analysis utilizing the Warp PLS method, and Analytical Hierarchy Process (AHP) employing the expert choice method. Descriptive analysis is utilized to depict the socio-demographic characteristics encompassing respondent information such as age, gender, highest education level, number of family dependents, occupation, farmer income, experience, and agricultural land ownership area (Sugiyono, 2012). Additionally, the structural equation model in Warp PLS comprises two components: the outer model and the inner model (Solimun et al., 2017). Furthermore, the research utilizes Analytical Hierarchy Process (AHP) to establish a hierarchical model encompassing objectives, criteria, and alternatives. Subsequently, the acquired data is processed using Expert Choice version 11 software application.

RESULTS AND DISCUSSION

Kademangan, situated in Pagelaran, Malang, Indonesia, serves as a prominent rice-producing village, with approximately 69 farmers registered under the Farmers Association (GAPOKTAN) "Mekar Sari II." Notably, Kademangan is renowned for its rice-centric agricultural activities. The demographic profile of the farmers reveals that 87.1% are male and 12.9% are female, with the majority falling within the age bracket of 56-65 years (29.03%), followed by 36-45 years (27.41%), and 46-55 years (19.35%). This age range is deemed productive, as per the classification by the Ministry of Health, Republic of Indonesia (2018). Age plays a pivotal role as it correlates with farmers' physical capabilities and energy levels. This aligns with the assertion by Meliyanawati et al. (2020) that age can influence the capacity and receptivity to new information or technology. Regarding education, the predominant level attained among respondents is high school (51.61%), followed by junior high school (9.68%), elementary school (20.97%), and D3/S1 degree (17.34%). This indicates a moderate education level among the respondents, which, according to Yuliana and Nadapdap (2020), can impact their readiness to embrace change, owing to its association with comprehension and analytical abilities.

The primary occupation of the majority of respondents is farming (61.29%), while 28.71% engage in agriculture as a supplementary source of income. The income of most respondents ranges between IDR 2,000,000 - IDR 5,000,000 (74.19%), encompassing revenues from both farming and non-farming endeavors. Family sizes vary, with the majority having three members (38.71%), although the number can extend up to five members or reduce to a single member. This pattern suggests an increasing proportion of expenses for essential needs, leaving a relatively small portion for other expenditures (Lestari et al., 2009). Farm sizes predominantly fall within the range of <0.5 hectares (30.6%) and 0.5-2 hectares (66.1%). As noted by Setyono (2018), farmers with smaller land holdings tend to exhibit reluctance towards innovation adoption due to fear of failure, whereas those with larger land holdings are more inclined to experiment with innovations on smaller plots. The experience level of the majority of farmers, spanning 15 years and above, is 80.65%. Farmer experience is considered instrumental in innovation implementation success, given that higher experience levels correlate with enhanced skills, knowledge, and adaptability to new technologies (Utari et al., 2022).

Table 1. Results of Validity and Reliability Test

Variable	Indicator	Loading factors	P-Value	Composite Reliability	Cronbach's Alpha	AVE
Value Standards		**>0.50**	**<0.05**	**≥0.70**	**>0.60**	**>0.50**
Innovation Characteristics (X1)	X1.1	0.852	<0.001	0.914	0.892	0.757
	X1.2	0.745	<0.001			
	X1.3	0.785	<0.001			
	X1.4	0.690	<0.001			
	X1.5	0.718	<0.001			
	X1.6	0.784	<0.001			
	X1.7	0.777	<0.001			
	X1.8	0.686	<0.001			
Subjective Norm (X2)	X2.1	0.798	<0.001	0.879	0.792	0.841
	X2.2	0.895	<0.001			
	X2.3	0.828	<0.001			
Perceived of Behavioral Control (X3)	X3.1	0.740	<0.001	0.857	0.791	0.740
	X3.2	0.692	<0.001			
	X3.3	0.687	<0.001			
	X3.4	0.830	<0.001			
	X3.5	0.741	<0.001			
Moral Norm (X4)	X4.1	0.794	<0.001	0.904	0.875	0.758
	X4.2	0.654	<0.001			

Variable	Indicator	Loading factors	P-Value	Composite Reliability	Cronbach's Alpha	AVE
Value Standards		**>0.50**	**<0.05**	**≥0.70**	**>0.60**	**>0.50**
	X4.3	0.727	<0.001			
	X4.4	0.867	<0.001			
	X4.5	0.782	<0.001			
	X4.6	0.735	<0.001			
	X4.7	0.732	<0.001			
	Y1.1	0.674	<0.001			
	Y1.2	0.702	<0.001			
	Y1.3	0.790	<0.001			
	Y1.4	0.668	<0.001			
Attitude (Y1)	Y1.5	0.730	<0.001	0.906	0.883	0.720
	Y1.6	0.762	<0.001			
	Y1.7	0.785	<0.001			
	Y1.8	0.748	<0.001			
	Y1.9	0.601	<0.001			
	Y2.1	0.722	<0.001			
	Y2.2	0.677	<0.001			
Intention (Y2)	Y2.3	0.562	<0.001	0.863	0.808	0.719
	Y2.4	0.872	<0.001			
	Y2.5	0.724	<0.001			
	Y2.6	0.721	<0.001			
	Y3.1	0.785	<0.001			
	Y3.2	0.694	<0.001			
Decision (Y3)	Y3.3	0.702	<0.001	0.879	0.831	0.744
	Y3.4	0.517	<0.001			
	Y3.5	0.831	<0.001			
	Y3.6	0.882	<0.001			

Source: Processed SEM-PLS Data, 2023

The analysis findings (see Table 1) indicate that all factor loadings exceed 0.50, meeting the criteria for convergent validity, as outlined by Solimun et al. (2017). Composite reliability values for all variables meet the criterion of ≥0.70, while Cronbach's Alpha values exceed 0.60 for all variables (Hair et al., 2014). Additionally, the Average Variance Extracted (AVE) values for all variables surpass 0.50. The goodness-of-fit test results indicate that all criteria are satisfied, indicating the adequacy of the research model. The Average Path Coefficient (APC) is 0.002, with Average R-Squared (ARS) and Average Adjusted R-squared (AARS) both less than 0.001, indicating statistical significance at the 5% level. Furthermore, the Average Block VIF (AVIF) is 1.972, and the Average Full Collinearity VIF (ARVIF) is 2.549, both below the threshold of 3.3, suggesting the model's adequacy. The Tenenhaus GoF (GoF) value of 0.569 falls within the large category, indicating strong predictive power. Moreover, Sympson's Paradox Ratio (SPR), R-Squared Contribution Ratio (RSCR), Statistical Suppression Ratio (SSR), and Non-linear Bivariate Causality Direction Ratio (NLBCDR) all equal 1, demonstrating the model's acceptability according to Solimun et al. (2017).

Table 2. Results of Hypothesis Test

Variable	Patch Coefficient	P-Value <0.05	Confirm
Innovation Characteristics (X1) → Attitude (Y1)	0.700	<0.001	Significant
Innovation Characteristics (X1) → Intention (Y2)	0.116	0.172	Not Significant
Subjective Norm (X2) → Intention (Y2)	0.091	0.230	Not Significant
Perceived Behavioral Control (X3) → Intention (Y2)	0.062	0.310	Not Significant
Moral Norm (X4) → Intention (Y2)	0.280	0.009	Significant
Attitude (Y1) → Intention (Y2)	0.399	<0.001	Significant
Perceived Behavioral Control (X3) → Decision (Y3)	0.280	0.009	Significant
Intention (Y2) → Decision (Y3)	0.564	<0.001	Significant
Innovation Characteristics (X1) → Attitude (Y1) → Intention (Y2)	0.279	<0.001	Significant
Innovation Characteristics (X1) → Intention (Y2) → Decision (Y3)	0.066	0.229	Not Significant

Variable	Patch Coefficient	P-*Value* <0.05	Confirm
Subjective Norm (X2) → Intention (Y2) → Decision (Y3)	0.052	0.281	Not Significant
Perceived Behavioral Control (X3) → Intention (Y2) → Decision (Y3)	0.035	0.347	Not Significant
Moral Norm (X4) → Intention (Y2) → Decision (Y3)	0.158	0.034	Significant
Attitude (Y1) → Intention (Y2) → Decision (Y3)	0.225	0.004	Significant
Innovation Characteristics (X1) → Attitude (Y1) → Intention (Y2) → Decision (Y3)	0.158	0.013	Significant

Source: Processed SEM-PLS Data, 2023
Notes: P-value ≤0.01 = Highly Significant, P-value ≤0.05 = Moderately Significant, and P-value ≤0.10 = Least Significant
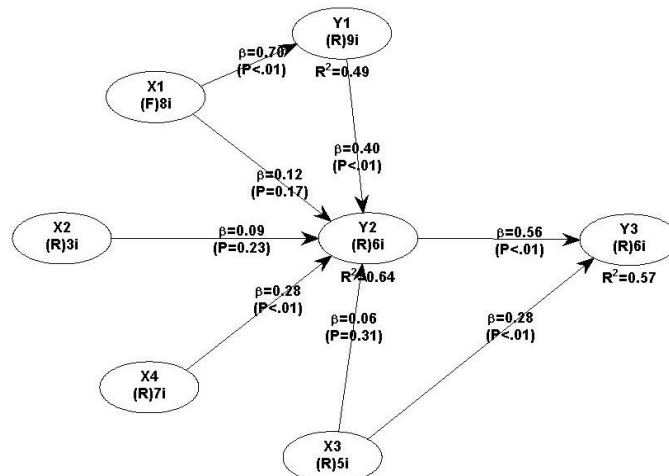

Figure 1. Results of Research Path Diagram

The Effect of Characteristics of Innovation on Attitudes, Intentions, and Decisions

The analysis results (see Table 2) revealed a significant effect of innovation characteristics on farmers' attitudes, accounting for 70%, with a p-value ≤0.01. Innovation characteristics, assessed through indicators such as relative advantage, compatibility, complexity, trialability, and observability, demonstrated a positive effect on farmers' attitudes, aligning with previous findings (Zeweld et al., 2017). Specifically, farmers' perception of the ease of understanding, learning, and application of new innovations correlated with a favorable attitude towards agricultural innovations. Furthermore, the analysis indicated a significant indirect effect of innovation characteristics on intention through attitude, accounting for 28%, with a p-value ≤0.01. Additionally, the study found a significant relationship between innovation characteristics and farmers' decisions, explaining 16% of the variance, with a p-value ≤0.05. This result is consistent with prior research (Permatasari et al., 2018), which underscored the positive effect of innovation characteristics on behavior change among organic rice farmers. It suggests that farmers in Kademangan perceive sustainable agriculture as compatible with their past experiences, cultural values, needs, and existing agricultural systems, in line with findings by Yuliana and Nadapdap (2020), emphasizing farmers' tendency to adapt gradually to agricultural innovations.

The Effect of Attitudes on Intentions and Decisions

The analysis results (Table 2) demonstrate a significant effect of 39% with a p-value of ≤0.01 for the attitude variable on farmers' intention to engage in sustainable agriculture. This implies that heightened favorable attitudes among farmers correspond to a greater inclination towards implementing sustainable agricultural practices. Consistent with previous research (Bagheri et al., 2019; Maleksaeidi & Keshavarz, 2019; Tama et al., 2021), our findings affirm a noteworthy association between attitude and behavioral intention. Additionally, our study reveals a significant relationship between attitudes, accounting for a 22% effect with a p-value of ≤0.01, and farmers' decisions. This finding aligns with prior research (Andry, 2018), which underscores the substantial impact of positive farmer attitudes on adoption decisions, such as the Bestari seed variety in Musi Rawas. Thus, farmers in Kademangan exhibit favorable attitudes towards sustainable agriculture, as assessed through cognitive, affective, and conative indicators, thereby influencing their implementation decisions positively. Notably, attitude variables serve as mediators between innovation

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characteristics, farmers' intentions, and decisions, as evidenced by the significant results of indirect effect path coefficients (Solimun et al., 2017).

The Effect of Subjective Norms on Intentions

The analysis results (Table 2) indicate that the subjective norm variable exerts no discernible impact on the intention to enact sustainable agriculture. This observation aligns with previous studies (López-Mosquera et al., 2014; Rezaei & Ghofranfarid, 2018), which assert the negligible influence of subjective norms on farmers' intentions, notwithstanding the recognized significance of the Theory of Planned Behavior (TPB) model in comprehending individual intention formation. Agriculture frequently interfaces with broader communal or social spheres, wherein certain farmers may find themselves more influenced by economic or technical considerations rather than social expectations. This intricate milieu consequently complicates the evaluation and quantification of subjective norms, leading to inconsistencies. As posited by Rezaei et al. (2019), while their findings may demonstrate a lack of correlation between subjective norms and intentions, it would be imprudent to underestimate the role of social pressures in molding specific behaviors.

The Effect of Perceived Behavioral Control on Intention

The analysis results (Table 2) reveal that the perceived behavioral control variable exerts no discernible influence on the intention to implement sustainable agriculture. This outcome refutes the initial hypothesis posited in this study and corroborates findings from research conducted by Maleksaeidi & Keshavarz (2019) concerning the intention to preserve biodiversity in Iran. This contradicts the conclusions drawn from several prior studies (Nguyen & Drakou, 2021; Tama et al., 2021; Yanakittkul & Aungvaravong, 2020), which identified perceived behavioral control as a robust predictor of farmers' behavioral intentions. Nevertheless, the study's findings indicate a positive and significant effect of perceived behavioral control on decisions, amounting to 28% with a p-value of ≤0.01. This finding resonates with research conducted by Tapsoba et al. (2023), which suggests that perceived behavioral control directly influences farmers' decisions to adopt agroecological practices in Bernin and Burkina Faso. This phenomenon may be attributed to the high dependency of the agricultural sector on governmental financial and technical assistance. Most local farmers benefit from subsidized support provided by the government, including the provision of organic fertilizers. However, farmers perceive the support rendered as inadequate to meet their agricultural requirements.

The Effect of Moral Norms on Intentions and Decisions

The analysis results (Table 2) demonstrate a significant relationship between moral norms and farmers' implementation intentions. This relationship exhibits an effect of 28% with a p-value of ≤0.01, representing the most substantial effect among all variables on farmers' intentions. This suggests that farmers perceive sustainable agriculture as aligning with their moral commitments, as evidenced by considerations of ethical matters, feelings of guilt, and adherence to life principles. This perception underscores the importance of adhering to nature and implementing environmentally friendly strategies to mitigate adverse impacts resulting from agricultural management practices. These findings corroborate existing research (Liu et al., 2017; Maleksaeidi & Keshavarz, 2019; Zhang et al., 2017), which posits that individual behavior is influenced not only by rationality and cost-benefit analyses but also by emotions and moral obligations, which play pivotal roles in shaping environmental behaviors. Additionally, researchers identified an indirect relationship between moral norms, exhibiting a significant effect of 16% on decisions with a p-value of ≤0.05. This value signifies farmers' sense of social responsibility towards the communal environment, wherein they play active roles in environmental preservation or endorse ethical farming principles. These findings align with prior research (Menozzi et al., 2015) and the viewpoints of Yazdanpanah et al. (2014), which assert that moral norms exert influence on intentions and behaviors related to water conservation in Iran.

The Effect of Intentions on Decisions

The analysis results (Table 2) reveal a significant relationship between intention and the decision to adopt sustainable agriculture, with an effect of 56% and a p-value of ≤0.01. This indicates that stronger and more positive intentions among farmers towards their agricultural practices correspond to a more favorable impact on various aspects of farmers' lives and decision-making processes. These findings are consistent with prior research (Tapsoba et al., 2023; Zeweld et al., 2017), which indicates that farmers' intentions exert a

positive and substantial influence on their decisions regarding the adoption of agroecological practices. It is evident that farmers in Kademangan generally harbor favorable intentions towards implementing sustainable agriculture, as measured by their inclination to implement and their intention to advocate for other farmers. In mediation analysis, the intention variable serves as a mediator between innovation characteristics, attitudes, and moral norms in influencing farmers' decisions. This is supported by the significant results of the indirect effect path coefficient (Solimun et al., 2017). These findings align with previous research (Bamberg & Möser, 2007), which suggests that intention mediates the impact of attitudes and moral norms on agroecological behavior and the adoption of sustainable agricultural practices (Coulibaly et al., 2021).

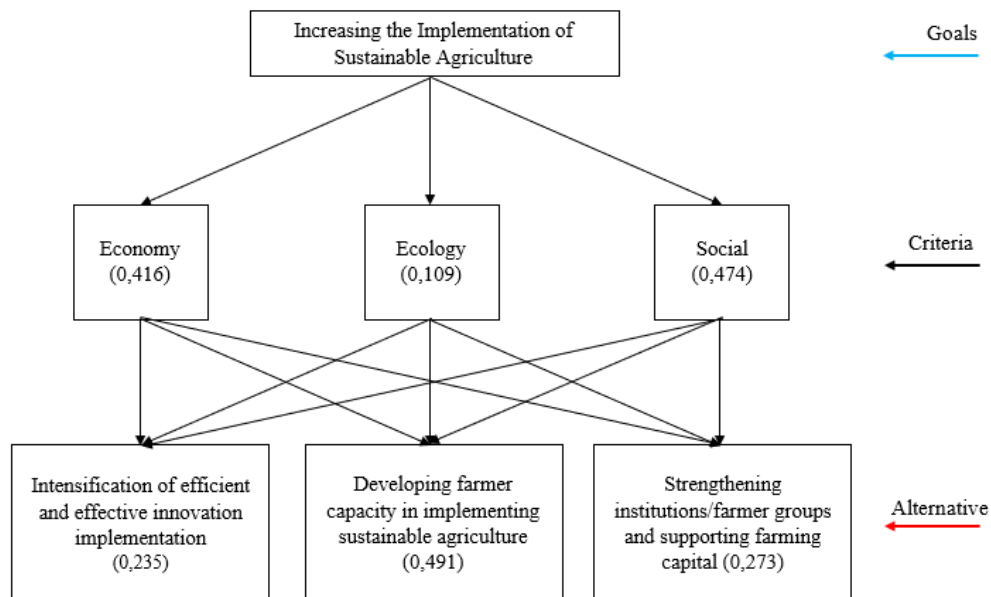**Strategies to Increase the Implementation of Sustainable Agriculture**

Figure 2. Hierarchy Model and Priority Weighting to Increase the Implementation of Sustainable Agriculture

The analysis results obtained (Figure 2) indicate that the eigenvalue of the objective criteria for implementing sustainable agriculture prioritizes social criteria, with an eigenvalue of 0.474 and an inconsistency level of 0.04, meeting the criteria for an inconsistency ratio of ≤10%. Subsequently, the analysis of eigenvalues concerning alternative objectives reveals that enhancing farmers' capacity in implementing sustainable agriculture emerges as the primary strategy for improving its application, with an eigenvalue of 0.491. Following this, strengthening farmer associations and providing capital assistance represents the second priority strategy, with an eigenvalue of 0.273. The third and final priority strategy entails intensifying the adoption of effective and efficient innovations, with an eigenvalue of 0.235. Respondents concur that enhancing farmers' capacity in sustainable agriculture is crucial for achieving the objective of increasing its application. Rustandi et al. (2020) define capacity as the farmer's ability, encompassing factors such as education level, farming experience, and participation in extension activities, to effectively and sustainably meet farming objectives. Moreover, Nguyen & Drakou (2021) elucidate that farmers equipped with a clear understanding of addressing climate change through sustainable agriculture are more inclined to modify their attitudes toward its implementation.

The second strategic priority for enhancing the implementation of sustainable agriculture is the reinforcement of farmer associations and provision of capital assistance. Farmer associations empower farmers by enhancing their bargaining leverage in various realms, such as price negotiations, access to agricultural technology information, resource availability, adaptation to climate change, and policy advocacy. Presently, there is minimal interaction among farmers, and local stakeholders acknowledge a prevailing lack of enthusiasm among farmer group members. Putra et al. (2016) underscore the pivotal role of farmer groups in disseminating agricultural technology information, often facilitated through extension methodologies. These extension activities significantly influence changes in farmers' knowledge, attitudes, and skills. Additionally, respondents highlighted the significance of capital assistance for farm businesses. They expressed concerns that insufficient assistance hinders the adoption of sustainable agriculture practices to meet agricultural needs

adequately. This observation resonates with the findings of Adawiyah et al. (2018), who underscored that the adequacy of assistance influences the adoption of UPSUS PAJALE (special efforts to enhance rice, corn, and soybean production) technology.

The third priority strategy for enhancing the implementation of sustainable agriculture is the intensification of efficient and effective innovations. Respondents concur that intensifying activities to apply such innovations is crucial, as they facilitate optimal resource utilization, biodiversity conservation, and enhanced productivity. Moreover, intensifying the adoption of agricultural innovations can address consumer demands, aligning with findings by Hardiyanti et al. (2022), which highlight shifts in consumer preferences towards health-conscious and sustainable food choices. Therefore, prioritizing the intensification of efficient and effective sustainable agricultural innovations can foster the development of a more efficient and environmentally friendly agricultural system, yielding long-term benefits for the community. The overall inconsistency rate stands at 0.02 or 2%, indicating acceptable coherence in the Analytic Hierarchy Process (AHP) analysis results, as they adhere to the criterion established by Syukron (2014) of a Consistency Ratio (CR) ≤10%.

CONCLUSION

The findings of this study indicate that innovation characteristics exert a significant influence on attitudes, intentions, and decisions. Furthermore, attitudes significantly impact both intentions and decisions, while moral norms and perceived behavioral control similarly wield significant influence over intentions and decisions. Notably, intentions significantly shape farmers' decisions to implement sustainable agriculture. Conversely, subjective norms and perceived behavioral control exhibit no discernible effect on farmers' intentions. Additionally, the study prioritizes the process of implementing sustainable agriculture based on social criteria. Subsequently, the primary strategy for enhancing sustainable agriculture application entails bolstering farmer capacity in sustainable agricultural practices, followed by the secondary strategy of fortifying farmer associations and providing capital assistance.

Furthermore, the study suggests that government intervention through policy measures aimed at bolstering extension activities to enhance farmer capacity and strengthening farmer associations and capital assistance to promote sustainable agriculture application is imperative. Moreover, the research underscores the need to consider other variables beyond those examined in this study to provide a comprehensive understanding of farmers' decisions regarding agroecological behavior.

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Research Article

Exploring Gender Dynamics in Sustainable Ecotourism: A Gender Perspective Review of Social Change and Livelihood Strategies Among the Tengger Tribe in Probolinggo District

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ABSTRACT

Probolinggo Regency in East Java presents notable tourist destinations and holds significant potential for sustainable ecotourism endeavors. Mount Bromo stands out as a prime natural attraction in this region of Indonesia, drawing both domestic and international visitors. The indigenous Tengger tribe inhabits the area surrounding Mount Bromo. With the goal of bolstering tourism, both locally and internationally, the Probolinggo Government has actively developed Mount Bromo's natural allure. This study aims to: 1) analyze the gender dynamics within horticultural farmer households in Ngadisari, Probolinggo, and 2) elucidate the catalysts and impediments to socioeconomic transformation within the Tengger tribe's engagement in ecotourism-related economic activities. Employing a qualitative approach with a gender perspective, this research deliberately selected Ngadisari, a village in Probolinggo, due to its pivotal role in supporting Mount Bromo's tourism and its predominantly Tengger population. Furthermore, Ngadisari has been earmarked by the Probolinggo authorities as a tourism-centric village. Data analysis entailed descriptive qualitative and gender analyses, with the aim of fostering the development of a gender-equitable, community-driven empowerment model.

INTRODUCTION

The tourism sector assumes a pivotal role in national development, acting as a determinant and catalyst for progress across various sectors (Yoeti, 2000). Indonesia, renowned for its rich cultural heritage and abundant natural resources, stands as a global tourist destination. Mount Bromo, situated in East Java, represents a prominent tourist site, supported by four regencies: Probolinggo, Pasuruan, Malang, and Lumajang. Probolinggo, among these regions, has endeavored to augment tourist influx by developing Mount Bromo's allure, employing strategies encompassing attraction enhancement, infrastructure provision, promotional endeavors, private sector engagement, and community involvement.

The Tengger tribe, indigenous to the Mount Bromo area, sustains ancestral traditions primarily through agrarian pursuits. However, the burgeoning tourism industry and escalating visitor numbers have invariably impacted their erstwhile agricultural-centric livelihoods. Consequently, their involvement in tourism-related economic endeavors is anticipated to surge in tandem with Mount Bromo's development initiatives.

As a signatory to the United Nations' Sustainable Development Goals (SDGs), Indonesia pledges commitment to fostering gender equality, albeit facing challenges as reflected in its modest gender equality index ranking. Cultural norms, economic circumstances, educational opportunities, and occupational dynamics are among the factors implicated in perpetuating gender disparities.

According to cultural lore, Tengger women historically held parity with men (Ramiyati, 2022). Their substantial involvement in farming encompasses diverse tasks beyond mere assistance to their spouses, encompassing seed sowing, pest management, and harvesting. Within the agricultural domain, both genders assume pivotal roles across on-farm and off-farm activities. However, despite aspirations for gender-neutral access and opportunities within the tourism sector, male predominance persists. Hence, the research endeavors to scrutinize the gender dynamics within horticultural farmer households in Ngadisari, Probolinggo, and to delineate the driving and inhibiting factors influencing the Tengger Tribe's engagement in ecotourism-related economic activities.

METHOD

The selection of the research site was purposefully executed based on specific criteria. Ngadisari, located in Sukapura, Probolinggo, was purposively chosen due to its predominant Tengger Tribe population, renowned for maintaining ancestral traditions believed to confer auspiciousness, fortune, and prosperity. Moreover, its proximity to Mount Bromo, a premier tourist destination in East Java, further justified its selection. This study adopts a descriptive qualitative analysis combined with gender analysis to formulate a gender-sensitive tourism development strategy.

RESULTS AND DISCUSSION

Ngadisari is situated in the southwestern region of Sukapura, Probolinggo, positioning it as the village nearest to the summit of Mount Bromo.
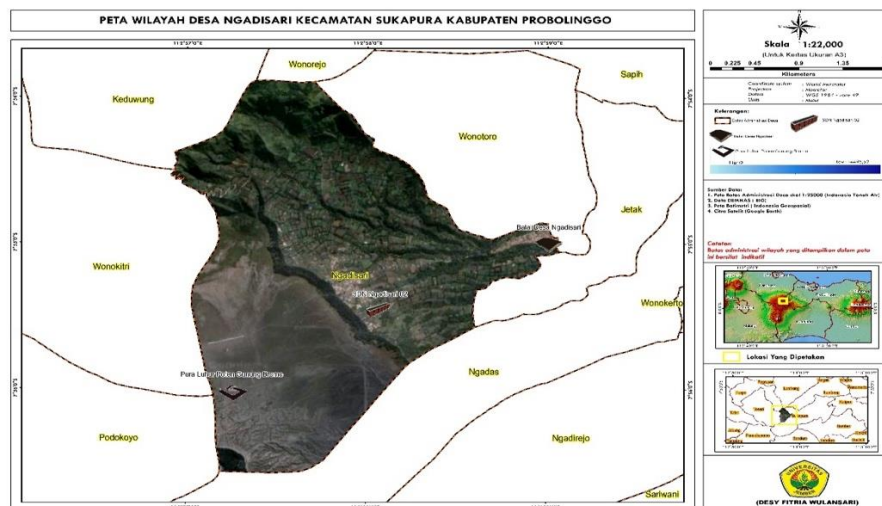
Figure 1. Research Site

Residents of Ngadisari engage in various professions spanning fields such as agriculture, entrepreneurship, civil service, tourism, and other occupations. Monographic data reveals the diverse array of professions embraced by the populace. Notably, agriculture emerges as the predominant profession, encompassing 1,114 individuals, signifying a pronounced inclination towards agricultural pursuits. This trend underscores the

community's enduring commitment to agricultural development, facilitated by generational land ownership, conducive environmental conditions, and favorable income prospects within the agricultural sector.

Distribution of Gender Roles in Horticulture Farming in Ngadisari, Sukapura, Probolinggo

Hubies (2010) delineates gender roles into reproductive, productive, and social domains. A reproductive role encompasses household and marital responsibilities; productive role entails agricultural pursuits; while social role encompasses traditional, religious, and communal activities. The Tengger community exhibits distinct average time allocations for productive, reproductive, and social activities.

a. Cooking

Cooking serves as the primary reproductive activity, facilitating the provision of meals for the family. Within households of potato farmers in Ngadisari, the responsibility of cooking primarily falls upon the wife. Consequently, the wife undertakes the preparation of all culinary necessities, transporting them to the rice fields for provisioning subsequent to completing domestic chores. This practice aligns with the assertion of IN:

"After the house is tidy, I will prepare and transport meals to the rice fields." (IN, 42 years old).

Furthermore, Mrs. PJ also said:

"At times, I rise at 5 o'clock. Following that, I prepare food and transport it to the rice fields. I remain in the fields until the afternoon." (PJ ,42 years old)

Informants IN and PJ assert that cooking is solely the responsibility of the wife within the household. The meals meticulously prepared by the wife are subsequently transported to the rice fields as lunch provisions, to be consumed during break time, as articulated by informant PJ.

"Upon returning home at 4 o'clock, I promptly take a shower. Approximately one hour later, once I have finished showering, I proceed to cook dinner." (PJ 42 years old).

Cooking is not limited to the morning; it extends into the afternoon upon returning from the rice fields, aligning with the assertion of Basriwijaya et al. (2021) that cooking is a necessary activity, as humans require sustenance for various tasks.

b. Parenting

Raising children entails wholehearted care, provision, and affection. Household role allocation varies among families, influenced by environmental factors, yet predominantly determined by mutual agreement between parents. In Ngadisari, potato farming households, child-rearing is perceived as a shared duty between husbands and wives, as articulated by informant TD:

"When we attend to our child, we work together, thereby collectively striving for the well-being of our offspring." (TD, 42 years old)

The majority of potato farmers in Ngadisari have adolescent children attending school in Probolinggo, thereby alleviating the need for intensive childcare on a daily basis. Parents express their affection by regularly visiting their children's boarding houses, as reported by informant IN:

"Both my kids are outta town; one's studying in Jogja, and the other's in junior high over in Probolinggo. The one in Probolinggo boards there, so me and my hubby pop over to see him often. And you know what? He comes back home every weekend." (IN, 42 years old)

The geographical distance separating children from parental supervision precludes direct oversight by parents. Nonetheless, parents cite various motivations for such separations, including the pursuit of novel experiences, fostering independence, and prioritizing access to superior educational institutions, as highlighted by Informants ST and SD:

Novikarumsari et.al (Exploring Gender Dynamics in Sustainable . . ., Gender Dynamics, Livelihood Strategies, Sustainable Ecotourism, Socioeconomic Transformation, Tengger Tribe, Tourism Development)

"Kids wanna go to the city, you know, try things out on their own, away from us. But as a parent, I reckon it's important for them to learn to stand on their own two feet by the time they hit junior high." (SD 53, 8/March/2023)

"Yeah, distance ain't a big deal for me. I just want my kids to go to a good school, you know?" (SD 53, 8/March/2023)

Children in households of potato farmers are typically not in school but engaged in work activities. Consequently, childcare becomes a shared responsibility between the husband and wife. While the husband contributes to work in the tourism and agricultural sectors, the wife undertakes the preparation of all childcare needs, including meal preparation.

c. Washing dishes

Washing dishes, a routine household chore linked to housekeeping and meal preparation, exemplifies the extensive engagement of women in domestic responsibilities, often positioning them as the primary figures in household management. This characterization implies that women bear the brunt of household tasks, including childcare, education, and maintaining cleanliness. Consequently, dishwashing is predominantly perceived as the wife's sole responsibility, reinforcing the notion of women's complete accountability for domestic duties.

"Yeah, once we're done cooking, it's just natural for all of us, even the wife, to pitch in and clean up, starting with washing the dishes and then doing some sweeping." (PJ, 42 year old, 17/March/2023)

As per the testimony of informant PJ, an array of household responsibilities including cooking, dishwashing, and house cleaning are deemed obligatory for women. These routine tasks, conducted both before and after fieldwork, become ingrained as daily duties for women, as highlighted by informant PJ.

d. Washing clothes

Washing clothes constitutes a daily household chore, given the necessity for individuals to have clean attire for daily wear. This responsibility falls squarely upon women due to patriarchal norms dictating their involvement in all domestic tasks, as conveyed by informant LK:

"So, we wake up in the morning, do a bit of washing, then head out to the fields. After that, we come back home, take another shower, and, well, by the time we're back from the rice fields, the cleaning's all done." (LK,45 years old).

Gender roles within horticultural agricultural practices among the Tengger tribe in Ngadisari, Sukapura, Probolinggo are categorized into three domains: reproductive, productive, and social. Reproductive responsibilities encompass various household tasks such as cooking, childcare, dishwashing, laundry, shopping, and housekeeping, predominantly undertaken by women, with minimal participation from men.

Social change in Ngadisari

Wilbert Moore (cited in Garna, 1992: 4) posits that social change constitutes a significant transformation in social structures encompassing values, norms, and cultural phenomena. This phenomenon is not exclusive to modern times but is inherent in human existence universally. Robert H. Lauer (cited in Garna, 1992: 8-9) defines social change as a comprehensive concept denoting alterations in social phenomena across various levels of human life, ranging from the micro to the macro. Parsons' Structural Functional Theory of social change, encapsulated in the AGIL scheme, delineates Adaptation, Goal Achievement, Integration, and Latency as key components. The process of social change leading to the erosion of folklore within the Tengger community is driven by adaptation, goal achievement, integration, and latency towards novel societal elements (Manggala, 2019). Local wisdom embodies indigenous insights imbued with cultural values and embraced by community members. In anthropological discourse, local wisdom is also known as indigenous knowledge or local intelligence, serving as the foundation of cultural identity. Concurrently, alongside cultural shifts, individuals gradually evolve inherited knowledge, thus crafting methodologies to cultivate understanding.

Knowledge creation essentially entails the development of original techniques or technologies for harnessing natural resources to sustain community livelihoods. Consequently, communities develop a system of indigenous knowledge and technology—local wisdom—encompassing diverse approaches to various aspects of life, including healthcare, food production, and environmental conservation (Handayani, 2011).

The concept of "ecotourism" denotes a tourism paradigm that optimizes utilization while conserving natural and cultural resources (Wahono, Poernomo, & Kusumah, 2019). Aligned with the burgeoning tourism potential in East Java, particularly in Bromo, central and regional governments are steadfast in their efforts to enhance infrastructure, develop tourist destinations, and undertake extensive domestic and international promotions to allure both local and international visitors. The concept of "sustainable ecotourism" advocates tourism development that maximizes utilization while preserving natural and cultural resources sustainably. Tourism initiatives, embracing the ecotourism concept, echo the regional government policies of Banyuwangi, guided by principles including environmental conservation, community engagement in tourism endeavors, offering multifaceted products encompassing education, recreation, and cultural values, and fostering a positive economic impact while mitigating adverse effects arising from tourism activities. The rapid growth of Indonesia's tourism sector has engendered a favorable societal impact, stimulating investments in accommodation, dining, transportation, culinary ventures, and other creative industries. Consequently, the tourism sector has become a significant source of employment opportunities for both men and women.

With the government's ongoing development of the tourist infrastructure on Mount Bromo, there has been a consistent rise in tourist footfall. According to data from the Culture and Tourism Office of Probolinggo in 2017, there has been a notable upward trend in tourist visits, encompassing both domestic and international travelers. In 2010, the tourist influx to Mount Bromo reached 18,642 individuals, escalating to 126,968 visitors by 2016, signifying a sevenfold increase within a span of six years. Presently, tourist arrivals continue to surge, particularly following the initiation of the tourist infrastructure enhancement program by the Probolinggo government. Recent advancements in the examination of social change and livelihood strategies within the gender ecotourism framework furnish the ensuing insights.

a) Andani (2017) delineated the multifaceted involvement of women in tourism endeavors within the Tourism Village of Tebing Tinggi, Okura, Pekanbaru. Women partake in various activities including regional arts, agriculture, food and beverage services, and souvenir crafting. However, their participation in the construction of tourist piers and local tourism organizations is relatively limited, owing to constraints in financial resources, expertise, and organizational acumen.

b) Women in the Tengger community contribute significantly to household welfare. Engaging in both trade and domestic responsibilities, women shoulder dual roles while also fulfilling household duties. Additionally, they commonly engage in farming as supplementary employment (Sadilla, 2022).

Tourism development in Tengger remains committed to environmental preservation, emphasizing ecotourism practices, and leveraging the strengths and potential of the local community as the cornerstone of its development strategy.

CONCLUSION

Gender roles encompass reproductive, productive, and social responsibilities. In the context of horticultural farming, reproductive roles entail tasks such as cooking, childcare, dishwashing, laundry, and shopping. The primary purpose of the Cultural Value of the Bromo Tengger Tribe is to foster the advancement of ecotourism and uphold cultural identity. This ethos underscores the importance of leveraging the strengths and potential of the local community as the bedrock of tourism development.

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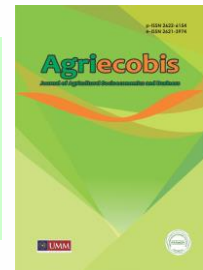
Research Article

Empowering Agriculture: Exploring Farmers' Perception of Avocado Pameling Innovation in East Java

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ABSTRACT

Export activities of agricultural commodities in Indonesia present significant opportunities, as evidenced by the implementation of the 'Gratieks' (Three Times Agricultural Export Movement) initiative aimed at bolstering the value of Indonesian agricultural exports. Leveraging this opportunity, the government collaborates with stakeholders in the agricultural industry across regions to foster the development of distinctive commodities. Among these notable products is the Pameling avocado, introduced as an innovative solution to the challenges faced by farmers in Tutur, Pasuruan, East Java, due to its various advantages. This study seeks to examine farmers' perceptions of the Pameling avocado innovation, conducted specifically in Tutur, Pasuruan, East Java. Utilizing a quantitative descriptive analysis approach, the study engaged 40 farmers as respondents. Findings reveal a positive outlook among farmers regarding the Pameling avocado innovation. Notably, indicators such as perceived relative advantage and observability attained a remarkably high rating of 97.8%, followed by the triability indicator (96.5%) and the appropriateness indicator (94.5%). Conversely, the complexity indicator exhibited the lowest score, standing at 26%.

INTRODUCTION

The Statistics Indonesia (BPS) has indicated a promising outlook for the exportation of agricultural commodities in Indonesia. According to data from BPS (2019), November 2019 saw a decrease in export value by USD14.01 billion or 6.17 percent compared to October 2019. However, the agricultural sector uniquely experienced a 4.42 percent yearly increase, reaching a value of USD330 million. In response, the Ministry of Agriculture of the Republic of Indonesia initiated various strategies aimed at elevating the value of Indonesian agricultural exports and improving farmers' welfare. Minister of Agriculture Regulation No. 19 of 2019 underscores the objective of boosting the competitiveness of agricultural commodities in the global market by fostering the expansion of agricultural exports. Developing nations exhibit substantial potential for exporting horticultural products within the agricultural commodities sector (Santosa et al., 2018).

The Ministry of Agriculture of the Republic of Indonesia is actively engaged in enhancing the value of Indonesian agricultural exports through the implementation of the 'Gratieks' (Three Times Agricultural Export Movement) Program. This strategic, long-term initiative aims to triple the export potential of horticultural commodities and their derivatives from 2020 to 2024, with a targeted annual production increase of 7%. Utilizing a Cluster System, agricultural commodities in Indonesia are being developed and poised for further advancement. The Cluster System employs an organizational approach, grouping farmers within specific geographic areas to harness their collective strength for improved economic capacity (Endalew et al., 2024). Pameling Avocado stands out as one of the premier commodities in this endeavor.

Pameling avocado, a premium commodity cultivated in Malang, is managed by PT Pameling Agro Nusantara (PAMOR). This innovative avocado variety offers distinct advantages over other varieties. These advantages encompass several key features: (a) sizable fruits, typically weighing between 600-2,000 grams each; (b) yellow, thick, and soft flesh; (c) a pleasant, sweet aftertaste; (d) relatively small seeds; (e) certification by the Technical Implementation Unit (UPT) of the Agriculture and Food Security Service; and (f) provision of technical guidance and support by the corporation to optimize crop yields for partner farmers. These enumerated advantages form the basis for fostering collaborations with diverse farmers throughout Indonesia.

Tutur, a sub-district within Pasuruan, encompasses an area spanning 86.30 km² and is situated along the slopes of Mount Bromo, ranging in elevation from 600 to over 1000 meters above sea level, resulting in moorland terrain. Moorland, characterized by aridity, relies heavily on seasonal rainfall for water supply, making it conducive for horticultural cultivation. Given its geographical and agricultural context, Tutur holds significant potential for agricultural endeavors, particularly in the cultivation of fruits and vegetables, including the Pameling avocado variety. The selection of Tutur is informed by the predominant occupation of its residents as horticultural farmers and the absence of prior Pameling avocado cultivation in the region. Additionally, farmers in Tutur face challenges stemming from the lack of guidance and support throughout the agricultural process, spanning from initial cultivation to harvest. These challenges manifest in issues such as substandard seed quality, difficulties in acquiring pesticides and fertilizers, and fluctuating market prices that fail to adequately offset farming costs. The Pameling avocado, introduced as an innovative solution, addresses these challenges by offering a novel concept in agricultural production. Innovation, as defined by Noviyanti et al. (2020), entails the introduction of new ideas, concepts, or practices, exemplified by the Pameling Avocado. The implementation of this innovation in Tutur has sparked varied opinions among farmers regarding its efficacy. Farmer acceptance of innovation is influenced by factors such as observability, trialability, simplicity, perceived advantages, and existing social networks and skills, as discussed by Kuehne et al. (2017). Therefore, a comprehensive study is warranted to explore farmers' perspectives in Tutur regarding the adoption of this innovation.

The process of adopting innovations is a communicative endeavor aimed at disseminating information regarding the innovation, leading to changes in decision-making, as posited by Rogers & Shoemaker (1971). Rogers (1983) further elaborates that the adoption of innovations entails the deliberate incorporation of novel concepts to guide appropriate and accurate behavior. Soekartawi (1988) asserts that this process involves cognitive evaluation and acceptance of new ideas, considering factors such as time and thoughtful deliberation. The decision-making process regarding new technology involves a cognitive journey from the discovery of an innovation to a definitive choice to accept or reject the idea, followed by confirmation. Consequently, adopting or rejecting new ideas or technologies entails implementing innovations with the objective of realizing changes in individual decisions. The introduction of the avocado innovation in Tutur is intricately linked to the implementation of the GRATIEKS (Three Times Agricultural Export Movement) initiative, aimed at addressing challenges encountered by PT Pameling Agro Nusantara (PAMOR) in Pameling avocado production. This study is grounded in Rogers' (1983) innovation diffusion theory, which highlights innovation characteristics such as relative advantage, compatibility, complexity, trialability, and observability, influencing farmers' perceptions of innovation adoption.

METHOD

Quantitative methodology was employed in this study to provide a comprehensive understanding of the research subject. The research was conducted in Tutur, located in Pasuruan. The selection of the research site involved a meticulous decision-making process, considering various factors. The primary criterion for selecting Tutur was its proximity to Malang and its significance as the cultivation site for Pameling avocado. Moreover, there is a notable scarcity of studies regarding the implementation of Pameling avocado technologies, particularly in Tutur, Pasuruan. The research sample was obtained using a census approach, which involves

the complete enumeration of all elements within a population. This method was chosen due to the homogeneity of the research subjects, all of whom had uniformly adopted the Pameling avocado innovation on their land. Consequently, the study comprised a single group of 40 farmers.

This study aimed to assess farmers' perspectives regarding the adoption of Pameling avocado technology. The assessment focused on innovation quality dimensions, including relative advantage, compatibility, complexity, trialability, and observability, as delineated in Rogers' theory (1983). Utilizing a quantitative descriptive analysis approach with a Likert scale, this study assessed farmers' perceptions of Pameling avocado adoption. The collected data were descriptively interpreted using predefined categories. Data analysis employed a numerical scale ranging from 1 to 5, with 5 representing very good, 4 representing good, 3 representing moderate, 2 representing poor, and 1 representing very poor perceptions. The parameters utilized to assess farmers' perceptions are outlined below.

Table 1. Criteria for Assessing Farmers' Perceptions

Score	Percentage	Category
1 – 1,8	20% - 36%	Very Poor
1,9 – 2,6	36,01 - 52%	Poor
2,7 – 3,4	52,01% - 68%	Moderate
3,5 – 4,2	68,01% - 84%	Good
4,3 – 5	84,01% - 100%	Very Good

RESULTS AND DISCUSSION

The following section presents the results and discussion derived from the study conducted among 40 farmers who have adopted Pameling avocado cultivation in Tutur.

Characteristics of Farmers
The survey examined the demographic and personal characteristics of farmers involved, adjusting for parameters such as age group, educational level, land size, agricultural experience, land ownership status, reference group, and access to information sources. These characteristics were derived from primary data collected through questionnaire interviews with farmers. The perspectives of fruit growers in Tutur regarding the Pameling avocado innovation are likely influenced by these characteristics.

Table 2. Characteristics of Farmers as Respondents

No	Variable	Number of Respondents	Percentage
1.	**Age**		
	18 - 30 year old	4	10%
	31 - 60 year old	32	80%
	≥ 61 year old	4	10%
2.	**Education**		
	Elementary school/equivalent	0	0%
	Junior high school/equivalent	13	32,5%
	Senior high school/equivalent	20	50%
	Higher Education	7	17,5%
3.	**Agricultural experience**		
	<5 years (less experience)	4	10%
	6-10 years (moderately experienced)	7	17,5%
	11-5 years (experienced)	18	45%
	>15 years (very experienced)	11	27,5%
4.	**Land size**		
	≤ 0.5 Ha (very narrow)	19	47,5%
	0.51 - 1.25 Ha (narrow)	14	35%
	1.26 - 2 Ha (medium)	4	10%
	> 2 Ha (broad)	3	7,5%
5.	**Land ownership status**		
	Owned	39	97,5%
	Rented	1	2,5%
6.	**Reference group**		
	1 Group	40	100%
	2 Group	0	0%
7.	**Access to information sources**		

No	Variable	Number of Respondents	Percentage
	Direct face-to-face	34	85%
	Electronic media	6	15%
	Print media	0	0%

Source: Data Analysis, 2024

Analysis of the characteristics of Pameling avocado farmers in Tutur reveals that the majority fall within the 31-60 age bracket, comprising 32 individuals, accounting for 80%. Conversely, farmers aged 18-30 and those aged 61 years and above each total 4 individuals, constituting 10% respectively. This age distribution suggests that farmers adopting Pameling avocado innovations are predominantly within the productive age group, consistent with the classification proposed by Harmanto et al. (2016), wherein individuals aged 15-64 are deemed productive. The prevalence of farmers within the productive age range facilitates their understanding and acceptance of new innovations aimed at enhancing farming practices. This observation is further supported by Setiyowati et al. (2022), who assert that farmers within the productive age bracket exhibit heightened enthusiasm and motivation toward agricultural activities.

The educational background of Pameling avocado farmers in Tutur primarily consists of individuals educated at the senior high school or equivalent level, comprising 20 farmers or 50% of the total. Farmers with an educational background at the junior high school or equivalent level account for 13 individuals, constituting 32.5%. Additionally, 7 farmers have received higher education, representing 17.5% of the sample. The predominance of farmers with 10-12 years of education (junior high school/equivalent) in Tutur is attributed to their reliance on farming experience accumulated over generations when making decisions regarding innovation adoption. This assertion aligns with Sholikah's (2018) observation that agricultural land management by farmers is often influenced by direct farming experience or intergenerational learning rather than formal education level alone.

Most respondent farmers possess agricultural experience spanning 11-15 years, comprising 18 individuals or 45% of the sample. This suggests a significant level of familiarity with farming practices among the respondents. The duration of farming activities is closely tied to farmers' primary livelihood, namely agriculture. Additionally, some younger farmers engage in entrepreneurial activities alongside farming, while others are relatively new to agriculture, resulting in shorter farming experience. The duration of farming activities significantly influences the adoption of Pameling avocado innovations. This observation is consistent with the findings of Mulyati et al. (2016) cited in Noviyanti et al. (2020), indicating that farmers with varying levels of agricultural experience are better equipped to navigate challenges encountered in farm management.

The majority of respondent farmers utilize cultivated land ≤ 5 hectares, comprising 19 farmers or 47.5% of the sample. This data indicates that the land area allocated by farmers for Pameling avocado adoption activities is predominantly small or limited. The land owned by these farmers typically represents residual land resulting from development and land conversion, leading to a prevalence of narrow land holdings. This circumstance underscores the feasibility of Pameling avocado innovation adoption among farmers, regardless of land size. Such adoption is facilitated by farmers' awareness of innovation application on their land and the provision of quality inputs to optimize land utilization (Ullah et al., 2020).

Regarding land ownership status, 39 farmers possess private land ownership, constituting 97.5% of the respondents. This suggests that the majority of farmers adopting Pameling avocado innovations in Tutur own their land outright. This ownership status affords farmers authority over land management, facilitating the acceptance and implementation of Pameling avocado innovations. Windani et al. (2022) suggest that land-owning farmers typically exhibit greater autonomy in management and quicker decision-making when adopting agricultural innovations compared to those who rent land.

Concerning reference groups, all respondent farmers have a single reference group utilized for decision-making regarding Pameling avocado adoption. The presence of reference groups influences farmers' decision-making processes, as they seek information and recommendations or observe behaviors within these groups (Cheung et al., 2019). Similarly, in adopting Pameling avocado innovations, farmers rely on observations and feedback from reference groups, with GAPOKTAN (Farmers Association) Nakulo serving as a prominent reference group. GAPOKTAN Nakulo, comprising farmer groups in Wonorejo, Lawang, Malang, was established to enhance the welfare of Pameling avocado cultivators. Harvests from GAPOKTAN Nakulo contribute to meeting both domestic and international demand for Pameling avocados, ultimately enhancing the economic status of its members. The success of farmers affiliated with GAPOKTAN Nakulo serves as an incentive for farmers in Tutur to adopt Pameling avocado innovations.

In Tutur, farmers predominantly rely on face-to-face communication as a relevant and accessible medium for accessing information. This communication method involves personal or group meetings with the company, facilitating interpersonal interaction (Joni et al., 2019). Through face-to-face communication, farmers can directly convey messages and openly discuss problems and solutions with the company. These meetings typically entail reviews of Pameling avocado innovation implementation progress and consultations between the company and farmers.

Farmers' Perception of Pameling Avocado Innovation

Farmers' perceptions of the Pameling avocado innovation can be assessed through the lens of Rogers' (1983) innovation characteristics framework, comprising five indicators: relative advantage, compatibility, complexity, triability, and observability. The following elucidates farmers' perceptions of Pameling avocado innovation adoption based on these innovation characteristics.

Table 3. Data Distribution of Farmers' Perception of Pameling Avocado Innovation

No	Variable	Indicator	Score	%	Category
1.	Relative advantage	Increase productivity	4,95	98,5%	Very High
		Increase income	4,85	97,0%	Very High
		TOTAL	9,8	98%	Very High
2.	Compatibility	Corresponds to farmers' cultivation habits	4,83	96,5%	Very High
		Corresponds to the farmer's experience	4,53	90,5%	Very High
		Corresponds to the needs of farmers	4,83	96,5%	Very High
		TOTAL	14,18	94,5%	Very High
3.	Complexity	Complex to understand and implement	1,5	30%	Very Low
		Complex cultivation techniques to perform	1,25	25%	Very Low
		Complex marketing of harvested crops	1,25	25%	Very Low
		TOTAL	4	26%	Very Low
4.	Triability	Easy to trial in farmers' fields	4,825	96,5%	Very High
		Easy to trial by both experienced and inexperienced farmers	4,825	96,5%	Very High
		TOTAL	9,65	96,5%	Very High
5.	Observability	Providing more crop yields than before	4,8	97,0%	Very High
		Being able to solve farmers' problems	4,9	98,5%	Very High
		TOTAL	9,8	98%	Very High

Source: Primary Data Processed, 2024

Assessment of Relative Advantage

The concept of relative advantage assesses the extent to which an innovation offers economic and social benefits, convenience, and satisfaction to adopters. This study evaluates relative advantage through indicators related to Pameling avocado cultivation production and income. The Relative Advantage assessment yielded a score of 9.8 or 98%, categorizing it as very high. This evaluation is substantiated by scores indicating increased farmer productivity (4.95 or 98.5%) and augmented farmer income (4.85 or 97.0%). Relative advantage provides insights into farmers' perceptions of an innovation, indicating whether it surpasses previous methods. Soekartawi (1988) asserts that innovations demonstrating superior relative advantage tend to experience faster adoption rates. The highest relative advantage value, observed in increased farmer productivity (98.5%), underscores the pivotal role of productivity in agricultural endeavors. Productivity, defined as the ratio of inputs to outputs over a specific period, is influenced by various factors, including agricultural inputs (e.g., land, capital, labor, and technology) and social and economic variables. Social factors encompass farmers' education level and experience, while economic factors entail resource allocation for seeds, fertilizers, pesticides, and equipment during production. The benefits accrued by farmers, such as seed provision, technical guidance, and marketing support for Pameling avocado, incentivize adoption and cultivation. This

elevation in farmer productivity consequently enhances income levels. With favorable benefits and substantial investments, farmers embrace innovation while enhancing their social standing (Cofré-Bravo et al., 2019).

Assessment of Compatibility

Compatibility refers to the degree to which an introduced innovation aligns with the social norms, past experiences, and needs of farmers in Tutur. It assesses the correlation between new and existing innovations, considering whether innovations replace, complement, or sustain previous practices. The suitability indicator scored 14.18, equivalent to 94.5%, indicating a very high level of compatibility. This assessment is corroborated by scores indicating the alignment of the innovation with farmers' cultivation habits and needs (4.83 or 96.5%) and their experience (4.53 or 90.5%). According to Soekartawi (1988), higher scores signify innovations meeting farmers' needs, facilitating adoption as improvements on existing technologies tailored to farmers' requirements. Thus, the introduction of pameling avocado aligns with farmers' practices, encompassing land cultivation and plant care. Adoption rates are influenced by familiar farming practices that can seamlessly integrate new methods (Kaine & Wright, 2022). Moreover, the Pameling avocado innovation offers assistance to Tutur farmers throughout the cultivation process, addressing their needs for support to achieve agricultural independence. Collaborative efforts between the government, private sector, and companies can enhance smallholder farmers' access to innovations for on-farm application (Sutherland et al., 2017).

Assessment of Complexity

Complexity refers to the difficulty level farmers encounter in understanding and implementing an innovation. The decision to adopt innovations depends largely on their perceived complexity. If an innovation is perceived as complicated, farmers may hesitate to adopt it, and vice versa. In this study, complexity is assessed based on the intricacy of caring for Pameling avocado. The evaluation reveals a very low complexity level, scoring 4 or 26%. This suggests that farmers find the Pameling avocado innovation easy to comprehend and apply. This perception is supported by farmers' understanding and application of Pameling avocado innovations, cultivation complexity, and marketing, all falling into the very low category. A low complexity level enhances the likelihood of farmers accepting an innovation (Doole et al., 2019). Farmers attribute the ease of understanding and application of Pameling avocado innovation to their existing experience in horticultural agriculture and the supportive assistance from the company. Consequently, farmers find it convenient to implement the Pameling avocado innovation on their land. Consistent with Soekartawi (1988), innovations with lower complexity levels are adopted more swiftly by farmers. The complexity level plays a crucial role in encouraging farmers to accept and adopt innovations (Vecchio et al., 2020).

Assessment of Triability

Triability denotes the ease with which farmers can experiment with or apply a new innovation independently. This accessibility allows potential adopters to assess new innovations or technologies without external involvement. The degree of ease in experimentation can be gauged based on indicators such as the simplicity of trialing Pameling avocado on farmers' land and its applicability by both experienced and novice farmers. The ease of trialing the Pameling Avocado innovation is classified as very high, scoring 9.65 or 96.5%. This assessment is supported by indicators indicating its straightforward implementation on farmers' land and its suitability for cultivation by farmers of varying experience levels. According to farmers' accounts, the Pameling avocado innovation is uncomplicated to integrate into their land and is manageable for both seasoned and novice farmers. Farmers' adoption of an innovation hinges on its ease and the benefits it offers (de Janvry & Sadoulet, 2020). The convenience facilitated by PT Pameling Agro Nusantara (PAMOR) in providing inputs and assistance empowers farmers to overcome obstacles encountered when experimenting with the Pameling avocado innovation. Therefore, the ease of experimentation is a crucial factor for farmers when adopting the Pameling avocado innovation on their land. This aligns with Soekartawi's (1988) assertion that the easier the adoption process of new technology or innovation, the more swiftly farmers will adopt innovations.

Assessment of Observability

Observability refers to the degree to which farmers directly perceive an innovation. When an innovation yields positive outcomes, there is a likelihood of its adoption by farmers. The level of observability in this investigation is assessed through indicators such as increased yields and the effectiveness of Pameling Avocado in addressing farmers' challenges. The observability level of the Pameling avocado innovation falls within the very high category, scoring 9.8 or 98%. This result is reinforced by the indicator with the highest

score, indicating that the Pameling avocado innovation effectively addresses issues faced by Tutur farmers, scoring 4.9 or 98.5%. This illustrates that through the adoption of the Pameling avocado innovation, farmers perceive it as a solution to their challenges. One such challenge is the fluctuation in horticultural commodity prices during harvest seasons, which can lead to financial losses for farmers if costs exceed revenues. However, with the benefits offered by adopting Pameling avocado, farmers find it more lucrative due to consistent market availability and fixed commodity prices, enabling them to cover operational expenses. Furthermore, farmers in Tutur conduct direct observations with their reference groups to gain insights into the entire process of Pameling avocado cultivation, from upstream to downstream activities. When farmers witness firsthand the ease of implementation and financial advantages of innovations on their land, it influences their intention to adopt innovations (Caffaro et al., 2020). Therefore, by directly observing these innovations, farmers can make informed decisions regarding their adoption, particularly concerning Pameling avocado.

CONCLUSION

Based on the study outcomes concerning farmers' perceptions of adopting Pameling avocado innovations in Tutur, Pasuruan, it is evident that farmers perceive the characteristics of the innovations very positively. Relative advantages and ease of observation scored 98%, ease of trial reached 96.5%, and suitability was at 94.5%. Conversely, the complexity indicator was notably low, at 26%. These results indicate a favorable perception among Tutur farmers towards the Pameling avocado innovation in their region, suggesting its efficacy in addressing farmers' challenges and enhancing their socio-economic conditions.

Recommendations stemming from this study suggest that the company should enhance information dissemination channels, particularly through electronic media platforms like WhatsApp groups and other online forums for discussions between the company, farmers, and relevant stakeholders. Moreover, leveraging online platforms such as websites, YouTube, and Instagram can augment farmers' access to Pameling Avocado-related information, potentially fostering partnerships with farmers beyond Tutur. Given the positive farmer perception of the Pameling avocado innovation, government and private sector support can further empower companies and breeders by providing assistance aimed at enhancing productivity. This assistance may include technology transfer initiatives spanning from harvesting to post-harvest activities, ultimately bolstering the competitiveness of Pameling avocado commodities in the international market.

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Research Article

Human Resource Development Strategy in the Beef Industry at CV Sakha Muria, Depok, West Java, Indonesia

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ABSTRACT

CV Sakha Muria, a beef distribution enterprise, has established a robust presence across Java. This research endeavors to delineate and scrutinize the principal determinants of the company, as well as to delineate priority strategies. Employing a descriptive method with a mixed-method approach, primary data was gathered through interviews and questionnaires, supplemented by secondary data extracted from pertinent academic journals and BPS datasets. Purposive sampling was employed, with a sample size of 19 individuals. Data analysis entailed the utilization of the Internal Factors Evaluation (IFE) Matrix, External Factors Evaluation (EFE) Matrix, Internal-External (IE) Matrix, SWOT Matrix, and QSPM Matrix. Findings indicate that the primary internal factor facilitating the work process of employees is the company's facilities, scoring 0.63, while the predominant external factor is the establishment of robust inter-company cooperation, scoring 0.61. The IE Matrix positions the company at V (2.95, 2.93), suggesting a stance of preservation and maintenance. SWOT analysis reveals the company's commitment to skill development, recruitment of technologically literate and highly motivated employees, and ongoing enhancements to the compensation system to sustain employee attraction. Additionally, the company entrusts experienced personnel with supervisory roles, establishes specialized teams to monitor regulatory changes, and mitigate their impact on employee management costs and procedures. The prioritized strategy, as per the QSPM Matrix with a value of STAS (6.95), underscores the imperative of enhancing employee skills in alignment with market dynamics and adapting to regulatory shifts or policy changes.

INTRODUCTION

Agribusiness encompasses profit-oriented activities within the agricultural domain. Ibrahim (2022) delineates agribusiness into three interdependent sectors: input, production (on-farm), and output sectors, each contributing to the economic landscape. Among the prominent sectors within the Indonesian agribusiness realm is animal science, particularly focusing on livestock commodities rich in animal protein, crucial for meeting the nation's nutritional demands. Beef, derived from livestock, is characterized by its high water content and diverse nutrient profile, including protein, fat, minerals, and minimal carbohydrates. This nutrient composition renders

beef conducive to bacterial proliferation and susceptible to spoilage (Ramang, 2021).

According to Badan Pusat Statistik (2019), findings from the survey on beef trade distribution reveal a notable 23.40% increase in beef prices from producers to ultimate consumers in the region of West Java. The parties engaged in this trade encompass producers who supply beef to distributors, wholesalers, retailers, and directly to end consumers. Data sourced from Badan Pusat Statistik of West Java (2022) indicates that Depok, in 2022, yielded 6,099,827 kilograms of beef, solidifying its position as one of the most consistent beef producers within West Java's domain. As demographic growth continues alongside enhancements in living standards, there emerges a discernible shift in consumer preferences, particularly regarding the quality of food. Fresh beef is characterized by its vibrant red hue, a distinct aroma evocative of freshness, and a resilient texture, which, when subjected to brief pressure, promptly reverts to its original form (Ibrahim, 2022).

CV Sakha Muria, owned by Ludy Sulistyono, operates as a beef distribution enterprise situated in Depok, West Java. The company vends beef via online marketplaces (such as Tokopedia and Shopee) and WhatsApp, facilitating direct deliveries from its warehouse and procurement outlets. Typically, shipments extend to various resellers across Java Island, encompassing locations like Surabaya, Jogjakarta, Semarang, Solo, alongside eateries in Bekasi and Cibubur. Notably, CV Sakha Muria maintains outlets in Depok (West Java), Pati, and Kudus (Central Java). Adhering to company protocols, including the utilization of protective gear such as gloves, hats, and masks, ensures both product hygiene and worker safety during the production process and storage activities. The company's prosperity hinges significantly on the caliber of its Human Resources (HR). Through a comprehensive analysis of HR performance, strategies for HR development can be tailored to suit prevailing circumstances and exigencies. Guided by the company's vision and mission, HR endeavors to fulfill its duties and responsibilities, thereby fostering employee performance congruent with corporate objectives (Ningrum et al., 2020).

The challenges encountered encompass various issues including discrepancies in inventory management arising from inadequate vigilance among staff leading to undetected goods during both receiving and shipping processes, inaccuracies in meat inventory calculations and recordings within the warehouse attributable to human error, and instances of data manipulation perpetrated by certain unscrupulous employees of CV Sakha Muria. Noteworthy instances of data falsification, such as stock reductions occurring in preceding months, came to light in March following suspicions raised. This arose partly due to the delegation of access to modify product availability to cashier administrators by the proprietor, thereby impacting warehouse stock records. Those implicated in these falsification activities include supervisors and cashier administrators lacking integration. Supervisors, owing to their supervisory responsibilities, bear accountability in this matter, necessitating the proprietor to terminate the employment of certain individuals. The identified issues within CV Sakha Muria hold the potential to incur financial losses, impeding the advancement and expansion of the beef distribution enterprise. Human Resource Development (HRD) serves as a strategic initiative aimed at enhancing employee competencies through educational interventions, training programs, and ongoing professional development endeavors, crucial for fostering sustained employee effectiveness within an enduring cycle (Umam and Atho'illah, 2021).

The objectives of this study, as delineated previously, encompass the identification and analysis of strategies, alongside the determination of priority strategies conducive to the development of human resources within the beef business domain of CV Sakha Muria, located in Depok, West Java.

Corresponding research conducted by Wahyunawati in 2023, titled "*Penggunaan Matriks SWOT Dan QSPM Dalam Menentukan Strategi Pengembangan Kompetensi Karyawan PT Ketapang Subur Lestari* (The Use of SWOT and QSPM Matrix in Determining Employee Competency Development Strategy at PT Ketapang Subur Lestari)", aimed to scrutinize internal and external factors while formulating optimal human resources development strategies. Employing analytical tools such as the Internal Factory Analysis Summary (IFAS) Matrix, External Factory Analysis Summary (EFAS) Matrix, Internal External (IE) Matrix, SWOT Matrix, and QSPM Matrix, the researcher concluded that (1) strengths predominated over weaknesses in the IFAS, (2) opportunities outweighed threats in the EFAS, and (3) an appropriate strategy entailed human resource management interventions, encompassing training and development initiatives aimed at enhancing and cultivating employee competencies across all domains, thereby enhancing company performance and profitability.

METHOD

This investigation spanned from September to November 2023, with the research site situated at CV Sakha Muria, positioned at Jl. Access UI No. 99, Gang Bakti RT/02 RW/09, Kelapa Dua, Cimanggis, Depok, West

Java. CV Sakha Muria was selected as the research site due to its consistent product sales across diverse marketplaces and endeavors towards innovative product development. The utilization of marketplaces by CV Sakha Muria facilitates access to pertinent information and data, thereby aiding in determining the company's targeted market segment.

A purposive sampling technique was employed, wherein samples were deliberately selected based on specific considerations, including individuals deemed to possess a comprehensive understanding of the topics under investigation (Sugiyono, 2015).

The research methodology adopted herein is descriptive, employing a mixed-method approach. Descriptive methodology entails compiling structured explanations, illustrations, or depictions based on systematically collected, accurate, and objective facts concerning various aspects, characteristics, and interactions of the phenomena analyzed. The mixed method approach combines both quantitative research methods. Qualitative techniques are used to outline and identify external factors well as to conduct a SWOT analysis. On the hand quantitative methods, such, as the IFE Matrix, EFE Matrix, IE Matrix and QSPM are used to develop and prioritize human resource development strategies within the beef industry context of CV Sakha Muria, in Depok, West Java.

Data utilized comprises both primary and secondary sources. Primary data is garnered from interviews, questionnaire completion, and field observations conducted at CV Sakha Muria, ensuring alignment with prevailing conditions and environmental contexts. Secondary data is obtained through literature review, electronic media, and documentation. Internal sources consist of 15 CV Sakha Muria employees, while external sources comprise one expert and three partners associated with CV Sakha Muria.

Data analysis is conducted qualitatively and quantitatively. Qualitative analysis entails data presentation via visuals, tables, and descriptive accounts. Quantitative analysis involves processing data using the IFE matrix, EFE matrix, IE matrix, SWOT matrix, and QSPM matrix.

The IFE and EFE matrices are utilized to identify and calculate internal and external factors, employing a congruent matrix methodology. Subsequently, the IE matrix is employed to delineate strategy arrangements across nine cells, based on outcomes derived from the IFE and EFE matrices. The SWOT matrix serves as a pivotal tool supporting the development of four types of managerial strategies, yielding four alternative strategy options: SO (Strengths-Opportunities), WO (Weaknesses-Opportunities), ST (Strengths-Threats), and WT (Weaknesses-Threats) strategies (David & David, 2016).

The decision-making stage in determining priority strategy utilizes the QSPM (Quantitative Strategic Planning Matrix) matrix, a technique elucidating appropriate or optimal strategic alternatives for the company, as posited by David and David (2016). The QSPM matrix incorporates alternative strategies derived from SWOT matrix analysis within its top row.

RESULTS AND DISCUSSION

The data collected via direct interviews and questionnaire responses from a total of 19 participants were utilized to construct IFE and EFE matrices, showcasing the weighted and rated outcomes. Subsequently, the IE and SWOT matrices were formulated based on internal and external assessments, incorporating data sourced from respondent questionnaires. The QSPM matrix was derived from the evaluation of alternative strategies generated by the SWOT matrix.

Internal and external factors identified from observations and interviews regarding human resource development strategies within the beef business context of CV Sakha Muria in Depok, West Java are delineated as follows:

Internal factors include:
a. Strength
1) The compensation or reward system provides employees with satisfaction.

In an interview session, Mr. Ludy, the proprietor of CV Sakha Muria, affirmed that employee satisfaction derived from the compensation or rewards provided by the company for performance is a pivotal factor in the workplace. He stated that:

"The salary structure within our company aligns with industry standards; nonetheless, additional compensation is provided for office and production staff at a rate of IDR 15,000 per hour for overtime, whereas drivers receive remuneration ranging from IDR 35,000 to 40,000." Regular events such as dinners, outings, and family

gatherings are arranged to foster staff satisfaction and well-being. At our annual family reunion, accolades are conferred upon two individuals based on criteria including attendance, performance, enthusiasm, and integrity. These awards typically take the form of cell phones and other items".

Yesabella and Nugroho (2023) define employee work satisfaction as an individual's perception of their employment, encapsulating both favorable and unfavorable attitudes alongside feelings of contentment or discontentment. Job satisfaction correlates positively with performance, thus fostering increased productivity among satisfied employees. An organization's reward system can significantly affect employee satisfaction. Company compensation provides both monetary and non-monetary incentives to employees in recognition of their contributions towards achieving organizational goals.

2) Company facilities support employee work processes.

The infrastructure owned by CV Sakha Muria is fully equipped with a warehouse containing production equipment and well-maintained shipping transportation. Additionally, the office conditions are sufficient to support employee performance. Adequate housing facilities have also been provided for employee comfort. Risma, the finance accounting representative of CV Sakha Muria, confirms this.

"The infrastructure offered is satisfactory. I frequently encounter manufacturing and storage equipment, such as freezers and cold storage, that are meticulously maintained after usage. When I wish to leave home, I see that the workplace is clean and orderly. Other amenities, such as the mess, are also useful for friends who work far from town. The only item that could be improved is the office computer, which needs to be updated because it occasionally fails to log into the system."

The workplace environment at CV Sakha Muria offers excellent facilities that not only streamline the work process but also boost employee motivation and productivity. This robust infrastructure of CV Sakha Muria can contribute to attracting and retaining employees, while also fostering a dynamic and innovative work environment within the company. According to Jones and Smith (2021), company facilities such as advanced technology, training, and a comfortable work environment can significantly enhance employee productivity and efficiency.

3) Employees have high dedication and responsibility towards work

CV Sakha Muria possesses comprehensive facilities and infrastructure, including a well-maintained warehouse with production equipment and efficient shipping transportation. Additionally, the office circumstances are sufficient to enhance employee performance. Appropriate housing facilities have been provided to ensure staff comfort. This statement aligns with the remarks made by Risma, who serves as the finance accounting representative of CV Sakha Muria. The details are as follows:

"We are accustomed to holding a general meeting once a month to evaluate for any misconduct and provide an early warning, so that they are more enthusiastic and energetic at work." I normally evaluate employees based on attendance, performance levels, employee enthusiasm, and honesty".

Triaji, storage manager at CV Sakha Muria, stated in an interview that:

"I'm still learning to improvise because this is a new field for me. For me, having to memorise several varieties of meat stands out. The review is intended to boost morale and correct my weaknesses so that I may be more excited at work".

The employees at CV Sakha Muria demonstrate an outstanding level of dedication and responsibility towards their work. The company's evaluations frequently enhance employee excitement, leading to increased discipline, diligence, and thoroughness in their job. Employee reactions to evaluations differ.

4) Employees have relevant skills to their duties and responsibilities in the company.

The employees of CV Sakha Muria possess individual abilities, perform specific activities, and bear distinct obligations. Employees possessing pertinent abilities are generally more adept at performing their tasks effectively. Acquiring pertinent skills can enhance efficiency, effectiveness, and contentment in the workplace. This is in accordance with the interview carried out with Mr. Ludy, the owner of CV Sakha Muria:

"Employees are allocated specific job roles based on their individual competencies. Task assignments are structured in alignment with the duties and responsibilities delineated during the employee recruitment process. Job roles and responsibilities are clearly communicated to candidates during recruitment, with preference given to experienced individuals; however, lack of experience is not a hindrance as employees comprehend their tasks upon commencement of duties".

During the interview, Joko Santoso, a warehouse employee at CV Sakha Muria, stated:

"As a warehouse staff member, my duties and responsibilities encompass various tasks including production, packaging, storage, and equipment maintenance, all assigned by Mr. Ludy. Over time, I have acquired a comprehensive understanding of these responsibilities."

The employees at CV Sakha Muria demonstrate a high level of expertise that closely corresponds to their job duties and responsibilities. Their skills extend beyond a deep understanding of the beef industry to include proficient operational capabilities, encompassing precise techniques in cutting, categorizing, and distributing beef. Such competencies enable employees to perform their tasks efficiently, ensuring optimal quality throughout the distribution process. Anderson and Brown (2022) observed a positive correlation between employees possessing requisite skills and the company's ability to achieve its objectives.

b. Weakness

1) Lack of direct supervision during implementation

Insufficient supervision can result in several issues, including decreased efficiency and frequent mistakes. Product delivery mistakes have been observed in CV Sakha Muria, which might be attributed to a lack of supervision. The following is an interview conducted with Mr. Ludy, the owner of CV Sakha Muria:

"I still make mistakes, such as a lack of supervision and an absence in communication between office and warehouse staff regarding meat stocks. Sometimes there is a misunderstanding in coordinating with the cashier administration to adjust the special promotional price of products that are approaching their expiration date. Other incidents include supervisors falsifying data and collaborating with store staff to make two original and phony reports".

Khurotin (2018) elucidates that the primary purpose of supervision is to oversee and control company operations, ensuring that work actions align with the organization's strategic aims. The purpose of the supervision is to study errors that arise to find a solution for the company's goal.

2) A small number of employees demonstrates less thoroughness or attentiveness in their work.

The employees of CV Sakha Muria continue to make several recurring errors. An often recurring error committed by certain employees is the absence of thoroughness or carelessness. This can have a significant impact on production, as well as affect the firm owner's trust in employees. Aji highlighted the common errors that frequently arise at CV Sakha Muria during the interviews as follow:

"Mistakes that happen in this company include inaccurate product weighing and some product stockpiles being empty at times. These are the only little errors that frequently occur in this company."

Employees at CV Sakha Muria demonstrating insufficient attention to detail and negligence in their duties may jeopardize product quality and overall company operations. Those lacking thoroughness may overlook critical tasks such as product sorting, inaccurate weighing, and inadequate monitoring of storage conditions.

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Patel and Sharma (2020) contend that improving employees' diligence and attentiveness in task execution is imperative for enhancing workplace productivity.

3) Standard Operating Procedures (SOPs) have not been fully implemented.

CV Sakha Muria has developed Standard Operating Procedures (SOPs) created by the owner. While these SOPs have been implemented by employees, full compliance has not yet been achieved. An interview with Mr. Ludy, the owner, provides further insight:

"Standard Operating Procedures (SOPs) have been meticulously developed to ensure optimal warehouse management. These include maintaining a consistently clean environment in the warehouse, as it serves as a crucial production space. While uniforms are not strictly mandatory for warehouse employees, they are required for store employees. Additionally, warehouse employees are required to maintain punctual attendance using fingerprint recognition, while store employees utilize their respective cellphones for attendance tracking. Furthermore, meticulous records are kept tracking incoming and outgoing goods. The currently established Standard Operating Procedures (SOPs) should be evaluated as achieving a rating of 70-80 out of 100".

Nikmah and Pratama (2023) elaborate on the necessity of ensuring optimal company operations by ensuring that each unit delivers its best performance and adheres to well-established Standard Operating Procedures (SOPs). SOPs serve as essential guides for individuals in completing specific tasks, acting as references for experienced personnel and training materials for new hires. Additionally, SOPs play a vital role in the performance evaluation process and offer various other benefits.

4) A small number of employees experience a lack of motivation at work.

A limited number of employees at CV Sakha Muria have the challenge of maintaining their motivation to fulfill their employment duties and responsibilities. Although the organization attempts to establish a conducive atmosphere, there are occasional individual factors affecting the amount of worker motivation. Risma, in her capacity as finance accounting, clarified various reasons for this during the interview:

"One of the most common challenges is collecting payments from difficult-to-pay clients. They become upset when I call them because they can't pay their bills. At times, I must suppress my emotional reactions to meet the demands of the role. However, I remain motivated by the aspiration to support my parents in meeting their needs and fostering personal enthusiasm."

The company owner plays a crucial role in demonstrating strong commitment to creating inspiration for employees in the face of challenges. Effective communication is a means of fostering staff morale. Mr. Ludy, the owner of CV Sakha Muria, mentioned this:

"Challenges with this company include decreased sales during the last three months. We evaluated the store, stock availability, why few resellers purchase our products, selling pricing difficulties, and other factors. Every employee has a big influence. As a result, we sometimes perform weekly evaluations by discussing, offering directions, and motivating employees to ensure that there are no problems in this organization."

Onsardi (2020) highlights motivation as a pivotal factor that instigates individuals to participate in particular activities. As such, motivation is widely regarded as a significant driving force shaping an individual's behavior.

The external factors consist of:
a. Opportunity
1) The establishment of a good cooperation between companies.

Establishing effective collaboration between companies stands as a pivotal determinant of success for CV Sakha Muria, operating within the meat distribution industry. Such collaboration forms a fundamental cornerstone in establishing a prosperous and enduring business network. The robust collaboration between CV Sakha Muria and Mr. Abu, functioning as a reseller, exemplifies this principle, as evidenced by the following:

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"I get along well with the owner of CV Sakha Muria. It began with a consumer reselling CV Sakha Muria items. The owner of CV Sakha Muria noticed my regular purchases within two months, thus I was added to his reseller group".

Another interview conducted with Yusuf as a reseller with the business named "Master Daging" revealed:

"I have an excellent relationship with Mr. Ludy (owner of CV Sakha Muria), and we've been working together since 2019. It's been a long time since I'm getting more benefits, such as competitive pricing."

An effective collaboration can foster an ongoing flow of information, yielding advantages for all stakeholders and the potential for a long-lasting corporate venture. CV Sakha Muria works together with multiple resellers to actively contribute to the sustainability of the beef industry. According to Anderson and Johnson's (2022) research, effective collaboration among companies is crucial for overcoming current business issues, fostering a mutually advantageous environment, and enhancing their collective market position.

2) High consumer trust in the company
The solid basis for upholding the company's reputation and image is in the high level of consumer trust in CV Sakha Muria. Consumers consider the beef provided by CV Sakha Muria as being of superior quality and safety, meeting demanding criteria. According to Sandiaji, the owner of Kita Steamboat and Yakiniku Restaurant, claims:

"The beef's price and quality of CV Sakha Muria have been carefully maintained. Furthermore, Mas Ludy (owner of CV Sakha Muria) has excellent sales and communication skills, therefore I always purchase meat stock from them."

In addition to the quality of the products sold, there is also efficient service and good communication. Yusuf as a reseller of CV Sakha Muria revealed the following:

"So far, the products offered have a good quality. Furthermore, the services offered are problem-free; they limit errors by being careful and meticulous with consumers, including us, who continue experiencing good service."

The high level of consumer trust in beef distributor companies derives from the company's consistent in providing high-quality products and satisfying services. Ensuring transparency regarding the source and manufacturing process of beef is crucial for building customer trust. Patel and Sharma (2022) assert that a high level of consumer trust significantly contributes to positive performance and the delivery of consistent, high-quality service by the company.

3) Experienced employees are a valuable asset in dealing with the high-demand labor market.
Experienced employees in the meat distribution industry may greatly contribute to the management of supply chains, assuring the availability of products, and upholding quality standards. According to Mr. Ludy, the owner of CV Sakha Muria, the following is an explanation:

"Effective employee management, clear assignment of tasks and responsibilities, and exposure to challenges are critical factors in the company's success. These factors are required for employees to obtain important experience and improve professionally, preparing them for future advancement within the company".

The insights gathered from the interview with Indah Desti Restiana, the Director of PT Dua Putra Perkasa Pratama, underscore the significance of experienced employees as valuable assets.

"Experienced employees in related fields have a competitive advantage in the professional world. Such employees typically display an excellent comprehension of their jobs and responsibilities, as well as confidence in their skill sets. Employers frequently seek experienced employees in specialized disciplines, emphasizing the value of experienced employees in the workplace".

Observations carried out at CV Sakha Muria indicate that employees demonstrate a high level of competence in carrying out their assigned duties. They demonstrate proficiency in product organization, timely distribution, and efficient management of consumer inquiries or complaints. Johnson and Williams (2022) conducted research that demonstrates the significant value of experienced employees for companies, especially during times of increased demand in the labor market. The positive effect that employee competence and knowledge have on organizational performance is the reason for this attribution.\

4) Technological advancements, including digital collaboration tools, have the potential to enhance employee productivity.

Using digital collaboration tools has been proven to increase staff productivity. These tools work as intermediaries for communication and interaction between owner and employees, as demonstrated by platforms like Zoom, which optimize weekly performance evaluations. During the interview, Anggie Retno, the administrative manager, provided further details about this matter.

"We always use WhatsApp groups to allow employees and owners to interact and communicate more effectively. The group can also serve as a source of up-to-date information, such as notifications regarding product price changes, stock availability, and upcoming promotions. Regarding attendance, employees in the warehouse utilize fingerprints, whereas employees at stores use their respective cellphones, which are recognized on the map. Every week or two, a Zoom meeting is held to address any issues that are impeding progress."

CV Sakha Muria can employ digital collaboration tools like WhatsApp groups and the Zoom application to streamline information dissemination and review processes. These technological platforms foster greater work flexibility and facilitate efficient communication channels between employees and management. This observation resonates with the conclusions drawn by Susanto and Utomo (2022), who highlight the positive impact of digital collaboration tools on enhancing employee productivity through the optimization of workflow processes and team communication.

b. Threat
1) Economic instability and market fluctuations can affect job stability and employee compensation.

Economic instability poses a significant challenge to companies, often necessitating adjustments to operating costs. In such scenarios, companies may face pressure to reduce expenses, potentially leading to measures such as salary cuts or constraints on salary increments for employees. Interviews were conducted with the company owner to explore this issue further:

"Our sales have fluctuated, and they have declined in the last three months, but we investigated what caused the problem. We are forced to lower the prices of the things we sell. We are looking for the greatest answer that will not affect this organisation, such as lowering staff compensation, and so on."

Market fluctuations within the meat industry result in unpredictable demand for products from CV Sakha Muria. Factors such as rising gasoline prices, increased meat supply expenses, and declining sales significantly impact the company. Permana and Wibowo (2022) emphasize that economic instability and market fluctuations profoundly affect job security and employee compensation. Changes in these conditions directly impact career sustainability and employee income levels.

2) Changes in employment-related government regulation or policy

New policies regarding adjustments in minimum wage and working hour provisions bear the potential to influence the operational cost framework of CV Sakha Muria. The enactment of new regulations within human resource management, encompassing employee termination protocols and training initiatives, can accelerate the accommodation to evolving facets of employee management. CV Sakha Muria adheres to its internal regulations, as delineated by its owner.

"Working in this company differs from working in state-owned companies in that it is a private company with greater flexibility. Employees in the warehouse work from 8 a.m. to 5 p.m. Meanwhile, the store's employees work eight-hour shifts. Although the salary does not match the Minimum Wage Standard (UMR), it is adequate for the employees' needs. Employees who will leave the warehouse need to find their replacement and provide training on the mechanics of working in this company until their replacements have a thorough knowledge."

CV Sakha Muria operates with its own set of regulations, setting it apart from state-owned companies. Policies concerning working hours, safety protocols, and remuneration have been meticulously enforced to align with labor mandates. The adept management of transparency and communication has fostered a thorough grasp of regulations, ensuring adherence and comprehension among stakeholders.

3) Job offers from competitor companies with better facilities for employees.

Competitor companies offering better and more favourable facilities for employees poses a threat to the company's ability to retain these employees. This situation poses a challenge for companies to effectively retain and inspire employees who are prone to relocation. Indah Desti Restiana, the Director of PT Dua Putra Perkasa Pratama, discussed the job offers from competitor companies that provide better facilities for employees during the interview.

"In addition to providing salaries and bonuses, companies must often have and provide adequate facilities for employees to work efficiently. These facilities must not only be useful, but also convenient for workers. Overall, facilities such as a comfortable workstation, a balanced workload, health care, and so on help employees focus on their work."

This viewpoint aligns with the research conducted by George and R. Jones (1996) as cited in Onsardi (2020). They found that salary and job satisfaction have a significant impact on employees' inclination to leave their current positions. Specifically, higher salaries tend to correlate with greater job satisfaction, which in turn reduces the desire to seek employment elsewhere. Conversely, lower salaries often result in lower job satisfaction, leading to a higher likelihood of employees wanting to leave their current company.

4) Employee well-being such as health and safety issues can negatively impact employee productivity

The presence of health and safety concerns within CV Sakha Muria can disrupt employee focus and productivity, consequently impacting overall efficiency. Specifically, the company has confronted health and safety challenges amid the COVID-19 pandemic, resulting in decreased demand for meat products and adversely affecting its operational performance.

Workplace accidents, unforeseen by employees, exert a significant influence not only on individual well-being but also on the uninterrupted flow of company operations. Effective management of such incidents is not solely the responsibility of the organization but is paramount for maintaining a safe work environment and enhancing employee productivity. The proprietor of CV Sakha Muria disclosed the subsequent incidents experienced by the employees:

"One of the accidents experienced by employees occurred while a driver was delivering items to a customer. The car he was driving was damaged owing to a lack of care while driving. Despite the material loss, the driver remains in fine condition. Other mishaps that occurred were minor, such as burning cables and other little items. I often advise other colleagues to work cautiously to avoid future accidents."

Another interview with Indah Desti Restiana, as Director of PT Dua Putra Perkasa Pratama, explained about health and safety as follows:

"Worker health and safety are critical to increasing employee productivity. Companies must provide health care services, such as Social Security Insurance (BPJS), which our company has given. Its function is to provide employees with health insurance, which includes treatment, examination, and care if they get sick. Another purpose is as a guarantee for work accidents, as we are also responsible for protecting employees so that they feel comfortable working for our company."

Sunarsi (2019) stated that it is mandatory for each company to establish and implement an occupational safety and health (OSH) program to minimise unanticipated incidents and promote a conducive work environment. Implementing a proficient Occupational Safety and Health (OSH) program has the potential to decrease accident frequencies and enhance the overall well-being of the workforce. The primary duties of the Human Resources Department include providing safety training, evaluating and mitigating hazards which cause a risk to employee well-being, and documenting any workplace incidents.

The process entails the identification and analysis of internal and external factors utilizing the Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) matrices. The IFE matrix employs empirical research to assess internal elements, encompassing strengths and weaknesses, across diverse domains. Ratings and weights assigned to these factors are employed to compute a score, subsequently presented in the table provided below.

Table 1. IFE Matrix

No	Internal Factor Strengths	RATING	WEIGHT	SCORE
1	The compensation or reward system provides employees with satisfaction.	3.4	0.17	0.58
2	Company facilities support employee work processes.	3.5	0.18	0.63
3	Employees have high dedication and responsibility towards work.	3.4	0.17	0.58
4	Employees have relevant skills to their duties and responsibilities in the company.	3.2	0.16	0.51
	Weaknesses			
1	Lack of direct supervision during implementation	2.0	0.08	0.16
2	A small number of employees demonstrates less thoroughness or attentiveness in their work.	1.8	0.09	0.16
3	Standard Operating Procedures (SOPs) have not been fully implemented.	2.2	0.08	0.18
4	A small number of employees experience a lack of motivation at work	1.9	0.08	0.15
	TOTAL		1.00	2.95

Source: Primary data processed, 2023

The EFE matrix in this study evaluates resource individuals based on external circumstances, which include both opportunities and threats. The opportunity and threat variables are assigned a rating and weight, resulting in a score that is presented in the following table.

Table 2. EFE Matrix

No	External Factor Opportunities	RATING	WEIGHT	SCORE
1	The establishment of a good cooperation between companies.	3.4	0.18	0.61
2	High consumer trust in the company	3.3	0.18	0.59
3	Experienced employees are a valuable asset in dealing with the high-demand labor market.	3.5	0.17	0.60
4	Technological advancements, including digital collaboration tools, have the potential to enhance employee productivity.	3.3	0.18	0.59
	Threats			
1	Economic instability and market fluctuations can affect job stability and employee compensation.	1.6	0.07	0.11
2	Changes in employment-related government regulation or policy	1.7	0.08	0.14
3	Job offers from competitor companies with better facilities for employees.	1.7	0.08	0.14
4	Employee well-being such as health and safety issues can negatively impact employee productivity	2.1	0.07	0.15
	TOTAL		1.00	2.93

Source: Primary data processed, 2023

The IFE matrix findings indicate that CV Sakha Muria's principal strength lies in the support provided by its facilities for employee workflows, achieving a score of 0.63. This is attributed to employees' perception that the company's facilities cultivate a conducive work environment and enhance productivity. Conversely, a notable

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weakness is the incomplete adherence to Standard Operating Procedures (SOPs), scoring 0.18, primarily due to occasional lapses by certain employees in complying with established standards.

In the EFE matrix analysis, a significant opportunity for CV Sakha Muria is identified in the realm of "strong intercompany collaboration," scoring 0.61. This collaborative synergy fosters benefits such as efficient information exchange and heightened operational efficacy, facilitating innovation, fostering a mutually beneficial corporate environment, and expanding market reach. Conversely, a noteworthy threat is posed by the potential negative impact of "welfare and security issues on employee productivity," scoring 0.15. This is attributed to the likelihood that employees experiencing perceived safety concerns may encounter heightened stress and discomfort, impeding their concentration and overall performance in the workplace.
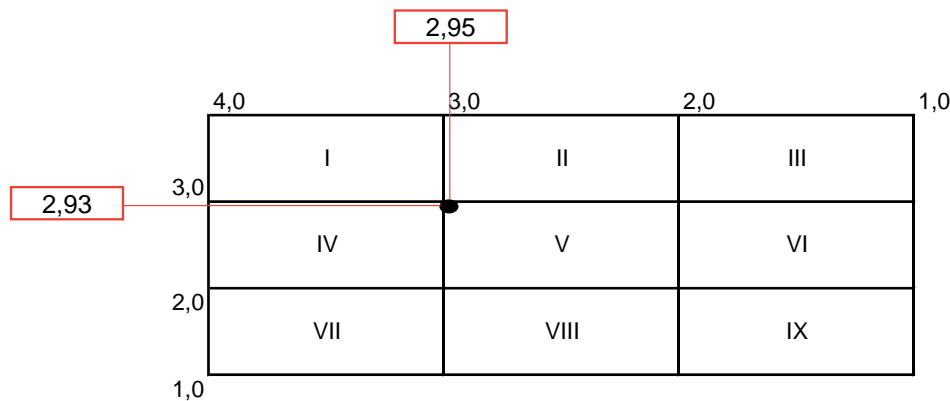

Figure 1. IE Matrix

Figure 1 illustrates the IE matrix for CV Sakha Muria, depicting a total score of 2.95 along the horizontal axis for the IFE matrix and 2.93 along the vertical axis for the EFE matrix. Both scores are documented within the IE matrix, placing CV Sakha Muria at point V with coordinates (2.95; 2.93). This positioning denotes a focus on preservation and consolidation. The recommended strategies for CV Sakha Muria encompass market penetration and the enhancement of personnel competencies. As CV Sakha Muria endeavors to implement market penetration strategies, the primary objective is to bolster employee competencies, thereby securing a larger market share. This strategy aims to augment employee capabilities through the optimization of satisfaction, trust, and welfare, thereby elevating product quality, while simultaneously nurturing the development of essential skills among the employees.

Table 3. SWOT Matrix

	STRENGTHS (S)	WEAKNESSES (W)
IFE **EFE**	1. The compensation or reward system provides employees with satisfaction. 2. Company facilities support employee work processes. 3. Employees have high dedication and responsibility towards work. 4. Employees have relevant skills to their duties and responsibilities in the company.	1. Lack of direct supervision during implementation 2. A small number of employees demonstrates less thoroughness or attentiveness in their work. 3. Standard Operating Procedures (SOPs) have not been fully implemented. 4. A small number of employees experience a lack of motivation at work.
OPPORTUNITIES (O)	**Strategi S-O**	**Strategi W-O**
1. The establishment of a good cooperation between companies. 2. High consumer trust in the company 3. Experienced employees are a valuable asset in dealing with the high-demand labor market. 4. Technological advancements,	1. Employing employee satisfaction, the company cultivates enhanced collaboration with other entities, fostering mutually beneficial business partnerships (S1, S2, O1, O2, O3). 2. The company enhances its product portfolio through the deployment of technology and leveraging employee expertise to drive diverse product innovations (S2, S3, S4, O2, O3, O4).	1. Empowering experienced employees to oversee and assess colleagues encountering challenges (W1, W2, W3, W4, O3, O4) 2. Recruiting individuals proficient in advanced technology, possessing a strong work ethic, and demonstrating high levels of motivation (W2, W3, W4, O1, O3, O4)

including digital collaboration tools, have the potential to enhance employee productivity.		
THREATS (T)	**Strategi S-T**	**Strategi W-T**
1. Economic instability and market fluctuations can affect job stability and employee compensation.	1. Enhancing employees' pertinent abilities to align with market dynamics and respond to changes in regulations or policies (S3. S4. T1. T2).	1. Offering employee benefits, such as health insurance, to ensure the safety and well-being of employees, so promoting careful and optimal work performance and fostering strong motivation towards the company (W2. W3. W4. T1. T3. T4)
2. Changes in employment-related government regulation or policy		
3. Job offers from competitor companies with better facilities for employees.	2. Conducting a thorough evaluation and revision of the compensation system with the goal of maintaining employee satisfaction and appeal (S1. S3. S4. T1. T2. T3. T4).	2. Establishing a specialized team to oversee regulatory modifications and assess strategies for reducing the financial and operational consequences on expenses and personnel management protocols (W1. T1. T2. T3)
4. Employee well-being such as health and safety issues can negatively impact employee productivity.		

Source: Primary data processed, 2023

Table 3 presents the outcomes of the SWOT matrix, which yielded a total of 8 alternative human resource development strategies at CV Sakha Muria. These strategies are categorized into SO, ST, WO, and WT, with each category containing 2 strategies. The findings of the SWOT analysis conducted on CV Sakha Muria are outlined as follows.

1. Strategi Strengths-Opportunities (S-O)
    The S-O strategy is an organizational strategy that capitalizes on organizational strengths to exploit prevailing opportunities.
a. Employing employee satisfaction, the company cultivates enhanced collaboration with other entities, fostering mutually beneficial business partnerships (S1, S2, O1, O2, O3). CV Sakha Muria acknowledges the strategic significance of employee satisfaction in fostering positive inter-organizational cooperation, thereby fostering mutually advantageous collaborations, and nurturing a favorable work culture.
b. The company enhances its product portfolio through the deployment of technology and leveraging employee expertise to drive diverse product innovations (S2, S3, S4, O2, O3, O4). By investing in adequate technological infrastructure, CV Sakha Muria accelerates the product development process, enhances operational efficiency, and responds promptly to market trends. Additionally, employees actively participate in innovation initiatives, fostering a culture of creativity in the workplace and promoting product diversity.

2. Strategi Weaknesses-Opportunities (W-O)
    The W-O strategy is an organizational strategy that takes advantage of opportunities to mitigate weaknesses within an organizational framework.
a. Empowering experienced employees to oversee and assess colleagues encountering challenges (W1, W2, W3, W4, O3, O4), CV Sakha Muria fosters a collaborative work culture. This approach capitalizes on the expertise and tenure of seasoned staff members, facilitating peer support and problem-solving. Through mentorship initiatives, employees cultivate collaboration and foster collective ownership of shared objectives.
b. Recruiting individuals proficient in advanced technology, possessing a strong work ethic, and demonstrating high levels of motivation (W2, W3, W4, O1, O3, O4) is integral to CV Sakha Muria's recruitment strategy. This meticulous selection process prioritizes candidate's adept at utilizing cutting-edge technology, maintaining precision and diligence to ensure consistent quality in daily tasks.

3. Strategi Strengths-Threats (S-T)
    The S-T strategy is an organizational strategy that takes advantage of strengths to mitigate the effects of threats.
a. Enhancing employees' pertinent abilities to align with market dynamics and respond to changes in regulations or policies (S3. S4. T1. T2). Employees of CV Sakha Muria who possess abilities that align with

current market demands have a notable competitive edge. Adapting to changes in regulations or policies is crucial for ensuring that firm activities align with legal and ethical standards.

b. Conducting a thorough evaluation and revision of the compensation system with the goal of maintaining employee satisfaction and appeal (S1. S3. S4. T1. T2. T3. T4). CV Sakha Muria modifies compensation to align with current industry trends. to guarantee that the organization can maintain a competitive wage and benefits offer. and instill strong motivation in employees.

4. Strategi Weaknesses-Threats (W-T)
   The W-T strategy is an organizational strategy that minimize weaknesses and mitigate threats

a. Offering employee benefits, such as health insurance, to ensure the safety and well-being of employees, so promoting careful and optimal work performance and fostering strong motivation towards the company (W2. W3. W4. T1. T3. T4). CV Sakha Muria ought to provide extensive health insurance to establish a secure working environment and alleviate the financial strain of employee healthcare.

b. Establishing a specialized team to oversee regulatory modifications and assess strategies for reducing the financial and operational consequences on expenses and personnel management protocols (W1. T1. T2. T3). The creation of this specialized team is focused on staying up-to-date with the most recent regulatory advancements and conducting a thorough examination of their possible effects on operational expenses and personnel management protocols..

The data derived from the SWOT matrix then establishes the prioritized approach through the utilization of the QSPM matrix in the following.

Table 4. QSPM Matrix

Key Factor	Weight	Strategy I		Strategy II		Strategy III		Strategy IV		Strategy V		Strategy VI		Strategy VII		Strategy VIII	
		AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS
STRENGTHS (S)																	
1. The compensation or reward system provides employees with satisfaction.	0.17	4	0.68	3	0.51	3	0.51	4	0.68	4	0.68	4	0.68	2	0.34	3	0.51
2. Company facilities support employee work processes.	0.18	3	0.54	4	0.72	3	0.54	4	0.72	4	0.72	3	0.54	3	0.54	4	0.72
3. Employees have high dedication and responsibility towards work.	0.17	3	0.51	3	0.51	4	0.68	3	0.51	4	0.68	4	0.68	3	0.51	3	0.51
4. Employees have relevant skills to their duties and responsibilities in the company.	0.16	4	0.64	4	0.64	4	0.64	3	0.48	4	0.64	4	0.64	3	0.48	3	0.48
WEAKNESSES (W)																	
1. Lack of direct supervision during implementation	0.08	3	0.24	2	0.16	3	0.24	3	0.24	3	0.24	3	0.24	4	0.32	3	0.24
2. A small number of employees demonstrates less thoroughness or attentiveness in their work.	0.09	2	0.18	1	0.09	3	0.27	2	0.18	3	0.27	2	0.18	3	0.27	4	0.36
3. Standard Operating Procedures (SOPs) have not been fully implemented.	0.08	2	0.16	2	0.16	3	0.24	4	0.32	2	0.16	3	0.24	2	0.16	3	0.24
4. A small number of employees experience a lack of motivation at work.	0.08	1	0.08	3	0.24	2	0.16	3	0.24	3	0.24	2	0.16	3	0.24	3	0.24
OPPORTUNITIES (O)																	
1. The establishment of a good cooperation between companies.	0.18	3	0.54	4	0.72	3	0.54	4	0.72	4	0.72	3	0.54	4	0.72	3	0.54
2. High consumer trust in the company	0.18	4	0.72	4	0.72	4	0.72	4	0.72	4	0.72	3	0.54	3	0.54	2	0.36
3. Experienced employees are a valuable asset in dealing with the high-demand labor market.	0.17	4	0.68	4	0.68	3	0.51	3	0.51	3	0.51	3	0.51	4	0.68	1	0.17
4. Technological advancements, including digital collaboration tools, have the potential to enhance employee productivity.	0.18	3	0.54	4	0.72	2	0.36	4	0.72	3	0.54	2	0.36	4	0.72	3	0.54

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Key Factor	Weight	Strategy I		Strategy II		Strategy III		Strategy IV		Strategy V		Strategy VI		Strategy VII		Strategy VIII	
		AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS
THREATS (T)																	
1. Economic instability and market fluctuations can affect job stability and employee compensation.	0.07	2	0.14	3	0.21	2	0.14	3	0.21	2	0.14	2	0.14	3	0.21	2	0.14
2. Changes in employment-related government regulation or policy	0.08	2	0.16	3	0.24	2	0.16	3	0.24	3	0.24	3	0.24	4	0.32	3	0.24
3. Job offers from competitor companies with better facilities for employees.	0.08	3	0.24	1	0.08	2	0.16	2	0.16	3	0.24	3	0.24	3	0.24	2	0.16
4. Employee well-being such as health and safety issues can negatively impact employee productivity.	0.07	2	0.14	2	0.14	2	0.14	3	0.21	3	0.21	3	0.21	4	0.28	4	0.28
STAS (*Sum Total Attractiveness Score*)			6.19		6.54		6.01		6.86		6.95		6.14		6.57		5.73

Source: Primary data processed, 2023

According to the QSPM calculation, strategy V emerges as the primary focus, garnering the highest Sum Total Attractive Score (STAS) of 6.95. This strategy entails developing employees' skills to adapt to market dynamics and navigate regulatory or policy shifts. Enhancing employee skills not only bolsters operational efficiency but also cultivates an innovative and competitive organizational milieu, thereby fostering sustained growth.

Conversely, Strategy VIII (5.73) exhibits the lowest STAS value. This strategy entails establishing a dedicated team to monitor regulatory changes and strategize methods to mitigate their impact on employee management costs and procedures. Organizations often prioritize strategic initiatives aligned with their objectives, particularly when faced with constraints such as limited time and financial resources.

CONCLUSION

The research findings on human resource development strategies within the beef business sector at CV Sakha Muria, located in Depok, West Java, indicate a robust internal condition, scoring 2.95 on the IFE matrix. This suggests that the strengths of CV Sakha Muria are well-positioned to effectively counterbalance any weaknesses. The results of the EFE matrix calculation further indicate that external factors possess the potential to mitigate prevailing threats within the external environment, registering a value of 2.93. These findings have generated several alternative strategies recommended for implementation at CV Sakha Muria.

The company is committed to enhancing employee skills to align with market trends and ensure compliance with regulatory or policy changes. This involves prioritizing the recruitment of technologically proficient individuals and those demonstrating meticulous attention to detail and a strong drive for impactful contributions. Efforts to improve employee welfare are manifested through the provision of health insurance facilities, aimed at fostering a conscientious and enthusiastic workforce.
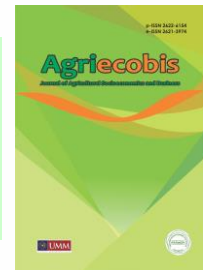
CV Sakha Muria fosters stronger collaborations with other enterprises by prioritizing employee satisfaction, akin to fostering mutually beneficial business partnerships. Meanwhile, the compensation system undergoes continuous evaluation and enhancement to maintain its attractiveness to employees. Furthermore, trust is placed in experienced employees who are tasked with overseeing and assessing colleagues facing difficulties. Additionally, a dedicated team is assembled to closely monitor regulatory changes and formulate strategies to mitigate their impact on costs and employee management procedures.

One of the leading strategies identified through the QSPM matrix is "Enhancing employee skills to align with market dynamics and adapt to changes in regulations or policies," scoring 6.95. The augmentation of employee capabilities not only bolsters operational efficiency but also cultivates an innovative and competitive organizational milieu, thereby fostering the company's long-term growth.

It is anticipated that CV Sakha Muria will further bolster training and development initiatives to augment employee competencies, alongside creating engaging and transparent career pathways for its workforce. Additionally, efforts to enhance employee well-being and productivity through the development of health and safety facilities are envisaged. Future researchers are encouraged to delve deeper into the internal and external factors that may influence the growth trajectory of CV Sakha Muria's employees.

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Research Article

Examining the Impact of Production Factors on Palm Oil Production Levels

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ABSTRACT

This study aims to investigate the influence of various factors on oil palm production levels. Specifically, it seeks to analyze the effects of production range, fertilizer expenses, and labor on oil palm production. Furthermore, it intends to evaluate the impact of production variables, namely oil palm production zone, fertilizer costs, and labor, on oil palm production levels. Factors such as land area, fertilizer expenses, and workforce are critical variables affecting oil palm production, significantly influencing its productivity. Data was collected through observations, interviews, and surveys. The decision to conduct tests followed the purposive sampling approach, involving 26 respondents. The production components notably influence the production rate, particularly labor and fertilizer costs. However, the land area's production rate does not exhibit a significant effect. Approximately 92.5% of the production rate is attributable to the substantial contribution of production variables, with the remaining 7.5% influenced by other factors. Among these variables, fertilizer costs emerge as the most influential factor affecting oil palm productivity in Suliliran Baru.

INTRODUCTION

Agriculture holds considerable significance as a contributor to the Indonesian economy, stemming from its designation as an agricultural nation (Fajar Oktavia & Fathin, 2022). Agricultural plantations, along with the oil and gas sector, are pivotal in bolstering the country's foreign exchange reserves. Notably, oil palm cultivation significantly fosters Indonesia's economic prosperity (Mulya Pratama et al., 2023). In 2022, the Directorate General of Plantations of the Indonesian Ministry of Agriculture reported a total oil palm plantation area of 15.38 million hectares. This encompassed 6.37 million hectares of smallholder-owned plantations, 598.7 thousand hectares owned by large state companies, and 8.40 million hectares owned by private companies (Tasya Billa & Iswarini, 2021). Paser, situated in East Kalimantan, dedicates 18,575 hectares to oil palm cultivation, yielding 16,771 kg per hectare.

Despite the extensive palm oil production across 15.38 million hectares of land, the actual output from oil palm cultivation remains modest in Indonesia, as highlighted by Syahrul Yasin Limpo, the Minister of Agriculture (Irmeilyana et al., 2021). Primary challenges faced by Indonesian oil palm farms include insufficient revenue from community-owned estates and suboptimal utilization of agricultural inputs. Production factors, defined by Triesia (2020), encompass components exclusively utilized during the production process. These factors, such as land extent, labor, and the application of fertilizers and pesticides, often impact output levels (Enita et al., 2023). Optimizing the utilization of production inputs can significantly enhance oil palm yield and improve farmers' well-being.

The generation rate within the arrival zone directly correlates with the number of plants within its designated range. Siswanto et al.'s (2020) study titled *Analisis Faktor-Faktor yang Mempengaruhi Produksi Komoditas Kelapa Sawit Perkebunan Rakyat dengan Pola Swadaya di Kabupaten Aceh Tamiang* (Analysis of Factors Affecting Production of Palm Oil by People in Tebing Linggahara, West Bilah, Labuhanbatu) elucidates the substantial impact of the arrival zone component on palm oil yields in the investigated area. This impact is supported by a centrality level of 0.000 or a t-value of 11.668. Labor is a critical production factor, as examined in Mustari et al.'s (2020) study titled *Analisis Faktor-Faktor yang Mempengaruhi Produksi Komoditas Kelapa Sawit Perkebunan Rakyat dengan Pola Swadaya di Kabupaten Aceh Tamiang* (Analysis of Factors Affecting the Production of Palm Oil Commodities from Community Plantations with a Self-Help Pattern in Aceh Tamiang). Nasution et al. (2023) affirms the pivotal role of fertilization in influencing plant growth and development. Lastly, Rafidah et al.'s (2022) research on the generation rate of oil palm in Laburan, Paser Belengkong, Paser, underscores the significant impact of fertilizer costs on palm oil farmer income, indicated by a t-value of 2.381.

The study aims to address the impact of production components, namely the specific arrival zone, fertilizer cost, and labor simultaneously, on oil palm production levels in Kota Suliliran Baru. Additionally, it evaluates the relatively minor impact of production variables, namely arrival zone, fertilizer cost, and labor, on oil palm production in Kota Suliliran Baru. Furthermore, it assesses the capacity of production components, particularly the arrival zone, fertilizer cost, and labor, to contribute to palm oil production in Suliliran Baru. Finally, it identifies the factors influencing oil palm production in Suliliran Baru.

METHOD

The study was conducted between October and December 2023 in Suliliran Baru, Paser Belengkong, Paser. Two types of data were employed: primary data obtained through direct interviews with selected farmers at the research site, and secondary data, referring to information gathered indirectly from papers provided by relevant agencies (Kaharuddin, 2021).

Purposive sampling method was employed for sample selection, entailing the deliberate selection of research data sources based on careful evaluation and review. The criteria for inclusion comprised land ownership ranging from 1 to 5 hectares and plant age ranging from 7 to 20 years. Zaluchu (2020) highlights the importance of meticulous subject selection, especially when the sample size is less than 100. However, when the number of subjects exceeds 100, a selection ranging from 10% to 15%, 20% to 25%, or even more can be considered. In this study, a sample size of 26 independent oil palm plantation farmers was utilized, representing 10% of the total population of 260 farmers in Suliliran Baru, Paser Belengkong, Paser.

Data collection involves quantitative descriptive analysis procedures, which entail processing data through statistical tests and subsequently interpreting the acquired test findings. Multiple linear regression analysis and hypothesis testing techniques are employed. Several tests are utilized, including:

(i) The normality test on the regression model is conducted to determine if the residuals conform to a normal distribution. The Kolmogorov-Smirnov method is used for normality testing, comparing a significance level (α) of 0.05 to obtain a comparison (p). A p-value greater than 0.05 indicates a normal distribution, while a p-value less than or equal to 0.05 suggests a departure from normal distribution (Nursalam, 2020).

(ii) The autocorrelation test examines whether there is a link between the residual in period t and the residual in the previous period t-1 (Mardiatmoko, 2020). Autocorrelation is considered to occur when a relationship is found. The Durbin-Watson test (DW Test) is utilized in this experiment to assess the proximity of autocorrelation.

(iii) Various direct recurrence tests are employed to determine the impact of independent variables on dependent variables (Aryani & Gustian, 2020). Multiple independent variables are tested using a centrality threshold of 5%. Subsequent conditions on many direct recurrences are utilized.

$$Y = \alpha + b_1X_1 + b_2X_2 + b_3X_3 + e$$

where:
Y : Dependent variable
α : Constant (Y value if X1, X2,..., e = 0)
$X_1, ..., X_3$: Independent variable
$b_1,..., b_2$: Regression coefficient (value of increase or decrease)
e : Error

The correlation coefficient, a measure quantifying the degree of linear correlation between variables (Soedyafa et al., 2020), indicates significant correlation when the obtained result is affirmative. An increase in variable X corresponds with a rise in production generated by Y, and vice versa. Conversely, a negative result suggests no correlation between these variables; an increase in variable X leads to a reduction in the output generated by Y.

The coefficient of determination (R2) test, commonly employed to assess the model's ability to explain variations in the dependent variable, is calculated using a specific formula (Soedyafa et al., 2020). A regression model is deemed of high quality if the coefficient of determination (R2) is defined as follows:

$$R^2 = (ESS/TSS0 = 1 - (RSS/TSS)$$

where:
R^2 : Coefficient of determination
ESS : *Explained sum of squares*
TSS : *Total sum of squares*

The F test is frequently utilized to demonstrate the collective association between all independent variables in the model and the dependent variable. The null hypothesis posits that the coefficients β1, β2, ..., βk are equal to zero, indicating a lack of direct proportionality (Zaki & Saiman, 2021). The subsequent test steps are as follows:

a) H0: β1 = β2 = ... = βk = 0; The null hypothesis being tested suggests that the overall effect of the independent variables in the model equals zero, implying that none of the independent factors significantly impact the dependent variable.

b) Ha: β1 ≠ β2 ≠ ... ≠ βk ≠ 0; The alternative hypothesis asserts a substantial relationship between the independent factors and the dependent variable, indicating that not all coefficients are equal to zero and that the independent variables collectively explain the dependent variable.

c) Hypothesis testing using F statistics, with the F calculation results obtained through the formula displayed below:

$$F\text{-}_{count} = R^2/(k\text{-}1) \, / \, (1\text{-}R^2)/ \, (1\text{-}R^2) \, (n\text{-}k)$$

Where:
n : Number of observations
k : Number of parameters (including intercept) in the model.

The process of selecting options (decision-making) or reaching conclusions involves several steps:

1) If the F-count value exceeds the F-table value, the null hypothesis (H0) is rejected, signifying that all independent factors can simultaneously influence the dependent variable.

2) Conversely, if the F-count is less than the F-table value, the null hypothesis (H0) is accepted, indicating that none of the independent factors significantly influence the dependent variable.

The t-test is commonly utilized to evaluate the individual impact of each independent variable on the dependent variable to ascertain their explanatory power (Yam & Taufik, 2021). The testing phases are as follows:

a) H0: bi = 0; The null hypothesis suggests that the parameter (bi) has a value of zero, indicating no significant impact of the independent variable on the dependent variable.

b) Ha: bi ≠ 0; The alternative hypothesis posits that the parameter (bi) has a value not equal to zero, indicating a significant impact of the independent variable on the dependent variable.
c) The determination of the variable under examination is based on comparing the t-count value with the t-table using a specific formula.

$$t\text{-}_{count} = bi / Sbi$$

Where:
Bi   : i-th independent coefficient
Sbi   : Standard deviation of the i-th independent variable

The process of decision-making or drawing conclusions involves the following criteria:
1) If the t-count value exceeds the t-table value, the null hypothesis (H0) is rejected, signifying a significant correlation between the independent variable and the dependent variable (Mutryarny & Rizal, 2022).
2) Conversely, if the t-count value is less than or equal to the t-table value, the null hypothesis (H0) is accepted, indicating an insignificant correlation between the independent variable and the dependent variable (Mutryarny & Rizal, 2022).

RESULTS AND DISCUSSION

The effect of production factors (such as land area, fertilizer costs, and labor) on the level of oil palm production in Suliliran Baru

To address the increasing demand for palm oil, various initiatives are underway to enhance the revenue generated from its production. Key production factors, such as land acreage, fertilizer, labor, and pesticides, typically exert significant influence on revenue (Masroni et al., 2023). Optimizing the utilization of these production inputs holds promise for enhancing oil palm productivity and improving the livelihoods of oil palm plantation farmers in Suliliran Baru Village, situated in Paser Belengkong District, Paser Regency. The income derived from oil palm farming is impacted by several production factors, including land area, energy consumption, labor input, and fertilizer expenses. Data analysis was performed using SPSS version 25, resulting in the following findings:

Table 1. Analysis Results of Simultaneous F Test

	Model	Sum of a Squares	Df	Mean Square	F	Sig.
	Regression	8385.724	3	2795.241	90.577	.000b
1	Residual	678.930	22	30.860		
	Total	9064.654	25			

The table data reveals an F-count value of 90.577 and an F-table value of 3.05. With the F-count value (90.577) surpassing the F-table value (3.05), the null hypothesis (H0) is rejected, and the alternative hypothesis (Ha) is accepted, indicating a robust influence of the variables in question. X1, X2, and X3 concurrently impact variable Y in Suliliran Baru Village. As per Yanita and Suandi (2021), the study underscores the significant influence of tree quantity, NPK fertilizer, super dolomite fertilizer, and pesticides on oil palm productivity. This contradicts the findings of Mas et al. (2023), Monita & Zebua (2023), and Rafidah et al. (2022), who suggested that factors such as land area, labor, and plant age have negligible effects on oil palm productivity.

The indirect effect of production factors (such as land area, fertilizer costs and labor) on the level of oil palm production in Suliliran Baru.

To evaluate the individual impact of each independent variable on the dependent variable, a significance level test is conducted by comparing the t-count findings with the t-table for the correlation coefficient of each independent variable separately. Subsequently, the T test is performed using SPSS version 25, resulting in the following outcomes:

Table 2. Analysis Results of T-Test

Model		Unstandardized Coefficient		Standardize Coefficient	T	Sig.
		B	Std. Error	Beta		
	(Constant)	13.142	2.995		4.388	.000
1	X1_ Land Area	.009	.021	.053	.424	.675
	X2_ Labor	.429	.125	.424	3.430	.002
	X3_ Fertilizer Cost	1.928E-6	.000	.540	5.169	.000

Based on the data processing results presented in the table above, the t-count value for land area (X1) is 0.424, corresponding to a probability result (sig value) of 0.675. The t-table result is 2.07387. Since the significance level of 0.675 is greater than or equal to 0.05, the null hypothesis (H0) is accepted, and the alternative hypothesis (Ha) is rejected. This indicates that the land area variable (X1) does not exert a significant effect on the variable (Y), specifically the level of oil palm production in Suliliran Baru (Ariesca et al., 2023). Additionally, the productivity of oil palm plantations is significantly influenced by various soil types, such as peat soil and mineral soil, as noted by previous studies (Atikah et al., 2022). Expanding the size of oil palm plantations is crucial for maximizing productivity and meeting the demand for palm oil (Wan Shahidan & Nadzri, 2020). The availability of land area significantly influences the productivity and growth of the palm oil sector.

Upon analyzing the data, the t-count value for labor (X2) is found to be 3.430, exceeding the t-table value of 2.07387. Consequently, the null hypothesis (H0) is rejected, and the alternative hypothesis (Ha) is accepted, indicating that the labor variable (X2) has a significant impact on the level of oil palm production in Suliliran Baru Village. Previous research by Sophia (2022) and Wahab & Dollah (2023) suggests that factors such as age, job experience, remuneration, and motivation of harvesters influence their productivity in oil palm output. The workforce plays a critical role in palm oil production, highlighting the importance of addressing labor-related issues to enhance productivity in the sector.

Furthermore, the t-count value for fertilizer costs (X3) is 5.169, surpassing the t-table value of 2.07387. Hence, the null hypothesis (H0) is rejected, and the alternative hypothesis (Ha) is accepted. This indicates that the fertilizer cost variable (X3) significantly affects the variable (Y), specifically the level of oil palm production in Suliliran Baru. Oil palm productivity in various regions has been enhanced through the application of phosphorus, potassium, and magnesium fertilizers. The high cost associated with synthetic fertilizers in the palm oil sector has led to the exploration of alternative approaches to mitigate production expenses (Lima et al., 2022). Sustainable oil palm production hinges on effective soil and fertilizer management to preserve soil fertility and reduce production costs. However, prolonged use of chemical fertilizers has been found to deplete soil nitrogen and organic carbon levels, as well as alter the composition of beneficial soil microorganisms (Salamat et al., 2021).

The contribution of production factors such as land area, fertilizer costs, and labor to oil palm production in Suliliran Baru.

To evaluate the combined influence of the independent variables on the dependent variable, the Adjusted R-Square value is computed. This entails employing the coefficient of determination (R2) test, as delineated by Sari et al. (2022). A low coefficient value implies restricted capability of the independent variables. Conversely, a value nearing 1 and diverging from 0 indicates that each independent variable can furnish all requisite information for predicting the dependent variable. Subsequently, scrutiny is directed towards analyzing the resulting coefficient of determination.

Table 3. Results of Determination Coefficient Analysis (R2)

Model	R	R Square	Adjusted R Square	Stad. Error of Estimate
1	.962a	.925	.915	5.555

The coefficient of determination (R2) stands at 0.915, signifying that 91.5% of the fluctuations in oil palm production are accounted for by alterations in land area, labor, and fertilizer costs. The residual 8.5% is influenced by other variables not encompassed in this study. Monita & Zebua (2023b) and Ramadan* & Hasmarini (2023) examined additional factors such as plant count, precipitation, and plant maturity in their investigations.

CONCLUSION

The preceding analysis has led to the following conclusions: Production parameters, namely land area (X1), labor (X2), and fertilizer expenses (X3), collectively wield a substantial influence on oil palm production in Suliliran Baru Village (Y). Both the labor variable (X2) and the fertilizer cost variable (X3) significantly affect the level of oil palm production (Y) in Suliliran Baru Village, as evidenced by their t-count values surpassing the t-table value. Conversely, the land area variable (X1) shows no tangible or significant impact on oil palm production (Y) in Suliliran Baru Village. The fertilizer cost variable (X3) emerges as the most influential among the three variables X1, X2, and X3, with a t-value of 5.169.

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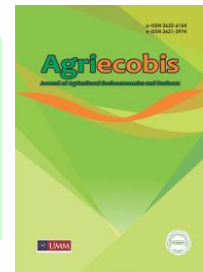
Research Article

Understanding Household Cooked Rice Waste: A Comparative Study between Rural and Urban Areas in Pasuruan, Indonesia

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ABSTRACT

Household food consumption patterns exhibit variability, with households serving as prominent contributors to food waste generation, thereby leading to adverse economic ramifications. This study aims to calculate the amount of household cooked rice waste, calculate the economic value loss from household cooked rice waste, and analyze the factors that influence household cooked rice waste in rural and urban areas. The investigation was carried out in two distinct locales: Purwo, Sekarmojo, Purwosari, Pasuruan (representing rural areas) and Sebani, Gadingrejo, Pasuruan (representing urban areas). The weight of household cooked rice waste is computed utilizing the fDMM (Faktor Dalam Masak Mentah or Factor in Raw Food Cooking) methodology. Economic loss incurred due to household cooked rice waste is estimated by multiplying the prevailing rice price by the converted volume of rice waste. Multiple regression analysis is employed to discern the contributing factors to household cooked rice waste. Findings indicate a higher incidence of household cooked rice waste in rural settings compared to urban counterparts, consequently resulting in greater economic repercussions. In Sekarmojo, household cooked rice waste is affected by several factors, including the quantity of rice cooked, household income, family size, and frequency of rice consumption. Likewise, in Sebani, household cooked rice waste is affected by variables such as the quantity of rice cooked, household size, frequency of rice consumption, and the utilization of mobile phones for food procurement.

INTRODUCTION

Population growth exerts multifaceted impacts encompassing food security and the proliferation of food waste (Mokrane et al., 2023; Vittuari et al., 2019). Globally, food waste has emerged as a paramount concern within the international community's purview (Çosan & Aymankuy, 2023; Trivedi et al., 2023; Wani et al., 2023). The swift expansion of the global economy has precipitated a surge in food waste generation, attributable to population growth and escalated consumption (FAO, 2013). According to the Food and Agriculture Organization (FAO), approximately one-third of the total food produced for consumption, equating to 1.3 billion tons annually, is loss or wasted. Jimmyanto et al. (2017) contend that population upsurges contribute to

escalated waste accumulation within nations, with solid waste accounting for 55-80% of urban waste, comprising both organic and inorganic components. Indonesia, ranking second globally in food waste contribution after Saudi Arabia, confronts a formidable challenge. As per data from the Ministry of Environment and Forestry (2020) cited in Saputra et al. (2017), national waste production has soared to 67.8 million tons. Indonesia's annual food waste production stands at 1.3 million tons, translating to an average per capita waste generation of 300 kilograms. This cumulative food waste amounts to IDR 27 trillion, a figure capable of sustaining 28 million individuals annually (Saputra et al., 2017). Alarmingly, despite this surplus, 19.6 million Indonesians still grapple with malnutrition. The economic value of this wasted food could substantially bolster efforts to alleviate food insecurity and malnutrition, starkly underscoring the impediment posed by food waste to Indonesia's progress towards achieving the Sustainable Development Goals (SDGs) in terms of food security and nutritional outcomes.

Households emerge as the primary agents driving food waste generation (Wulandari et al., 2020). According to Alfiati (2018), variables such as family size, maternal age, and maternal education level significantly shape household food consumption patterns. Neff et al. (2015) assert that inadequate awareness, knowledge, motivation, and behavioral patterns among communities are pivotal in exacerbating food waste. Kowalska (2017) contends that income levels serve as determinants of food waste, with affluent nations exhibiting distinct patterns from those with lower incomes. Moreover, Nafiroh et al. (2019) highlight the critical role of family size in influencing household food waste volumes. Anriany and Martianto (2013) observe a gender-based disparity in food waste generation, with women being identified as the primary contributors. Extant literature consistently underscores the impact of family size and familial behaviors in shaping the magnitude of household food waste.

Household food consumption patterns exhibit variability influenced by factors such as food availability, socio-cultural norms, nutritional awareness, economic circumstances, and environmental considerations. Urban consumption behaviors, shaped by factors like readily accessible information and food sources, as well as diverse dining practices both within and outside the home, can contribute significantly to food waste generation (Fami et al., 2019). This phenomenon is often driven by consumer perceptions of food quality and variety. In contrast, rural communities, characterized by distinct home dining practices, limited food options, and ingredient availability, experience differing levels of food waste compared to their urban counterparts. The resulting food waste poses considerable economic burdens on households and contributes to environmental degradation. Consequently, this study aims to examine the behavior of rural and urban communities in generating rice waste in their households. This study aims to calculate the amount of household cooked rice waste in rural and urban areas, calculate the economic value loss due to the formation of household cooked rice waste, and analyze the factors affecting the formation of household cooked rice waste in rural and urban areas.

METHOD

This study was conducted in two distinct locations: Purwo, Sekarmojo, Purwosari, Pasuruan, representing rural households, and Sebani, Gadingrejo, Pasuruan, representing urban households. These locations were purposefully chosen to investigate household cooked rice waste generation behaviors in rural and urban settings. Participants comprised households residing in the designated research sites. Random sampling techniques were employed in both locations to select participants. The sample size was deliberately set as follows: 45 households were chosen from Purwo, Sekarmojo, Purwosari, which represents a population of 78 households, and 45 households were selected from Sebani, Gadingrejo, Purwosari, representing a population of 62 households.

The data utilized in this study is classified as primary data. Primary data collection involved administering surveys, conducting interviews, and distributing questionnaires. The questionnaire encompassed respondent attributes such as family size, gender, age, education, occupation, and income. Measurement of household cooked rice waste involved direct weighing using digital scales with a capacity of 10 kg and an accuracy of 1 g. Data collection spanned one month to streamline the process and expedite the retrieval of economic value. Each participant recorded daily remaining rice quantities on a provided table throughout the month. The implementation team closely monitored each sample weekly using a combination of online and direct data gathering methods conducted by researchers.

a. Analytical method to calculate the amount of household food waste

The specific data required for collection pertains to the weight of leftover rice post-cooking within households. To determine the reduced rice weight from leftovers, the cooking weight is multiplied by the fDMM (Factor in Raw Food Cooking). Daily residual rice quantities from each household were gathered using plastic bags and measured against the cooking weight. The fDMM formula was applied to assess the volume of food waste resulting from raw rice consumption at the household level. Additionally, to calculate food loss, it is essential to convert cooked food weight to its raw weight using the fDMM (Factor In Raw Food Cooking). The FDMM for standard cooked rice stands at 0.347, while for coconut milk cooked rice, it is 0.376, calculated through the predetermined methodology.

$$\text{Raw Food Weight} = \text{Cooked Food Weight (grams)} \times \text{fDMM}$$

b. Analytical method to calculate the loss of economic value due to the formation of household cooked rice waste

The economic value of household cooked rice waste is calculated by multiplying the current market price of rice by the quantity of waste generated. This involves applying a conversion factor of 0.347 to the quantity of rice waste produced by households. Hence, the resulting economic value represents the monetary equivalent of rice waste generated. The formula utilized is expressed as follows:

$$NE = BSMSK \text{ (grams)} \times H \text{ (IDR/gram)}$$

where:
NE = Economic Value (IDR);
BSMSK = Weight of Leftover Food After Conversion (grams) ;
H = Market Price of rice per gram (IDR/gram)

c. Analyzing the factors affecting the formation of household cooked rice waste

To determine the factors affecting the formation of household cooked rice waste, multiple regression analysis was used. The following is the multiple linear regression model:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + e$$

where:
Y = household cooked rice waste (expressed in kilograms per capita per month);
X1 = the quantity or amount of cooked rice consumed daily (measured in kilograms per day);
X2 = household income (measured in Indonesian Rupiah per month);
X3 = the number of family members (measured in individuals);
X4 = the mother's education level (measured in years);
X5 = the frequency of rice consumption per day;
X6 = a dummy variable indicating active use of mobile phones for food purchases; and
X7 = a dummy variable representing the habit of eating out. The error term is denoted by 'e', while 'a' signifies the constant, and 'b1', 'b2', 'b3', 'b4', 'b5', 'b6', and 'b7' represent the regression coefficients associated with each respective variable.

RESULTS AND DISCUSSION

Amount of household cooked rice waste

Utilizing distributed questionnaires among respondents residing in rural (Sekarmojo) and urban (Sebani) areas, the monthly quantity of food waste, specifically cooked rice, was estimated. The comprehensive estimation calculations are outlined in Table 1.
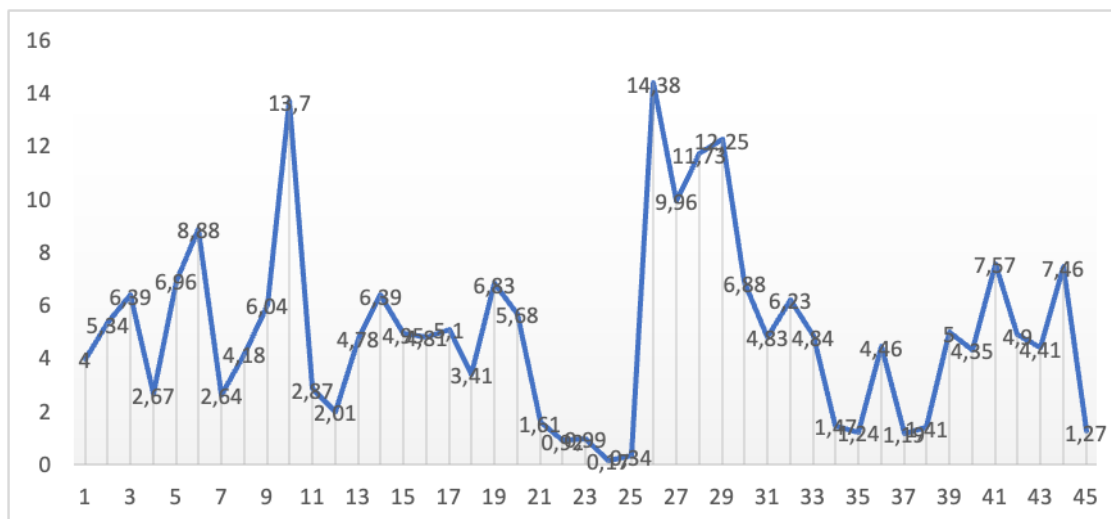
Table 1. Amount of Household Cooked rice Waste

Location	Number of Respondents	Household Cooked Rice Waste		
		Cooking Food Weight (Kg/month)	fDMM	Raw Food Weight (Kg/month)
Sekarmojo	45	227.49	0.347	78.93903
Sebani	45	145.38	0.347	50.447
Total				129.38589

Source: processed data 2022

This study investigates household cooked rice waste, referring to the quantity of rice produced by households but left unconsumed and subsequently discarded. Table 1 presents the total weight of leftover rice at each research site. In Purwo, Sekarmojo, a monthly total of 227.49 kilograms of cooked rice waste was identified, equivalent to 78.93903 kilograms of raw rice. In Sebani, 145.38 kilograms of cooked rice waste was discovered monthly, translating to 50.447 kilograms of raw rice. The findings indicate that each household in Purwo, Sekarmojo, generates 1.1727 kg/month or 0.0584 kg/day (equivalent to 58.47 grams/day/household) of raw rice leftovers, while in Sebani, each household produces 1.21 kg/month or 0.0321 kg/day (equivalent to 32.1 grams/day/household) of raw rice leftovers. This signifies a higher quantity in Purwo, Sekarmojo, compared to Sebani. Sugiyarto (2021) highlighted the scarcity of research on food waste in rural areas, specifically citing the case of cooked rice waste in Yogyakarta neighborhoods, amounting to 0.051 grams per day of raw rice. Additionally, noted an average of 37.6 grams per day per household of cooked rice waste in Indonesia.

Figures 1 and 2 depict the distribution of household cooked rice waste across the two research sites. As shown in Figure 1, households in Purwo, Sekarmojo, generated a maximum of 14.38 kg of cooked rice waste per month and a minimum of 0.17 kg per month. The total quantity of cooked rice waste produced by households in this area amounted to 227.49 kg per month, averaging 5 kg per family per month. In contrast, Figure 2 illustrates that households in Sebani produced a maximum of 5.95 kg of cooked rice waste per month and a minimum of 0.95 kg per month. Consequently, the total monthly waste generated in this region was 145.38 kg, averaging 3 kg per household per month.

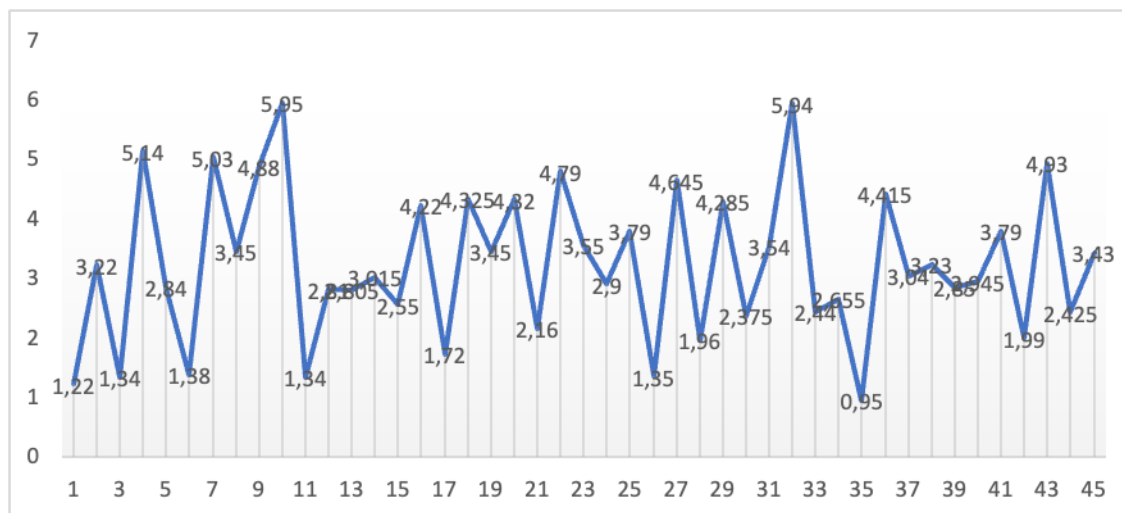**Figure 1.** Graph of Household Cooked Rice Waste in Purwo, Sekarmojo, Purwosari, Pasuruan

Figure 2. Graph of Household Cooked Rice Waste in Sebani, Gadingrejo, Pasuruan

The economic value loss caused by the generation of household cooked rice waste

Table 2. Economic Value Loss from Food Waste

Location	Number of Respondents (persons)	Price of Rice (IDR)	Raw Rice Waste (KG/Month)	Economic Value Per Month (IDR)	Average Of Economic Value Per Month (IDR/Household/Month)
Purwo, Sekarmojo	45	9,500	78.93903	750,395.78	16,675
Sebani	45	10,500	50.447	529,693.5	11,770

Source: processed data 2022

The disposal of cooked rice waste in households can lead to economic losses (Annunziata et al., 2021; Sunday et al., 2022). These losses can be quantified by multiplying the quantity of cooked rice waste converted to raw rice waste by the prevailing price of rice. The rice price utilized is the mean price reported by respondents during interviews. In Purwo, Sekarmojo, Purwosari, Pasuruan, respondents reported a rice price of IDR 9,500, while in Sebani, Gadingrejo, Pasuruan, it was IDR 10,500. Table 2 presents the projected economic losses resulting from rice wastage at the individual household level. In the Purwo region of Sekarmojo, the conversion of raw rice waste leads to an economic loss of IDR 750,395.78 per month, equivalent to IDR 16,675 per household per month. In Sebani, the economic loss is smaller at IDR 529,693.5 or IDR 11,770 per household per month. This variable is subject to fluctuations based on the rice price at the research site. Excessive rice cooking and family members purchasing food from external sources were identified as contributing factors based on interview findings.

a. Factors affecting household cooked rice waste

This study examined the influence of various factors on the production of cooked rice waste in households. Variations in the quantity of cooked rice waste per household are illustrated in Figures 1 and 2. A disparity in cooked rice waste quantities exists between rural and urban settings, with rural areas showing higher levels compared to urban areas. The variables investigated in this study to ascertain the determinants of household cooked rice waste include the quantity of rice cooked, household income, family size, maternal education level, frequency of rice consumption, mobile phone usage for food ordering, and dining habits outside the home. Household factors contributing to cooked rice wastage, as noted by Matharu et al. (2022) and Nunkoo et al. (2021), encompass feelings of guilt, lack of awareness, space constraints, inadequate policies, and time constraints. These factors have been identified in previous research exploring attitudes toward food waste in households. The impact of these factors on cooked rice waste generation is presented in Tables 3 and 4.

Table 3. Results of the analysis of factors affecting household cooked rice waste in Serkarmojo

Variable	Coefficient of the Parameter	T$_{count}$	Probability
Constant	1,287	1,583	0,032
Quantity of rice cooked per day (kg/day)	2,671	4,178	0,000
Household income (IDR/month)	0,001	1,957	0,058
Number of family members (people)	-1,179	-1,722	0,094
Education level of the housewife (years)	-0,194	-1,051	0,330
Frequency of eating rice	-0,112	-2,654	0,007
Active use of mobile phone for food purchasing	0,566	0,604	0,550
Eating habits outside the home	2,194	2,207	0,129

Source: results of data analysis 2022

Table 4. Results of the analysis of factors affecting household cooked rice waste in Sebani

Variable	Coefficient of the Parameter	T$_{count}$	Probability
Constant	0,016	1,227	0,099
Quantity of rice cooked per day (kg/day)	0,319	2,832	0,013
Household income (IDR/month)	0,365	0,200	1,821
Number of family members (people)	0,365	2,227	0,077
Education level of the housewife (years)	-0,019	0,030	-0,639
Frequency of eating rice	0,132	0,805	0,161
Active use of mobile phone for food purchasing	0,927	2,102	0,083
Eating habits outside the home	0,016	0,027	0,599

Source: results of data analysis 2022

Table 3 depicts the outcomes of the analysis concerning factors influencing the generation of cooked rice waste within households in Sekarmojo. These variables encompass the quantity of rice cooked, household income, number of family members, and frequency of rice consumption. A notable positive correlation is observed between the quantity of cooked rice and the produced waste, indicating that an increase in cooked rice volume corresponds to a higher amount of waste. Respondents from Sekarmojo typically prepare around 1 kilogram of rice daily, adjusted to household size and composition. The primary occupation of household heads, often engaged in rice cultivation, ensures a steady rice supply, contradicting Li et al. (2021), who contend that rural residents consume more due to limited access. Household income exhibits a significant positive effect, suggesting that higher incomes lead to increased waste. The mean income in Sekarmojo, IDR 4,170,000, falls below the 2022 Pasuruan Regional Minimum Wage of IDR 4,365,000, with residents employed in farming, labor, manufacturing, and trade. Greater financial means enable larger food purchases, contributing to more waste, as noted by Saputro et al. (2021). Conversely, family size shows a significant negative correlation with waste generation, indicating that larger families produce less waste. Household food consumption is directly influenced by family size, necessitating accurate rice portion estimation to minimize waste. Respondents report an average family size of 5 individuals. Additionally, increased rice consumption frequency among family members correlates with reduced waste. Interviews reveal a twice-daily rice consumption habit, often with breakfast skipped or taken outside due to morning fieldwork. The Sekarmojo community practices waste reduction by repurposing cooked rice as animal feed, fertilizer through fermentation, or drying for alternative food products. Such practices contribute to waste minimization within households.

Table 4 illustrates the variables influencing rice waste production in households of Sebani, encompassing the quantity of rice cooked, family size, rice consumption frequency, and mobile phone use for food purchases. An increase in cooked rice quantity positively impacts waste production, akin to findings in Sekarmojo. Accurate rice preparation knowledge is crucial for housewives to minimize waste, as higher cooking quantities correspond to increased waste. Sebani's average rice consumption is 0.75 kg/day lower than Sekarmojo's, correlating with a family size average of 4 individuals. Family size significantly increases cooked rice waste production; as family members rise, so does waste. Additionally, frequent rice consumption correlates with increased waste, as indicated by Hidayat et al. (2020), attributing this trend to overeating due to food availability. Mobile phone use for food ordering significantly impacts waste production, prevalent in urban areas for its convenience and menu diversity accessible only via mobile. Fami et al. (2019) emphasize the role of information technology in waste production, a key rural-urban distinction. Sekarmojo's investigation indicates insignificant mobile phone effects on waste, attributed to low active usage and limited online food app access.

CONCLUSION

In Purwo, Sekarmojo, cooked rice waste weighed 227.49 kilograms monthly, equivalent to 78.93903 kilograms of raw rice. Sebani yielded 145.38 kilograms of cooked rice waste monthly, or 50.447 kilograms of raw rice. Economic losses from wasted cooked rice in Purwo, Sekarmojo, total IDR 750,395.78 monthly, equating to IDR 16,675 per household. Sebani's loss is smaller at IDR 529,693.5 or IDR 11,770 per household monthly. Key determinants of cooked rice waste in Sekarmojo include rice volume, household income, family size, and consumption frequency. In Sebani, waste determinants encompass rice quantity, household size, consumption frequency, and mobile phone use for food orders.

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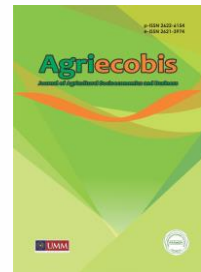
Research Article

Factors Affecting Technical Efficiency in Potato Farming: A Data Envelopment Analysis (DEA) Study in East Java, Indonesia

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ABSTRACT

Potato farming has a crucial role in promoting the agricultural sector of East Java, Indonesia, with significant consequences for regional economic growth and acting as the main source of income for farmers. However, the primary challenge that potato farmers face involves improving production efficiency in order to strengthen the sustainability and competitiveness of the agricultural industry. This study aims to analyze the technical efficiency of potato farming in East Java and identify the factors affecting this efficiency. The study focuses on the areas of Sumberberantas and Wonokerso in East Java, which serve as key centers for growing potatoes. The study includes a group of 82 farmers as respondents, with 40 from Sumberberantas and 42 from Wonokerso. Data Envelopment Analysis (DEA) is a method that systematically examines levels of technical efficiency. It is complimented by Tobit Regression Analysis, which assists in identifying the relevant elements affecting efficiency. The findings indicate that the average technical efficiency score is 0.840, suggesting that farmers have the potential to increase their efficiency by up to 16%. Gender and land area for potato farming are identified as crucial factors affecting technical efficiency, while age, education, and farming experience have no effect.

INTRODUCTION

The horticulture sector plays a vital role in Indonesia's economic growth. One significant measure of this is the contribution of horticultural products to the country's GDP, which stands at 1.58% (BPS, 2023). Moreover, the wide variety of horticultural goods presents lucrative business opportunities and job prospects. According to data from the Statistics Indonesia (BPS), out of 135.6 million employed individuals aged 15 and above in February 2022, about 40.64 million were engaged in agriculture by March 2022, accounting for nearly 30% of the total workforce. Thus, fostering the horticulture sector is poised to drive economic development and bolster the national economy.

Among these horticultural products, potatoes stand out as a crucial commodity with substantial potential for development both nationally and regionally. Enhancing the competitiveness of potatoes is crucial for advancing Indonesia's horticulture sector. Potato cultivation plays a significant role in supporting the agricultural sector in East Java, providing a vital income source for many local farmers and contributing to the regional economy. However, one of the primary challenges faced by potato farmers is improving production efficiency to ensure the sustainability and competitiveness of the agricultural industry. Agricultural science, as defined by Soekartawi (2002), involves the efficient allocation of resources to maximize profitability within a specific timeframe. Additionally, according to Shinta (2011), a farmer achieves technical efficiency compared to peers when employing the same inputs results in higher physical outputs.

Increasing production requires the optimal use of inputs without causing harm to the environment. Farmers aim to increase productivity and profitability but may encounter reduced productivity due to various factors, including inefficient input use, land degradation from pesticide misuse, inappropriate pharmaceuticals, and the use of inferior seeds. Assessing the technical efficiency of production factor utilization in potato farming provides farmers with valuable insights for adjusting input levels appropriately. Therefore, this study aims to analyze the technical efficiency levels of potato farming in East Java and identify the factors influencing this efficiency.

METHOD

The investigation into the technical efficiency of potato farming in East Java employed a multistage sampling approach. Initially, two regencies, Batu and Probolinggo, were purposively selected due to their significance as centers of potato production within East Java. Subsequently, the selection of sub-districts was conducted randomly, guided by information sourced from pertinent institutions such as the Department of Agriculture, Agricultural Extension Agency, and BPS data. The chosen sub-districts from each regency encompassed Bumiaji representing Batu and Sumber representing Probolinggo. Following this, one village was randomly chosen from each sub-district: Sumberberantas and Wonokerso. The study unfolded between July and November 2023, encompassing activities ranging from location surveys to data collection, processing, and analysis.

The sampling technique employed in this study is simple random sampling. As elucidated by Beins (2012), simple random sampling entails affording every member of the population an equal opportunity of being selected as a sample. The determination of the sample size was conducted utilizing the Slovin formula. According to information gleaned from village officials, there are 344 potato farmers in Sumberberantas and 626 in Wonokerso. The calculation of the sample size for farmers was executed using the Slovin formula:

$$n = N / (1+Ne^2)$$

Where:
n = sample size
N = population size
e = error (degree of error of respondent data)

With a predetermined margin of error of 15%, the total number of sampled farmers based on these computations amounts to 82 farmers in total, comprising 40 farmers from Sumberberantas and 42 farmers from Wonokerso. The data collection methodology employed in this study encompasses two approaches: primary data collection utilizing observation and interviews, and secondary data collection involving literature review and documentation.

Methods for Analyzing the Level of Allocative Efficiency of Potato Farming

The analysis of technical efficiency in potato farming across East Java was conducted utilizing the Data Envelopment Analysis (DEA) method. Employing the DEA formula under the assumption of Variable Returns to Scale (VRS), a variant of the DEA method, enables the measurement of relative efficiency among decision-making units (DMUs), typically referred to as potato farmers in this study, while accommodating varying scales among these units. The efficiency score is derived from the comparison of inputs and outputs within each DMU. In this context, a technical efficiency score of one signifies optimal efficiency, whereas a score below one indicates relative technical inefficiency.

In this study, potato production serves as the output variable, while the input variables encompass land area (m2), seed quantity (kg), chemical fertilizer amount (kg), manure quantity (kg), solid pesticide quantity (kg), liquid pesticide volume (l), and labor hours (HOK). The DEA formula under VRS is expressed as follows:

$$\text{Min}_{\theta,\lambda}\ \theta$$
$$St - yi + Y\lambda \geq 0,$$
$$\theta_{xi} - X\lambda \geq 0,$$
$$N1'\lambda = 1$$
$$\lambda \geq 0$$

Where:
N1'λ=1 is a convexity constraint.

In the equation for technical efficiency (TE), Yi represents the total potato production of farmer i, Xi is an Nx1 vector denoting the total inputs for farmer i, Y represents a 1xM vector representing production, N is an NxM matrix depicting total inputs utilized, λ stands for an Mx1 vector of weights, and s is a switch. The DEA model applied in this study is characterized as an input-oriented DEA model, given that farmers exert greater control over inputs compared to output generation.

Furthermore, this study adopts a variable return to scale (VRS) approach due to the inherent variability observed in agricultural operations, such as seasonal fluctuations and technological advancements, which can influence production scale. This method is deemed more realistic in modeling efficiency, considering that agriculture does not consistently operate at a uniform scale. Consequently, employing the VRS in DEA model is deemed more precise and pertinent to capturing the diverse operational dynamics encountered in agricultural settings.

Factors Affecting the Technical Efficiency of Potato Farming

The analysis of factors influencing the technical efficiency of potato farming in East Java employed Tobit Regression Analysis utilizing Stata 14.2. Tobit Regression is a regression model that assumes independent variables are unrestricted in value, while non-independent variables are constrained. In essence, Tobit Regression incorporates censoring on the non-independent variable during its computation. In this study, the technical efficiency value serves as the censored variable, constrained within the range of 0.00 and 1.00.

The variables considered to impact technical efficiency, derived from prior research and tailored to the research site's conditions, encompass age, gender, education level, farming experience, and the land area dedicated to potato cultivation. The Tobit model utilized in this study is formulated as follows:

$$TE = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$$

Where:
TE = Technical efficiency score (0-1)
X1 = Age
X2 = Gender
X3 = Education
X4 = Farming experience
X5 = Land area for Potato Farming
ε = Error
β = Estimated parameter

RESULTS AND DISCUSSION

Analysis on Technical Efficiency of Potato Farming

The utilization of Data Envelopment Analysis (DEA) method in this study is aimed at elucidating the diverse impacts of inputs on potato production in East Java, particularly in the villages of Sumberberantas and Wonokerso. The DEA analysis in this study adopts the Variable Return to Scale (VRS) assumption, intending to assess the proportion of output that can vary with the proportional addition of inputs. This concept of returns to scale is symbolically represented by α and β, where α signifies the proportional addition of inputs and β

denotes the proportional addition of output. If β > α, it indicates Increasing Returns to Scale (IRS), while β < α implies Decreasing Returns to Scale (DRS) outcomes (Cooper et al., 2011).

The variables considered in this study primarily comprise two categories: output and input. Potato production serves as the output (Y) and is utilized as an indicator of technical efficiency, influenced by various input variables. The input variables encompass land area (X1), seeds (X2), chemical fertilizer (X3), manure (X4), solid pesticide (X5), liquid pesticide (X6), and labor utilization (X7).

The application of the Variable Return to Scale (VRS) approach in DEA is justified by the suboptimal utilization of inputs in potato farming at the research site, owing to limited resources and other associated factors. The VRS approach in DEA assumes that the ratio between input and output additions is not uniformly consistent, thereby allowing for the flexibility of input and output changes to either enhance (Increasing Returns to Scale/IRS) or diminish (Decreasing Returns to Scale) efficiency values. The distribution of potato farming production scale is detailed in Table 1 below.

Table 1. Scale Distribution in Production of Potato Farming

Scale Distribution	Number of Farmers	Percentage (%)
Decreasing Return to Scale (DRS)	18	22
Constant Return to Scale (CRS)	28	34
Increasing Return to Scale (IRS)	36	44
Total Sampel	82	100

Source: Primary Data, 2024 (processed)

According to Table 1, the analysis reveals that the majority of respondent farmers operate on an Increasing Returns to Scale (IRS) production scale, comprising 36 farmers, accounting for 44% of all respondents. Farmers operating under IRS conditions indicate that the increase in output surpasses the increase in inputs utilized. Conversely, 18 farmers, constituting 22% of all respondents, operate on a Decreasing Returns to Scale (DRS) production scale. This signifies that the increase in potato output is smaller than the increase in production inputs.

The disparity in technical efficiency values derived from the VRS model facilitates the categorization of scale efficiency into Constant Return to Scale (CRS), Increasing Return to Scale (IRS), or Decreasing Return to Scale (DRS). In the IRS category, the augmentation in output exceeds the increase in inputs provided. Conversely, in the DRS category, the rise in output is inferior to the augmentation in inputs supplied. Meanwhile, in the CRS category, every unit increase in input consistently yields an output equivalent to the input.

IRS and DRS represent inefficient scenarios, with IRS indicating that the DMU has not achieved maximum production, necessitating an increase in business scale (additional inputs). Conversely, DRS signifies an inefficient scenario where the DMU's production scale is excessively large, warranting a reduction in production scale (Huguenin, 2012).

Based on the data processing results using DEAP version 2.1 software with the VRS model, the technical efficiency level values are generated. The distribution of technical efficiency in potato farming is depicted in Table 2 below:

Table 2. Distribution of Technical Efficiency of Potato Farming under VRS Model

Efficiency Level	Technical Efficiency Score	Total (Person)	Percentage (%)
Very Low	0.278 – 0.459	4	5
Low	0.460 – 0.641	13	16
Medium	0.642 – 0.823	13	16
High	0.824 – 0.999	14	17
Full Efficient	1	38	46
Total		82	100
Average Score of TE		**0.840**	
Maximum Score of TE		**1.00**	
Minimum Score of TE		**0.278**	

Source: Primary Data, 2024 (processed)
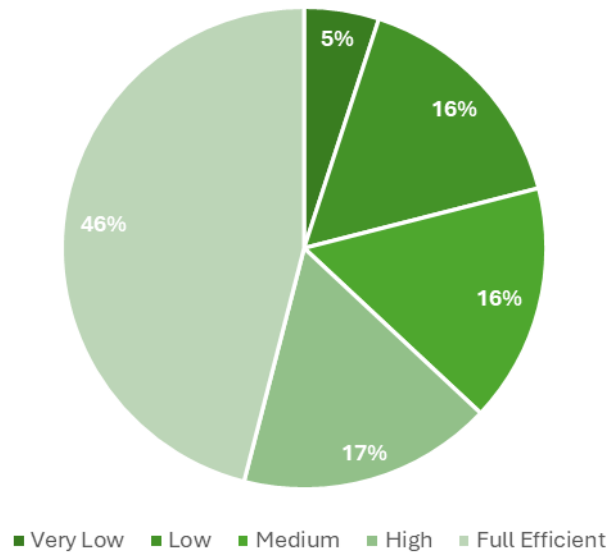
Figure 1. Technical Efficiency Level
Source: Primary Data, 2024 (processed)

According to Table 2, employing the VRS approach in DEA, the majority of farmers are operating at full efficiency, indicated by a value of 1.00, comprising 38 farmers or 46% of all respondent farmers. There are 4 individuals (5%) operating at a very low efficiency level, 13 individuals (16%) at a low efficiency level, 13 individuals (16%) at a medium efficiency level, and 14 individuals (17%) at a high efficiency level. The average technical efficiency value of potato farming in the study area stands at 0.840. Farmers who haven't achieved efficient potato farming practices may reference those who have attained technical efficiency.

Factors Affecting the Technical Efficiency of Potato Farming in East Java

In Data Envelopment Analysis (DEA), some farmers may still fall short of achieving technical efficiency. This shortfall can stem from various factors beyond the mere utilization of farmer inputs, including internal factors inherent to the farmers themselves. To explore the impact of these internal factors on farmers' technical efficiency, Tobit Regression Analysis can be employed.

In the analysis of factors influencing the technical efficiency of potato farming, the technical efficiency values obtained from DEA calculations are regressed against several socio-economic variables. The Tobit Regression utilizes both dependent and independent variables. The dependent variable in Tobit Regression is the technical efficiency value, ranging from 0 to 1, while the independent variables consist of socio-economic factors such as age (in years), gender, education (in years), farming experience (in years), and the land area for potato farming (in square meters).

The outcomes of Tobit Regression analysis for potato farming in East Java, focusing on Sumberberantas and Wonokerso, are depicted in Table 3 below.

Table 3. Hasil Analisis Regresi Tobit Usahatani Kentang

Variable	Coefficient	Probabilities (Pr>|t|)
Age	-0,0037061	0,412
Gender	0,2743542	0,116**
Education	0,0085688	0,484
Farming Experience	0,0033843	0,471
Land area for Potato Farming	-0.0000298	0,017*
Pseudo R2		0.1006
Prob > chi2		0.1311

*Significance at 5% true level
**Significance at 15% true level

Source: Primary Data, 2024 (processed)

Table 3 presents the outcomes of Tobit Regression Analysis concerning the influence of socioeconomic factors on the technical efficiency of potato farming. To assess the significance of each independent variable (socioeconomic factors) and the dependent variable (technical efficiency), it's imperative to examine the prob> |t| values. A prob> |t| value less than α = 15% suggests significance, indicating that the independent variable exerts a noteworthy impact on the dependent variable. Conversely, if prob> |t| exceeds α = 15%, it implies that the independent variable lacks significance in influencing the dependent variable (Winarso et al., 2021).

The explanation of Table 3's Tobit Regression Analysis results is detailed as follows:

1. Pseudo R2

According to Table 3, the pseudo R2 value is 0.1006. This indicates that the variables including age, gender, education, farming experience, and land area planted with potatoes collectively explain approximately 10.06% of the variation in technical efficiency of potato farming. The remaining 89.94% of the variation is attributed to other factors not included in the model. Generally, a higher percentage of Pseudo R2 suggests a better-fitting model (Nurhadirat & Zain, 2018).

2. Prob > chi2

The Prob > chi2 value in the Tobit model represents the error rate, indicating the model's overall goodness of fit. In this case, the Tobit model exhibits an error rate of 13.11%. Given that this value is lower than the chosen significance level of α = 15%, it suggests that the model is statistically significant and suitable for analyzing socioeconomic factors influencing technical efficiency. Therefore, the Tobit model is deemed feasible for investigating the impact of socioeconomic variables on technical efficiency.

3. Partial Test

The partial test is conducted to assess whether the individual variables of age, gender, education, farming experience, and land area planted with potatoes have a significant impact on the technical efficiency of carrot farming. This is achieved by examining the probability value (p-value) associated with each variable, with significance levels typically set at 0.05 (5% error rate) or 0.15 (15% error rate).

a. Age

Based on the findings presented in Table 3, it appears that the variable representing the age of farmers exhibits a probability value of 0.412, surpassing both the 5% and 15% error rates. Consequently, the variable of age is deemed statistically insignificant in its effect on the technical efficiency of potato farmers. Moreover, the coefficient associated with the age variable is -0.0037061. This implies that as farmers age, there's a decrease in technical efficiency by approximately 0.0037061 units.

These results align with previous research by Ningsih et al. (2015), which suggests that advancing age correlates with a decline in physical abilities among farmers, consequently diminishing their overall performance and efficiency. Similarly, findings from Artamevia et al. (2023) also support this notion, highlighting a negative coefficient associated with the age variable. This decline in efficiency is attributed to the diminishing ability of older farmers to comprehend and adopt agricultural technologies, alongside a decrease in vitality and productivity levels.

b. Gender

Based on the information provided in Table 3, the probability value associated with the gender variable is 0.116, which falls below the 15% error rate threshold. Therefore, the gender variable is considered statistically significant in its influence on the technical efficiency of potato farmers. The coefficient for the gender variable is 0.2743542, indicating that an increase in the proportion of male farmers corresponds to a rise in technical efficiency by approximately 0.2743542 units.

These findings are in line with the research conducted by Taiwo et al. (2014), which suggests that male farmers tend to exhibit higher levels of efficiency compared to their female counterparts. This may be attributed to various factors such as differences in access to resources, decision-making power, and labor allocation within farming households.

c. Education

Based on the results presented in Table 3, the probability value associated with the education variable is 0.484, exceeding both the 5% and 15% error rate thresholds. Consequently, the education variable is deemed statistically insignificant in its impact on the technical efficiency of potato farmers.

The coefficient for the education variable is 0.0085688, indicating the magnitude of its effect on the technical efficiency of farmers. The average education level of farmers in this study is 6 years, which corresponds to completion of elementary school. This educational attainment may influence farmers' attitudes towards innovation acceptance. Research by Maryanto et al. (2018) suggests that individuals with lower levels of education may exhibit reluctance towards adopting new innovations introduced by extension workers, thereby potentially reducing farmers' efficiency.

Additionally, formal education may not significantly impact efficiency as it primarily focuses on general knowledge rather than specialized agricultural information (Sholeh, 2013). Hence, the level of education alone may not determine farmers' efficiency levels in potato farming.

d. Farming Experience

Based on the data provided in Table 3, the probability value associated with the farming experience variable is 0.471, surpassing both the 5% and 15% error rate thresholds. Therefore, the variable of farming experience is considered statistically insignificant in its influence on the technical efficiency of potato farmers.

The coefficient for the farming experience variable is 0.0033843, indicating the magnitude of its effect on farmers' technical efficiency. This suggests that farming experience has a minimal impact on the technical efficiency of potato farmers.

These findings are consistent with the research conducted by Nyagaka and Obare (2010), which suggests that while age and experience may not directly affect technical efficiency, they may indirectly influence decisions regarding the utilization of production inputs. Similarly, research by Kune et al. (2016) supports this notion, indicating that the positive sign of the coefficient for farming experience does not necessarily translate into a significant real-world effect. This could be attributed to the fact that farmers often adhere to traditional and hereditary practices in planting and cultivation, minimizing the direct impact of farming experience on technical efficiency.

e. Land area for Potato Farming

Based on the data in Table 3, the probability value associated with the variable representing the land area for potato farming is 0.017, which falls below the standard error rate of 0.05. Consequently, the land area variable is deemed statistically significant in its impact on the technical efficiency of potato farmers.

The coefficient for the land area variable is -0.0000298, indicating the magnitude of its effect on farmers' technical efficiency. This suggests that for every 1 square meter increase in land area dedicated to potato farming, there is a corresponding decrease in technical efficiency by approximately 0.0000298 units.

These findings align with the notion that land area plays a crucial role in determining the scale of farmers' operations, thereby influencing their overall efficiency levels (Pradnyawati and Cipta, 2021). As farmers expand their land holdings for potato cultivation, they may encounter challenges in effectively managing larger farming operations, potentially leading to a decline in technical efficiency.

CONCLUSION

Based on the analysis of the technical efficiency of potato farming in East Java, it can be concluded as follows:

1. The analysis utilizing the DEA approach with the VRS assumption indicates a prevailing state of technical inefficiency in potato farming across East Java. While 46% of farmers achieve full efficiency (1.00), a significant portion operates below optimal levels: 5% at very low efficiency, 16% at low efficiency, 16% at medium efficiency, and 17% at high efficiency. The average technical efficiency across the study area stands at 84%, suggesting a potential improvement opportunity of 16% to attain maximum efficiency.

2. Significant factors influencing technical efficiency include gender and the land area dedicated to potato farming. An increase in male farmers positively impacts efficiency, while expanded land area dedicated to

potato cultivation negatively affects efficiency. Conversely, age, education, and farming experience did not demonstrate significant effects on technical efficiency.

Based on the conclusions, it is suggested that farmers optimize input usage in potato farming, ensuring compliance with recommended guidelines for chemical fertilizers and pesticides. Additionally, knowledge-sharing initiatives among farmers could facilitate the adoption of best practices, thereby narrowing the efficiency gap across the research area. By implementing these suggestions, potato farmers in East Java can work towards enhancing technical efficiency and overall agricultural productivity.

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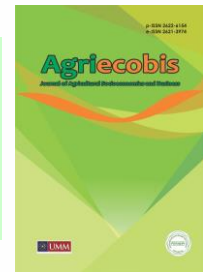
Research Article

The Effect of Land Slope Level on Productivity of Pujon Agroforestry

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ABSTRACT

The slope of the land can influence accessibility, water movement, and soil characteristics, thereby affecting the productivity of agroforestry plants. This study aims to analyze the effect of land slope on agroforestry productivity. The methods employed included field observations and questionnaires to collect data. A total of 100 farmers from various locations participated as respondents in this study. Regression analysis was conducted to determine and compare the influence of land slope on the productivity of agroforestry crops. The results of the analysis indicated that land slope does not significantly affect land productivity. The highest net income for farmers on slopes of 15-30% was from chili crops, amounting to Rp 76,987,600 per year with a B/C Ratio of 2.97, while the lowest was from cauliflower crops, with an income of Rp 31,586,800 per year and a B/C ratio of 1.74. The distribution of plant species across different slope levels was relatively uniform. Thus, the slope of the land does not have a significant effect on the success and productivity of the agroforestry system.

INTRODUCTION

Studying the level of land slope in relation to agroforestry productivity is essential for understanding the relationship between land topography and the success of agroforestry systems. Optimal utilization of forest land at varying slope levels for the production of agroforestry, wood, non-timber forest products, and environmental services is crucial for improving community welfare while ensuring sustainability. The productivity of agroforestry on different slopes varies according to their shape and characteristics. Slope shape significantly impacts the rate of erosion and soil loss (Abhishek et al., 2019). Research indicates that concave and complex slopes experience less soil loss compared to equivalent uniform slopes, whereas convex and complex slopes exhibit higher erosion rates (Alice, 2016; Alice et al., 2018). Agroforestry, which involves the combined and/or sequential use of forest land for agricultural and forestry activities, aims to maintain forest and environmental functions (Doe & Johnson, 2018).

The implementation of agroforestry is anticipated to enhance farmers' welfare while addressing global warming, environmental degradation, and poverty (Debashis et al., 2017). The agroforestry system is designed to provide economic and social benefits, thereby improving community welfare. Additionally, agroforestry ensures

sufficient food availability, supplies raw materials for biofuels, and fulfills ecological functions for the community (Tamrin et al., 2017). Primarily, agroforestry is expected to optimize sustainable land use, guaranteeing and enhancing community needs, and increasing the ecological carrying capacity, particularly in rural areas (Khofifah et al., 2017).

The level of land slope can affect agroforestry productivity by influencing several crucial factors related to plant growth and production. On steep land, water tends to flow more quickly and does not absorb into the soil properly, leading to dryness in plants and reduced productivity (Brown, 2021; Sedigheh et al., 2023). Plants on steep land also face challenges in accessing water, necessitating the use of proper irrigation techniques. Additionally, steep land is prone to erosion, which can strip away the fertile topsoil layer and diminish nutrient availability, thereby affecting plant productivity (Bautista & Garcia, 2019; Abisola et al., 2021). When studying the impact of land slope on agroforestry productivity, it is important to consider factors such as the types of plants cultivated, planting patterns, water management, and suitable management techniques for steep land conditions.

In general, plants suitable for planting on land with a slope greater than 15 degrees are those resistant to erosion, such as woody plants with strong root systems. Additionally, land management techniques, such as terracing and contour cropping, are employed to minimize erosion and maintain soil fertility (Farooq et al., 2019; Duraisamy et al., 2020). Examples of forestry plants include pine trees (Pinus merkusii Jungh. et de Vriese), while agricultural plants include chicory, chayote, cucumber, taro, ginger, banana, durian, and jackfruit. Agroforestry-based land patterns aim to enhance farmers' abilities in cultivating various plant species, thereby increasing their income. The role of agroforestry extends beyond providing income; it also serves an ecological function in mitigating flooding and landslides (Claire et al., 2018; Garcia & Lee, 2023).

To study the effect of land slope on agroforestry productivity, it is essential to directly measure parameters such as erosion rate, soil fertility, water availability, and plant productivity. This approach enables the assessment of land suitability for agroforestry systems and the identification of appropriate techniques and plant species for the terrain (Ickowitz et al., 2019; Chukwuebuka et al., 2020). Understanding these relationships can provide more effective land management recommendations. The purpose of this study is to examine agroforestry farming and the relationship between land slope and agroforestry crop productivity, with the goal of determining the impact of slope on agroforestry production.

METHOD

Sampling among agroforestry farmers was conducted using a non-probability sampling method, indicating that not every member of the population had an equal chance of being selected. This approach was necessary because the total population of research respondents was unknown. The Slovin method was employed to determine the appropriate sample size, ensuring that the sample could adequately represent the entire population. For this research, a tolerance limit of 10% was adopted, corresponding to an accuracy level of 90%. Slovin's formula is as follows (Wythoff, 2018):

$$n = \frac{N}{1+N(a)^2}$$
$$n = \frac{6148}{1+6148(0.1)^2}$$
$$n = 98,399$$

Respondents were rounded up to 100 farmers.
Where:
n = sample
N = population
e = standard error value (10%)

Data collection in the Pujon Malang District, East Java, Indonesia, utilized a non-probability sampling method (Vehovar et al., 2016). This approach implies that each member of the population did not have an equal chance of being selected as a sample because the exact number of respondents available to complete the research questionnaire was unknown. According to Sugiyono (2018), a questionnaire is a data collection technique that involves asking respondents questions to obtain relevant information that meets the research needs. Data was collected directly from the research location, and field surveys included measurements of land slope levels,

topographic data, and plant productivity data, providing a more in-depth understanding of the interaction between land topography and agroforestry productivity.

Data analysis was conducted using both descriptive and quantitative methods. Descriptive analysis provided an overview of the background for selecting plant types, general respondent data, and data on farmers' income and expenditure in forest use. Quantitative analysis was used to quantify these aspects and identify patterns or correlations. The following equation was employed for the analysis (Edy et al., 2023; Sutarni & Fitri, 2023):

$$TR = P \times Q$$

Where:
TR = (Total Revenue)/total revenue
P = (Price) Selling price on site or in the market
Q = (Quanty) Production amount

To calculate farmer profits, use the formula:

$$\Pi = TR - TC$$

Where:
TC = (Total Cost) costs of planting, maintenance, labor, etc.
Π = Profit from food and non-timber crops.
TR = (Total Revenue) total revenue.

To find out how much correlation and influence the independent or independent variables have on the level of land slope on agroforestry productivity (Y), namely: land (X1), erosion (X2), sustainability (X3), on productivity (Y).

$$Y = a + B_1X_1 + B_2X_2 + B_3X_3 + e$$

Information:
Y = Productivity
a = constant
B1-3 = regression coefficient X1-X3
X1 = Land
X2 = Erosion
X3 = Sustainability

RESULTS AND DISCUSSION

Observation results table, the number of male respondents was 79 people and 21 female respondents, a total of 100 respondents were sampled in this study.

Table 1. Characteristics of Respondents

No	Characteristics	Number of Farmers	Presentation
Gender			
1	Man	79	79.00 %
2	Woman	21	21.00 %
	Total	**100**	
Age			
1	15 – 64	91	91.00 %
2	>64	9	9.00 %
	Total	**100**	

Source: processed data

Based on the data presented in the table, 91 respondents (91% of the total) fall into the productive working age category, whereas 9 respondents (9% of the total) belong to the non-productive working age category. This indicates that the majority of farmers possess strong physical capabilities, enabling them to effectively manage

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forests and thereby enhance their agricultural income. This finding aligns with Nurfatriani et al. (2023) and Wulandari et al. (2023), who assert that farmers' physical strength aids in forest management and has the potential to increase agricultural revenue.

Agroforestry Commodities at Land Slope Level

Farmers implement an agroforestry system, where each cultivates multiple or different types of plants on a single plot of land. The agroforestry crops planted on slopes ranging from 0-45˚ include chilies, carrots, cabbage, cauliflower, mustard greens, tomatoes, and ginger. Additionally, the land supports tree species such as sengon (*Albizia chinensis*), mahogany (*Swietenia mahagoni*), suren (*Toona spp.*), jackfruit (*Artocarpus heterophyllus*), and avocado (*Persea americana*). Annual plants like various vegetables, such as cabbage, mustard greens, chilies, and carrots, are grown during the rainy season. Farmers prefer vegetable cultivation due to the presence of a central vegetable trading market, which facilitates easier marketing of their produce.

Agroforestry Farmer Income

The farming analysis in this study was conducted on three land models for various agricultural commodities. The analysis included assessments of revenue, total costs, income, and the benefit-cost (B/C) ratio as measures of feasibility. Table 2 presents the farmer income at different land slope levels using the agroforestry pattern.

Table 2. Agroforestry Farmer Income

Plant Type	Total revenue (TR)	Total cost (TC)	Income ha/year (μ)	B/C Ratio
Slope 15-30%				
Chili	116,067,600	39,080,000	76,987,600	2.97
Carrot	91,708,200	37,740,000	53,968,200	2.43
Cauliflower	74,166,800	42,580,000	31,586,800	1.74
Tomato	76,114,132	43,246,668	32,867,468	1.76
Mustard	67,204,444	23,780,000	43,424,444	2.83
Cabbage	91,034,000	39,580,000	51,454,000	2.30
Average	**86,049,196**	**37,667,778**	**48,381,419**	**2.34**
Slope 30-45%				
Chili	89,499,310	32,471,000	57,028,310	2.76
Ginger	79,611,520	32,851,000	46,760,520	2.42
Tomato	66,758,632	25,483,222	41,275,410	2.62
Cabbage	49,647,570	27,309,000	32,338,570	1.82
Carrot	94,989,360	39,691,000	55,298,360	2.39
Average	**76,101,278**	**31,561,044**	**46,540,234**	**2.41**
Moisture >45%				
Carrot	82,104,400	29,180,000	52,924,400	2.81
Ginger	89,971,800	40,580,000	49,391,800	2.22
Cauliflower	77,931,400	39,380,000	38,551,400	1.98
Mustard	75,991,200	32,580,000	43,411,200	2.33
Tomato	50,476,600	18,046,668	32,429,932	2.80
Average	**75,295,080**	**33,153,334**	**43,341,746**	**2.28**

Source: processed data

In Table 2, the highest average net income of farmers on a slope of 15-30% was obtained from the chili commodity, amounting to IDR 76,987,600 per year, while the lowest was from the cauliflower commodity, at IDR 31,586,800 per year. The limited number of cauliflower farmers, small land areas, and high maintenance costs contribute to this lower income. Conversely, many farmers cultivate chilies on this slope, resulting in high productivity and substantial yields, reflected in a benefit-cost (B/C) ratio greater than one, indicating the profitability of the agroforestry pattern at various slope levels. According to Adityas et al. (2018) and Zahroh (2022), chili farming is more profitable and economically viable than cauliflower farming due to supportive revenue analysis, technological advancements, and sustainable agricultural practices. This is related to erosion, productivity, and sustainability of agroforestry, as presented in Table 3.

Table 3. Correlation of Land Slope Level on Productivity and Sustainability

		Land Slope	Erosion	Continuity	Productivity
Land Slope	Pearson Correlation	1	0,854	0,797	0,128
	Sig. (2-tailed)		0,000	0,000	0,242
	N	86	86	86	85
Erosion	Pearson Correlation	0,854	1	0,771	0,152
	Sig. (2-tailed)	0,000		0,000	0,164
	N	86	86	86	85
Sustainability	Pearson Correlation	0.797	0,771	1	0,294
	Sig. (2-tailed)	0.000	0.000		0,064
	N	86	86	86	85
Productivity	Pearson Correlation	0.128	0,152	.294	1
	Sig. (2-tailed)	0.242	0,164	,064	
	N	85	85	85	85

Source: processed data

The basis for decision-making is that if the significant value is <0.05, it is considered correlated; if the significant value is >0.05, it is not considered correlated (Wu et al., 2020). According to the table above, it can be concluded that land slope and productivity are not correlated. This is confirmed by the Pearson correlation result of 0.128, indicating a low degree of relationship (0.00 to 0.20). Additionally, the significant value for the relationship between agroforestry composition and profits is 0.2, which is greater than 0.05, thus indicating no correlation. This lack of correlation is attributed to the similarity in plant types across different land slope classifications at the research location. Consequently, the income remains consistent because the crops and market prices are similar. Therefore, it can be concluded that land slope has no relationship with land productivity. In contrast, Aninda et al. (2022) and Cavassin Diniz et al. (2018) found a relationship between productivity and land slope in their research.

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0,591 [a]	0,349	0,325	5,577

Source: processed data

Based on the coefficient of determination test results, the R Square value is 0.349, indicating that 34.9% of the variations in productivity are explained by the existing variables. These results demonstrate that land slope, erosion, and sustainability account for only 34.9% of the influence on productivity, while the remaining 65.1% is influenced by other variables, as presented in Table 4.

Table 5. t-test Analysis

Variable	Productivity			Information
	B	t	Sig	
Constant	10.513	4.263	0.000	
Land	0.250	1.544	0.125	Not Significant
Erosion	-0,134	-0.544	0.587	Not Significant
Sustainability	0.209	2.526	0.013	Significant

Source: processed data

Based on the results of the equation in the table above, the following equation can be obtained:

$$Y = 10.153 + 0.25X_1 - 1.34X_2 + 0.209X_3$$

Where:
Y = Productivity
X_1 = Land
X_2 = Erosion
X_3 = Sustainability

The analysis of the multiple linear regression equation revealed that the constant value is 10.153. This result indicates that when land slope, erosion, and sustainability are zero, the company value changes by 10.153%. The regression coefficient analysis shows that the land slope (X1) has a positive regression coefficient value of 0.25 for the productivity variable. This means that an increase of 1 unit in the land slope, with other independent variables held constant, will increase the company value by 0.25. The erosion regression coefficient (X2) has a negative value of -4.020, indicating that an increase of 1 unit in the erosion variable, with other independent variables held constant, will decrease the company value by 4.020. For the sustainability regression coefficient (X3), a positive value of 0.29 was found. This suggests that an increase of 1 unit in the sustainability variable, with other independent variables held constant, will increase the company value by 0.29. Based on the significance levels, erosion and land slope variables do not have a significant effect on productivity. However, Bhandari et al. (2021) and Pierce & Lal (2017) assert that the degree of erosion and other land-related factors significantly impact agricultural production. The sustainability variable does have a significant effect on productivity, as its significance value is smaller than 0.05.

Slopes in agroforestry exhibit varying productivity based on their shape and characteristics. Concave and complex slopes experience less soil loss but higher erosion rates compared to equivalent uniform slopes (Minsuk et al., 2020; Evgenia, 2022). Agroforestry has been shown to reduce energy expenditure and increase productivity during wood harvesting (Nyanchi, 2019; Pawel et al., 2022). Implementing agroforestry systems on slopes can control erosion and landslides by strategically arranging trees and plants according to the morphological units formed by previous landslides (Madaline et al., 2021; Mengistu et al., 2021). Despite the significant impact of slope on agroforestry productivity, some studies suggest that slope does not have a significant effect on productivity. However, using agroforestry on slopes to control erosion and landslides by arranging vegetation based on past morphological units remains beneficial (Rasu et al., 2021). Overall, integrated agroforestry systems and effective soil fertility management play crucial roles in maintaining soil fertility and promoting sustainable crop production.

CONCLUSION

Agroforestry crop commodities planted on slopes ranging from 0-45˚ in Pujon include chilies, carrots, cabbage, cauliflower, mustard greens, tomatoes, and ginger. These crops grow under a canopy of multiple tree species (MPTS) such as sengon (Albizia chinensis), mahogany (Swietenia mahagoni), suren (Toona spp.), jackfruit (Artocarpus heterophyllus), and avocado (Persea americana). Vegetable plants on slopes of 15-30% have a B/C ratio of 2.34, on slopes of 30-45% a B/C ratio of 2.41, and on slopes above 45% a B/C ratio of 2.28. The finding that the slope of the land does not significantly affect productivity provides valuable new insights for the development of sustainable agroforestry practices. Understanding the relationship between land slope and agroforestry productivity can help in developing strategies to optimize agroforestry systems across various topographies.

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INTRODUCTION (*Heading 1*) (bold, 12pt)

This section could also provide the expected results. The introduction must be written in single line spacing. The introduction comprises of: (1) research problem; (2) insight and problem solve planning; (3) summary of theoretical studies and the results of the present study (state of the art), related to the observed problems (gap), and (4) research aims.

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METHOD

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The specification and type of tools and materials must be written in case the researches have been conducted by using them.

The qualitative research, such as classroom action research, case studies, and so forth, need to mention the researcher attendance, research subject, and participated informants, as well as the methods used to explore the data, research location, research duration, and the description of research results validation.

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RESULTS AND DISCUSSION

This section is the main part of the research result article in which the "fix" results are served. The data analysis processes, such as statistical computing and hypothesis testing, are not necessary to be served. The materials reported are the analysis results and hypothesis testing results. In addition, tables and graphics are also can be showed to enunciate the verbal narration. Tables and images must be given a comment or discussion. The details of qualitative research written in some sub-topics which directly related to the focused category.

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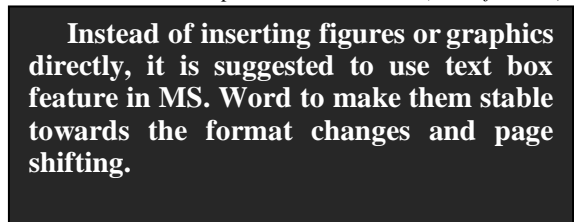
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Figure 1. Example of image information

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CONCLUSION

This part provides the summary of results and discussion which refers to the research aims. Thus, the new principal ideas, which are essential part of the research findings, are developed.

The suggestions, which are arranged based on research discussed-findings, are also written in this part. These should be based on practical activities, new theoretical development, and/or advance research.

ACKNOWLEDGMENT

This section can be written in case there are certain parties need to be acknowledged, such as research sponsors. The acknowledgement must be written in brief and clear. In addition, avoid the hyperbole acknowledgment.

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Supplementary Material

Supplementary material that may be helpful in the review process should be prepared and provided as a separate electronic file. That file can then be transformed into PDF format and submitted along with the manuscript and graphic files to the appropriate editorial office.

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