

Determinants of Sorghum Farmers' Decisions to Adopt New Superior Varieties: Evidence from Lamongan Regency

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ABSTRACT

Sorghum as an alternative commodity to substitute rice and other cereal crops, showing to its high adaptability to arid environments and limited rainfall. However, sorghum production has witnessed a decline, leading to a reduction in sorghum supply, thus impacting the provision of food and raw materials for industries. This research aims to ascertain farmers' decisions in selecting new superior varieties (NSV) and whether the utilization of NSV enhances farmers' productivity and income. The study was conducted in Patihan Village, Lamongan Regency, with a sample size of 55 sorghum farmers. Logistic regression analysis was employed to determine the factors influencing farmers in adopting new superior sorghum varieties. The findings indicate that factors influencing farmers in utilizing NSV include education, land size, farming experience, participation in farmer groups, and harvest orientation. Although the utilization of NSV does not increase sorghum farmers' productivity, the income of sorghum farmers adopting NSV has increased.

Keywords: Sorghum; New Superior Varieties (NSV); Socio-economic; Productivity; Income

INTRODUCTION

Agriculture plays a crucial role in food security by enhancing productivity, reducing vulnerability to natural disasters, and improving water and soil quality (Mwangi & Kariuki, 2015). However, the demand for food needs often remains unmet due to limited supply. The reasons behind this include dwindling land availability due to land use conversion and uncertain climatic conditions, leading to crop failures (Priyanto et al., 2023). Food crops in Indonesia consist of rice, maize, legumes, and tubers. Rice is the primary food crop cultivated as it serves as the staple food source in Indonesia (Caruso et al., 2016). Yet, one alternative commodity, such as sorghum, which thrives in arid lands, remains underutilized.

Sorghum in Indonesia is predominantly cultivated in East Java, Central Java, West Java, and East Nusa Tenggara (Winarti et al., 2020). Sorghum exhibits high adaptability to dry and semi-arid environments, limited rainfall, and high land temperatures, where other cereal crops like maize

cannot thrive (Miriti et al., 2023). Sorghum cultivation is becoming increasingly important as an alternative food source in the face of climate change threats and global warming, as it reliably yields harvests during dry seasons (Smale et al., 2018).

Farmers play a vital role in supporting sorghum cultivation as an alternative food source through efficient agricultural production for food and industrial raw material needs. However, farmers face challenges such as shrinking land availability, limited capital, pest and disease outbreaks (Susanti, 2023). According to information from the Agricultural Extension Agency, rodent infestations occurred in nearly all villages of Babat Subdistrict, Lamongan Regency, in 2019 and 2020, resulting in a decrease in sorghum production.

The decline in sorghum productivity leads to a decrease in sorghum supply, impacting the provision of food and industrial raw materials. Thus, micro, small, and medium enterprises (MSMEs), livestock feed industries, and mushroom growers will encounter difficulties in sustaining their businesses. Sorghum, as an industrial food raw material, can be processed into rice and sorghum flour, further developed into processed products such as popped sorghum, sorghum noodles, sorghum pasta, cookies, and cakes (Dhutmal et al., 2020). Meanwhile, sorghum, as an animal feed raw material, is processed and mixed with other grains; however, its usage is limited due to its antinutritional content (Ronda et al., 2019). Mushroom growers use sorghum as a mushroom growth medium, where Costa & Damanhuri (2019) found that its use could accelerate the first harvest time and increase the number of fruit bodies per baglog due to its high protein and carbohydrate content, affecting mycelium growth and color. Failure to meet sorghum raw material availability will impact business sustainability.

The majority of Indonesia's population are farmers who employ traditional production methods and exhibit low technology adoption rates. This results in decreased productivity levels and unmet sorghum supply (Mwangi & Kariuki, 2015). The decline in sorghum supply can be addressed if farmers adopt technological innovations through new superior sorghum seed varieties. New Superior Varieties (NSV) are technological innovations with high adoption potential among farmers due to their practicality, high yield potential, and resistance to pests and diseases. Based on Bobihoe & others (2021) research, the use of superior seeds influences productivity by requiring high-quality superior seeds to enhance productivity. The superior sorghum varieties cultivated in Babat Subdistrict, Lamongan Regency, include the bioguma variety, which features medium-sized stems, white seeds, pleasant taste with higher brix content, and larger seeds (Aryani et al., 2022).

Numerous studies have been conducted on farmers' preferences and the potential of high-yielding varieties to enhance crop production (Acheampong et al., 2018; Anam, 2018; Surdianto et al., 2021). However, further research is needed to explore the factors influencing farmers' decision-making processes, as these decisions are not solely driven by income, farming experience, and attitudes towards new technologies (Apriliana & Mustadjab, 2016; Li et al., 2020; Wangi, 2023). Therefore, this study aims to identify the factors influencing farmers' decisions in selecting NSV and

compare the productivity and income of farmers using NSV and non-NSV. This research is essential for informing the formulation of sorghum commodity development plans and encouraging farmers to adopt NSV to address supply issues.

LITERATURE REVIEW

Decision Making

Decision-making is the process of selecting the best alternative action made to achieve specific goals (Amalia & Firmadhani, 2022). Decision-making competency defines good decisions using rational rules to achieve optimal outcomes. This entails considering all available options, their consequences, and making decisions based on which combination will yield results closest to the desired outcome with minimal undesired consequences (Bruin et al., 2020). Decision-making styles are preferred methods of decision-making based on time and situation. According to Leslie (2022), there are five decision-making styles: rational, intuitive, dependent, avoidant, and spontaneous. Rational style is based on a set of logical rules, intuitive style relies on emotion, dependent style involves seeking opinions from others to make decisions, avoidant style is characterized by avoidance in decision-making, and spontaneous style involves quick decision-making with little thought. Before selecting and utilizing sorghum varieties, the decision-making process is initiated. Decisions in variety selection significantly contribute to increasing sorghum production (Mangesti et al., 2021).

Decision-making is influenced by several factors, including cultural, social, individual, and psychological factors (Leslie, 2022). Cultural factors are influenced by social class, in this study represented by land size because larger land size correlates with higher social class (Wangi, 2023). Social factors are influenced by a group, represented by farmers' involvement in farmer groups in this study (Mwaura, 2014). Individual factors are influenced by education and the number of dependents (Martey et al., 2020). Psychological factors are influenced by the learning process, represented by farming experience in this study (Wangi, 2023).

New Superior Varieties

New Superior Varieties (NSV) are technological components that play a significant role in increasing production yields (Bahtiar et al., 2023). Agricultural technology encompasses all types of enhanced techniques and practices to influence agricultural output growth, with the most common crop technologies including new varieties and management methods, soil fertility management, weed and pest control, irrigation, and water management (Mwangi & Kariuki, 2015). The utilization of NSV in farming, when coupled with appropriate cultivation techniques, can significantly contribute to production enhancement (Bahtiar et al., 2023). Superior varieties offer technical and economic benefits for agricultural enterprise development, such as higher quality harvests tailored to consumer preferences, crop resistance to pests and diseases, and high adaptability to environmental

conditions, thus reducing input costs such as fertilizers and pesticides (Samrin & Amirullah, 2018). Bioguma sorghum is a new superior variety (NSV) released by the Agricultural Research and Development Agency (Dinas Pertanian, 2022). Bioguma sorghum is bred from the numbu sorghum variety. Bioguma sorghum features include taller sorghum stalks reaching up to 266 cm, biomass weight of 54.30%, sweetness or brix content of around 15%, sap volume of about 122 ml, higher seed production, potential yield of 9.3 tons/ha, and resistance to diseases such as leaf rust, leaf spot, anthracnose, and stem rot.

Productivity and Income

Productivity is the quantity of units (output) to be produced within a specific period, utilizing human and material resources (input) optimally, safely, and efficiently. In the context of land as a production factor, crop productivity indicates the ability of plants to produce products per unit area of land (Karmini, 2018). Productivity growth is driven by three main factors: changes in production technology, efficiency improvement, and changes in product mix. Technical changes occur when existing boundaries shift due to changes in the production process. Efficiency acquisition components consist of changes in technical, allocative, or scale efficiency. Technical efficiency improvement occurs when inputs are optimally utilized, resulting in increased output. When inputs are optimally combined, allocative efficiency will be achieved, often accompanied by increased input expenditure leading to the production of the same output quantity at a lower cost. Scale efficiency occurs when the production cost of an output matches the operating scale. Product mix changes occur when consumers switch their demand to higher-quality outputs with increasing income. Productivity changes are caused by intensification, which involves the increased use of inputs such as capital, labor, water, fertilizers, and changes in prices resulting in increased value (Majiwa, 2017).

Income is the total revenue derived from factor production costs and the total output produced by an economy within a specific period (Sari, 2019). Income is measured based on all sources and the largest components of wages and salaries (Yundari & Artati, 2021). Income can be obtained from agricultural machinery rental proceeds, sales of goods and services, and sales of agricultural production. Factors influencing the magnitude of income earned include the quantity of production factors, work efficiency, and natural resource conditions (Sari, 2019). Meanwhile, according to Coble (2017), income can be influenced by planting seasons, selling prices, and sales of produced goods.

MATERIALS AND METHODS

The research was conducted in Patihan Village, Babat District, Lamongan Regency, with the location determination being purposive as Lamongan Regency itself is a strategic center for sorghum development strategies (Anam, 2018), with one of the areas being Patihan Village, chosen as the research location, which had a cultivation area of 40 hectares in 2022 (BPP Babat, 2022).

Furthermore, Patihan Village is one of the areas cultivating two sorghum varieties, namely the superior variety (bioguma) and the local variety (KD4).

Quantitative data for this study were obtained from primary data through interviews guided by questionnaires. The sample determination method employed total sampling or census method, where the entire population becomes the research sample (Bell et al., 2022). Based on data from the farmer groups, there were 55 sorghum farmers, thus all of them became the research sample. Data collection involved interviews, with farmers answering questions regarding individual or household characteristics and their cultivation practices, particularly their socio-economic conditions, production in one planting season, farming costs, and the varieties used.

Binary Logistic Regression

The analytical tool used in this study is logistic regression. The reason for using this method is because the data used are categorical in nature for the dependent variable, which is nominal data, while the independent variables consist of categorical data with both ratio and nominal data types. Logistic regression (binary logistic regression model) is a regression model used to find the relationship between independent variables and a dependent variable that is dummy-scaled (Greene, 2018). Logistic regression is employed to address the research question regarding the factors influencing farmers in the adoption of new superior sorghum varieties. The factors to be tested in this study include education, land size, farming experience, participation in farmer groups, harvest orientation, and household size. These factors serve as independent variables that affect the dependent variable, which is the farmers' decision in selecting new superior sorghum varieties or not using new superior sorghum varieties.

The logistic regression model with one independent variable (X) and a dichotomous dependent variable (Y) is referred to as a simple logistic regression model. The dependent variable can be categorical or qualitative, while the independent variable can be qualitative or quantitative. A value of Y = 1 indicates the presence of an influence, whereas Y = 0 indicates the absence of an influence (Pranowo & Zainuddin, 2024). The logistic regression model is formulated by expressing the value of $p(y=1 | x)$ as $\pi(x)$, denoted as follows:

$$g(x) = \frac{\exp(g(x))}{1 + \exp(g(x))} \dots\dots\dots (1)$$

The equation above is referred to as the logistic regression function, indicating the relationship between the independent variables and the non-linear probability. To achieve a linear relationship, a transformation called the logit transformation is often performed. The logit form of $\pi(x)$ is expressed as $g(x)$, as follows (Eliya et al., 2019):

$$\ln = \frac{[\pi(x)]}{[1 - \pi(x)]} = Y + \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 D_5 + \beta_6 D_6 \dots\dots\dots (2)$$

Based on the equation above, the variable Y represents the variable whose value will be determined, namely the farmers' decision, while the variables X and D represent the inputs that will

be sought to determine the farmers' decision. Variable X1 is education, X2 is land size, X3 is farming experience, X4 is the number of family members, D5 is participation in farmer groups, and D6 is harvest orientation.

T-test

The t-test is a test used to determine the significant difference between two sample means. Independent t-test is a type of statistical test used to compare the means (μ) of different groups (Syafriani et al., 2023). The analysis will be conducted using the Stata 14 software tool. The t-test in this study will compare the mean productivity and income of farmers using new superior sorghum seed varieties with those not using new superior sorghum seed varieties. The analysis results will indicate whether there is a difference in productivity and income between farmers using NSV and non-NSV seeds. The formula for the difference in means between the two groups (\bar{X}_d) is shown in Equation 3 (Xu et al., 2017).

$$\bar{X}_d = \bar{X}_a - \bar{X}_b = \frac{1}{n_a} \sum_{j=1}^{n_a} X_a - \frac{1}{n_b} \sum_{j=1}^{n_b} X_b \dots\dots\dots (3)$$

Where \bar{X}_1 and \bar{X}_0 represent the means of groups a and b, respectively; $j=1, 2, \dots, n$ denotes the j th observation; n_a and n_b represent the total number of observations in groups a and b, respectively; X_a and X_b are the values to be compared (productivity and income). Subsequently, the t-test score was calculated using equation 4.

$$T_{test} = \frac{X_d}{\sqrt{\left(\frac{1}{n_a} + \frac{1}{n_b}\right) \frac{(n_a-1)s_a^2 + (n_b-1)s_b^2}{df}}} \dots\dots\dots (4)$$

Where df or degrees of freedom is obtained from the calculation $n_0 + n_1 - 2$; s_a^2 and s_b^2 represent the variances of groups a and b, respectively.

RESULTS AND DISCUSSION

Characteristics of Sorghum Farmers

The respondents in the study are sorghum farmers located in Patihan Village, with characteristics determined based on socio-economic conditions such as education, land size, farming experience, harvest orientation, family size, and production. It is known that the average land area used by farmers for sorghum cultivation is 0.38 hectares, with an average production of 1.08 tons. Most of the land managed by farmers is privately owned. Based on previous research, land area has a significant impact on increasing production because larger agricultural land sizes imply more resources. Farmers who own and manage more resources have a higher capacity to learn and implement new technologies (Li et al., 2020). The average farming experience among farmers is 19.05 years. This means that farmers with longer experience are more likely to accept and implement new innovations, comparing them with previous ones (Wangi, 2023). The variable of participation in farmer groups has an average value of 76.4%, indicating that most farmers are active

and participate in farmer groups. Participation indicators include attending meetings (attendance rate), participating in discussions, and engaging in organized activities. Farmer participation in farmer groups fosters more relationships and interactions with key figures in the sorghum value chain and provides greater access to information about New Superior Varieties (NSV) (Sanya et al., 2020).

The average education level of farmers is 7.38, equivalent to junior high school, meaning that the majority of respondents are sufficiently educated and have the ability and mindset to adapt more easily to their environment (Andriani et al., 2019). The average harvest orientation of sorghum is 85.5%. Most of the farmers' production will be sold, indicating the reason behind the low adoption of superior sorghum varieties, which is assumed to spoil a few months after harvest (Acheampong et al., 2018). The average number of family members of the respondents is 3.12 people. This means that the more family members the farmer has, the farmer has the potential for labor that can help in their farming activities, but also, the greater the needs that need to be met by the farmer (Nurliani et al., 2023). The characteristics description can be seen in Table 1.

Tabel 1. Respondents Characteristics

Variables	Measurements	Mean	Std. dev.
Education	Year	7.382	3.336
Land area	Ha	0.389	0.145
Farming experience	Year	19.054	6.589
Activity in farmer groups	1 if farmers are active in farmer groups, 0 if farmers are not active in farmer groups	0.764	0.428
Harvest outcome orientation	1if the harvest is for sale, 0 if other	0.855	0.356
Number of family members	Person	3.127	0.883
Production	Ton	1.080	0.325

Source: Processed Primary Data, 2024

Application of New Superior Varieties

Crop patterns in the research location consist of rice - rice - sorghum - rice. This cropping pattern is related to water availability relying on rainfall, with irrigation water needs in the third planting season met by pumping river water (Surdianti et al., 2021). Superior seed varieties are one of the production factors that determine the success of farming. Superior varieties are those that have specific advantages such as short planting periods, resistance to pests and diseases, and suitability to local conditions (Nurliani et al., 2023).

Based on field results, there are two types of sorghum varieties cultivated in the research location: bioguma variety (NSV) and KD4 variety (non-NSV). Bioguma seeds are obtained from assistance provided by Agricultural Extension Centers, while KD4 seeds are usually obtained by farmers from previous harvests. The seed requirement for sorghum in one planting season ranges from 2-3 kg. The average land size of sorghum farmers is 0.38 hectares, with this amount of seed producing sorghum at 1.08 tons/ha. The harvest yield is already influenced by factors outside the research variables such as pests and diseases. Sorghum prices are differentiated into two types:

wet sorghum and dry sorghum. Wet sorghum is sorghum without undergoing the sun-drying process, while dry sorghum has undergone drying. The price of wet bioguma sorghum is Rp 3,000/kg and dry sorghum is Rp 5,000/kg. Meanwhile, the price of wet KD4 sorghum is Rp 2,000-2,500/kg and dry sorghum is Rp 4,000/kg.

Farmers applying new superior varieties amount to 19 farmers, equivalent to 35%, while 36 farmers, equivalent to 65%, still use local varieties. Although the use of superior varieties has many advantages, not all farmers are willing to use them. Based on previous research (Saleh & Dirgantara, 2023), farmers' reasons for not using NSV seeds include the suitability of NSV seeds to their land and farmers' lack of understanding. Farmers still lack adoption of superior seeds due to local community habits. Farmer group meetings usually discuss planting schedules and production factors used. Farmers typically follow advice from local community leaders, resulting in planting non-NSV seeds.

Tabel 2. Difference Between NSV and Non NSV

Measurement	NSV	Non NSV
Number of farmers	19	36
Number of seeds (kg)	2.97	2.67
Production (ton)	1.16	1.04
Price (Rp)	Rp 3,473	Rp 3,250

Source: Processed Primary Data, 2024

Factors Influencing Farmers' Decisions in Using New Superior Seed Varieties

The factors influencing farmers to use new superior seed varieties (NSV) in Patihan Village were analyzed using logistic regression analysis method with Stata 14 software. The dependent variable in this study is a dummy variable that has values between 0 and 1. A value of one indicates the farmer's decision to use NSV seeds (bioguma), while a value of zero indicates the farmer's decision to use local seeds (KD4). The independent variables suspected to influence the dependent variable are Education, land area, farming experience, number of family members, participation in farmer groups, and harvest orientation. The following are the results of logistic regression analysis:

Tabel 3. Output Logistic Regression

Variable	Coefficients	Std. Err.	Sig.	OR
Education (X1)	0.355 **	0.149	0.02	1.426
Land area (X2)	4.284 *	2.393	0.07	72.51
Farming experience (X3)	0.158 **	0.075	0.03	1.172
Number of family members (X4)	-0.611	0.440	0.17	0.543
Activity in famer groups (D5)	-1.451 *	0.876	0.10	0.234
Harvest outcome orientation (D6)	-1.936 **	0.972	0.05	0.144
Number of respondents	55			
Log likelihood	-27.095			
LR chi2	16.720			
Prob > chi2	0.011			
Pseudo	0.236			

Note: ** significant at the 5% level; *significant at the 10% level

Source: Processed Primary Data, 2024

The results of the logistic regression test presented in Table 3 indicate that the -2 Log likelihood value is -27.095, which represents a decrease from -35.452. This implies that the addition of the dependent variable to the model significantly improves its fit. The LR chi2 value is 16.72 with a chi2 probability value of 0.0104 (less than $\alpha = 0.05$). This LR chi2 value indicates that at least one independent variable significantly influences farmers' decisions to use NSV seeds. The Pseudo R Square value is 0.2357 or 23.57%, meaning that the variability of the dependent variable can be explained by the variability of the independent variables, while the remaining 63.8% is explained by factors outside the model.

The independent variables that have a significant positive effect on farmers' decisions to use new superior variety seeds (NSV) in Patihan Village are education, land area, farming experience, and harvest orientation. Meanwhile, the variable of participation in farmer groups has a significant negative effect on farmers' decisions to use new superior variety seeds of sorghum.

Education has a positive influence on farmers' decisions to use new superior variety sorghum seeds, with a significant value of 0.018 at a 5% level. This is also indicated by the odds ratio value of 1.426 > 0, meaning that H0 is rejected, indicating that the education variable has a chance of 1.426 times to choose NSV seeds. This suggests that the higher the level of education of farmers, the higher the likelihood of choosing NSV seeds. This is consistent with research by (Andriani et al., 2019; Noviyanti et al., 2020), which state that education is a factor influencing farmers' decisions because education affects farmers' ways of thinking and can facilitate adaptation to the environment. Education has a positive impact in the research location, with farmers' education levels dominated by elementary education, but many farmers have completed junior and senior high school as well as university education. Consequently, the level of technology adoption is more easily absorbed.

Land area has a positive influence on farmers' decisions to use NSV, with a significant value of 0.073 at a 10% level. This is also indicated by the odds ratio value of 72.513 > 0, meaning that H0 is rejected, indicating that the land area variable has a chance of 72.513 times to choose NSV seeds. This suggests that farmers with larger land areas tend to adopt NSV technology in this study. The reason is that larger agricultural land tends to have higher income, motivating farmers to use NSV seeds to increase production (Li et al., 2020). Increased land area has a beneficial effect on increasing production (Priyanto et al., 2022).

Farming experience has a positive influence on farmers' decisions to use NSV, with a significant value of 0.034 at a 5% level. This is also indicated by the odds ratio value of 1.172 > 0, meaning that H0 is rejected, indicating that the longer a farmer's experience, the greater the chance of choosing NSV seeds. This implies that the longer a farmer's farming experience, the greater the likelihood of using superior sorghum varieties. Based on the characteristics of farmers in Patihan Village, they have more than 19 years of farming experience. This experience reflects a high level of expertise and adaptation to technological innovations in farming. The longer farming experience allows farmers to have a better understanding and comparison of production results, seed variety

resistance, maintenance, and other factors, making it easier to make decisions in choosing varieties (Wangi, 2023).

Participation in farmer groups has a significant negative effect on farmers' decisions to use NSV, with a value of 0.098 significant at the 10% level. Based on the odds ratio value of 0.234 > 0, H₀ is rejected, indicating that the participation variable in farmer groups has a chance of 0.234 times to choose NSV seeds. The reason is that in the research location, farmer groups do not discuss new superior varieties much, but rather focus on fertilizer subsidies, pest control, and group programs. Farmer groups have limited access to information and resources needed to understand the benefits and use of superior seeds. Meanwhile, seed sources are easily obtained because they are available at the Agricultural Extension Agency (BPP). This is similar to the research by Apriliana & Mustadjab (2016), where the activity of farmer groups has a negative effect because farmers do not have adequate information about superior seeds, so they are reluctant to try something new and unfamiliar.

The harvest orientation has a negative effect on farmers' decisions to use NSV seeds, with a value of 0.046 significant at the 5% level. Based on the odds ratio value of 6.934 > 0, it means that H₀ is rejected, indicating that the harvest orientation variable has a chance of 6.934 times of choosing NSV seeds. The harvest orientation variable is adjusted to the socio-economic conditions in the research location. Farmers who use new superior varieties of sorghum are those who consume their harvest. The advantages of NSV sorghum are larger stalks, higher sweetness levels (brix content), higher sap volume, and higher seed production (Dinas Pertanian, 2022). NSV sorghum (bioguma) has a seed weight of 195.06 grams per plant (Anggita et al., 2022). According to Avif & Dewi (2022), the content of bioguma sorghum is 9.72% water, 6.82% protein, 1.81% fat, 2.21% crude fiber, and 72.92% carbohydrates. Sorghum in Patihan Village is processed into various products such as flour, popped sorghum, and biscuits because sorghum contains gluten-free.

Productivity and Income of Farmers Based on the Use of New Superior Varieties

The t-test output results indicate that the productivity of sorghum farmers using superior variety seeds has an average productivity of 2.75 tons/ha, while sorghum farmers not using NSV seeds have an average of 2.93 tons/ha. The productivity of farmers using NSV seeds is lower than those using non-NSV seeds because during the high planting season, the NSV seedlings are taller, making them more susceptible to bird pests. Although the productivity level of NSV sorghum farmers is lower, their income is higher due to the higher selling price of NSV sorghum.

The net income of sorghum farmers using superior variety seeds has an average of Rp 3,128,621 million/ha, while sorghum farmers not using NSV seeds have an average of Rp 2,379,869 million/ha. This aligns with the research of (Sayekti et al., 2020), which shows that farmers using new superior varieties gain greater profits compared to those not using them.

The significant value (t-value) of productivity is 0.18, exceeding the critical threshold of 0.05. The significant value (t-value) of income is 0.06, meaning it falls below the critical threshold of 0.1. These results indicate that there is no significant difference in productivity and there is a significant difference in income between farmers using NSV seeds and those not using them.

Tabel 4. Output T-test

Variable	Obs.	Productivity (Ton/Ha)		Income (Million/Ha)	
		Mean	Std Err	Mean	Std Err
NSV (1)	19	2.75	0.11	3,128,621	373072
NSV (0)	36	2.93	0.08	2,379,869	214140
Difference		0.18	0.3	748,752	158932
Sig (t-value)		0.18 (0.091)		0.06* (0.967)	

Source: Processed Primary Data, 2024

CONCLUSIONS

Conclusion and Recommendation/Policy Implication is the answer to the research question(s) not a summary of the research. Conclusion is no more than 5% of the total writing page. Farmers' approach to meeting supply needs involves adopting technology through the use of new superior variety seeds (NSV) in sorghum cultivation. Based on the above discussion, it can be concluded that the factors significantly influencing farmers' decisions to use NSV are activity in farmer groups, harvest outcome orientation, education, and farming experience. The productivity of farmers using NSV seeds is lower than those using non-NSV seeds because during the high planting season, the height of NSV seed plants is higher, making them more susceptible to bird pests. However, despite the lower productivity of NSV sorghum farmers, their income is higher. This research will be beneficial for farmers in seed selection and for the government as a basis for future agricultural policy-making to utilize new superior varieties.

Recommendations to the Department of Agriculture and Agricultural Extension Offices (BPP) are expected to be more proactive in providing information on new superior varieties. Information that can be provided includes correct cultivation techniques and commodity development strategies for sorghum to increase farmers' interest in planting NSV seeds. Sorghum farmers expect facilities and solutions for rat and bird pest attacks to minimize crop failures. NSV sorghum has the potential to increase farmers' income because of its higher selling price, thus farmers are encouraged to use NSV seeds.

REFERENCES

- Acheampong, P. P., Owusu, V., & Nurah, G. (2018). How does Farmer Preference matter in Crop variety Adoption? the case of Improved Cassava varieties' Adoption in Ghana. *Open Agriculture*, 3(1), 466–477. <https://doi.org/10.1515/opag-2018-0052>
- Amalia, R., & Firmadhani, C. (2022). *Teknik pengambilan keputusan* (M. R. Setiawan (ed.)). CV. Rtujuh Mediaprinting.
- Anam, C. (2018). Penelitian Pengembangan Tanaman Sorghum Sebagai Komoditas Bahan Alternatif Kebutuhan Pokok Makanan. *Praja Lamongan*, 1(1), 1–20.
- Andriani, R., Rasmikayati, E., Mukti, G. W., & Fatimah, S. (2019). Faktor-faktor yang Mempengaruhi

- Keputusan Petani Mangga dalam Pemilihan Pasar di Kabupaten Indramayu. *Jurnal Penyuluhan*, 15(2), 286–298. <https://doi.org/10.25015/penyuluhan.v15i2.27736>
- Anggita, Ferdita W., Harsono, P., & Sakya, Amalia T. (2022). Effects of Plant Growth Promoter on Growth Response and Yield of Several Sorghum Varieties in Sukoharjo. *E3S Web of Conferences*, 361(04003), 1–5. <https://doi.org/10.1051/e3sconf/202236104003>
- Apriliansa, M., & Mustadjab, M. (2016). Analisis Faktor-Faktor yang Mempengaruhi Pengambilan Keputusan Petani Dalam Menggunakan Benih Hibrida Pada Usahatani Jagung (Studi Kasus di Desa Patokpicias, Kecamatan Wajak, Kabupaten Malang). *Habitat*, 27(1), 7–13. <https://doi.org/10.21776/ub.habitat.2016.027.1.2>
- Aryani, N. F., Khatimah, K., Tajuddin, F. N., Khairunnisa, A. I., Magfira, N., & Aminudin, N. W. (2022). *Budidaya Tanaman Sorgum (Sorghum bicolor (L .) Moench)* (O. Jumadi, M. Junda, M. W. Caronge, A. Mu'nisa, F. Koes, & N. Muhammad (eds.)). Universitas Negeri Makassar.
- Avif, A. N., & Dewi, A. O. T. (2022). Analisis Kandungan Zat Gizi, Fenol, Flavonoid, Fitat, dan Tanin pada Sorgum (*Sorghum bicolor* (L.) Moench). *Nutri-Sains: Jurnal Gizi, Pangan Dan Aplikasinya*, 6(2), 65–74. <https://doi.org/10.21580/ns.2022.6.2.7083>
- Babat, B. K. (2022). *Luas Panen, Produksi, dan Produktivitas Sorgum di Kecamatan Babat Tahun 2021-2022*. BPP Kecamatan Babat, Lamongan.
- Bahtiar, Arsyad, M., Salman, D., Azrai, M., Tenrirawe, A., Yasin, M., Gaffar, A., Sebayang, A., & Ochieng, P. J. (2023). Promoting the new superior variety of national hybrid maize: Improve farmer satisfaction to enhance production. *Agriculture*, 13(1), 174.
- Bell, E., Bryman, A., & Harley, B. (2022). *Business research methods*. Oxford university press.
- Bobihoe, J., & others. (2021). Improving rice productivity through the new superior varieties of rice in the irrigation land, Jambi Province. *IOP Conference Series: Earth and Environmental Science*, 807(4), 42001.
- Bruin, W. B. De, Parker, A. M., & Fischhoff. (2020). Decision-Making Competence : More Than Intelligence ? *Association for Psychological Science*, 29(2), 186–192. <https://doi.org/10.1177/0963721420901592>
- Caruso, R., Petrarca, I., & Ricciuti, R. (2016). Climate change, rice crops, and violence: Evidence from Indonesia. *Journal of Peace Research*, 53(1), 66–83.
- Coble, L. H. (2017). *Income Diversification and Seasonality for Smallholder Farmers in Kilosa, Tanzania*. University of Florida.
- Costa, J. C. ., & Damanhuri. (2019). Pengaruh Komposisi Media Pembibitan terhadap Pertumbuhan dan Hasil Beberapa Jenis Jamur Tiram (*Pleurotus* spp.). *Jurnal Produksi Tanaman*, 7(10), 1885–1892.
- Dhutmal, R. R., More, A., & Jayewar, N. E. (2020). Current status and future prospects of millets with special reference to sorghum (*Sorghum bicolor* Moench (L.)). *IJCS*, 8(6), 2493–2499.
- Eliya, K., Paul, D., Ted, N., Julius, O., Weyesa, G. W., Ling-Ling, C., & Wen-Jun, W. (2019). Assessing factors influencing farmers adoption of improved potato varieties in Malawi. *International Journal of Economy, Energy and Environment*, 4(1), 1–13.
- Greene, W. H. (2018). *Econometric Analysis*. Pearson. <https://books.google.co.id/books?id=xGZRvgAACAAJ>
- Karmini. (2018). *Ekonomi Produksi Pertanian*. Mulawarman University Press.
- Leslie, G. (2022). *How Trauma Impact Decision-Making*. City University of Seattle.
- Li, H., Huang, D., Ma, Q., Qi, W., & Li, H. (2020). Factors influencing the technology adoption behaviours of litchi farmers in China. *Sustainability*, 12(1), 1–13. <https://doi.org/10.3390/su12010271>
- Majiwa, E. B. O. (2017). *Productivity and Efficiency of the Agricultural Sector: Afrika with a Special Focus On Rice Farming and Processing in Kenya*. Queensland University of Technology Business School.
- Mangesti, R. A., Yanfika, H., & Rangga, K. K. (2021). Pengambilan Keputusan Petani Memilih Varietas Padi di Kecamatan Bangun Rejo Kabupaten Lampung Tengah. *Journal of Extension and Development*, 3(01), 36–43.
- Martey, E., Etwire, P. M., & Kuwornu, J. K. M. (2020). Economic impacts of smallholder farmers' adoption of drought-tolerant maize varieties. *Land Use Policy*, 94, 104524.
- Miriti, P., Regassa, M. D., Ojiewo, C. O., Melesse, M. B., Miriti, P., Regassa, M. D., Ojiewo, C. O., &

- Melesse, M. B. (2023). Farmers' preferences and willingness to pay for traits of sorghum varieties: Informing product development and breeding programs in Tanzania. *Journal of Crop Improvement*, 37(2), 253–272. <https://doi.org/10.1080/15427528.2022.2079038>
- Mwangi, M., & Kariuki, S. (2015). Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. *Journal of Economics and Sustainable Development*, 6(5), 208–217.
- Mwaura, F. (2014). Effect of farmer group membership on agricultural technology adoption and crop productivity in Uganda. *African Crop Science Journal*, 22, 917–927.
- Noviyanti, S., Kusmiyati, & Sulistyowati, D. (2020). Adopsi Inovasi Penggunaan Varietas Ungul Baru Padi Sawah (*Oryza Sativa* L.) Di Kecamatan Cilaku Kabupaten Cianjur Provinsi Jawa Barat. *Jurnal Inovasi Penelitian*, 1(4), 771–781.
- Nurliani, Rosada, I., Adam, A. M. T., & Nabila, A. B. (2023). Farmer's Response To The Use Of Hybrid Corn Seeds Superior Varieties. *International Journal of Agriculture and Environmental Research*, 09(05), 842–856.
- Pertanian, D. (2022). Sorghum Bioguma 1. *Dinas Pertanian*, 1.
- Pranowo, I. G., & Zainuddin, A. (2024). Analisis Sikap Patni Terhadap Atribut Pupuk Subsidi Di Kabupaten Jember. *Jurnal Ekonomi Pertanian Dan Agribisnis (JEPA)*, 8(1), 97–112.
- Priyanto, M. W., Mulyo, J. H., Irham, I., Perwitasari, H., & Siregar, A. P. (2022). Does climate change adaptation improve technical efficiency of rice farming? Findings from Yogyakarta Province Indonesia. *Jurnal Manajemen Dan Agribisnis*, 19(2), 184–194. <https://doi.org/10.17358/jma.19.2.184>
- Priyanto, M. W., Mulyo, J. H., Irham, I., Perwitasari, H., & Siregar, A. P. (2023). Farmer awareness, risk perception and adaptation to climate change: Is the Indonesians' climate program makes a difference? *Journal of Sustainability Science and Management*, 18(2), 34–50.
- Ronda, V., Aruna, C., Visarada, K., & Bhat, B. V. (2019). Sorghum for animal feed. In *Breeding Sorghum for diverse end uses* (pp. 229–238). Elsevier.
- Saleh, W., & Dirgantara, Y. (2023). Analisis Keputusan Petani dalam Memilih Varietas Padi Benih Unggul (Kasus Kecamatan Pamijahan, Kabupaten Bogor). *Jurnal Ilmiah Management Agribisnis (Jimanggis)*, 4(1), 19–30.
- Samrin, & Amirullah, J. (2018). Kajian adaptasi varietas unggul baru padi sawah pada musim hujan dan kemarau di sulawesi tenggara. *Jurnal Triton*, 9(1), 21–29.
- Sanya, L. N., Sseguya, H., Kyazze, F. B., Diiro, G. M., & Nakazi, F. (2020). The role of variety attributes in the uptake of new hybrid bananas among smallholder rural farmers in central Uganda. *Agriculture and Food Security*, 9(1), 1–13. <https://doi.org/10.1186/s40066-020-00257-7>
- Sari, L. (2019). *Analisis Pendapatan Petani Padi Di Desa Bontorappo Kecamatan Tarawang Kabupaten Jeneponto*. Universitas Megeri Makassar.
- Sayekti, A. L., Setiani, R., Hayati, N. Q., Nugrahapsari, R. A., Prabawati, S., Maharina, K. E., Mulyono, D., Puspitasari, N., Waryat, N., & Yufdy, M. P. (2020). Hubungan Kepemilikan Aset Produksi terhadap Keputusan Petani untuk Menggunakan Varietas Unggul Baru Pepaya Merah Delima (The Association of Production Assets on Farmer Selection of A New Variety, Merah Delima Papaya). *Jurnal Hortikultura*, 30(2), 177–184. <https://doi.org/10.21082/jhort.v30n2.2020.p177-184>
- Smale, M., Assima, A., Kergna, A., Thériault, V., & Weltzien, E. (2018). Farm family effects of adopting improved and hybrid sorghum seed in the Sudan Savanna of West Africa. *Food Policy*, 74(July 2016), 162–171. <https://doi.org/10.1016/j.foodpol.2018.01.001>
- Suminarti, N., Guntoro, A., & Fajrin, A. (2018). Aplikasi Bahan Organik pada Tanaman Sorghum (*Sorghum bicolor* L. Moench) var. KD4 di Lahan Kering untuk Peningkatan Penyediaan Hara. *Jurnal Lahan Suboptimal*, 7(2), 144–156.
- Surdianti, Y., Sunandar, B., Kurnia, & Sutrisna, N. (2021). Pertumbuhan dan Produktivitas Varietas Padi Unggul Baru dan Preferensi Responden di Kabupaten Majalengka. *E3S Web of Conferences*, 306(01033), 1–11.
- Surdianto, Y., Sunandar, B., Kurnia, & Sutrisna, N. (2021). Growth and productivity of new superior rice varieties and respondents' preference in Majalengka Regency. *E3S Web of Conferences*, 306(01033), 1–11. <https://doi.org/10.1051/e3sconf/202130601033>

- Susanti, A. (2023). Korporasi Petani Sorghum sebagai Penyangga Ketahanan Pangan Nasional. *Nasional Multidisciplinary Sciences*, 2(3), 185–193.
- Syafriani, D., Darmana, A., Syuhada, F. A., & Sari, D. P. (2023). Statistik Uji Beda Untuk Penelitian Pendidikan (Cara Dan Pengolahannya Dengan SPSS). In H. Sukma (Ed.), *Cv.Eureka Media Aksara* (pp. 1–50). Eureka Media Aksara.
- Wangi, P. A. S. (2023). *Pengambilan Keputusan Petani dalam Memilih Varietas Unggul Benih Jagung Hibrida (Studi Kasus Desa Cepogo, Kecamatan Kembang, Kabupaten Jepara)*. Universitas Islam Malang.
- Winarti, C., Arif, A. Bin, Budiyanto, A., & Richana, N. (2020). Sorghum development for staple food and industrial raw materials in East Nusa Tenggara, Indonesia: A review. *IOP Conference Series: Earth and Environmental Science*, 443(1), 12055.
- Xu, M., Fralick, D., Zheng, J. Z., Wang, B., Tu, X. M., & Feng, C. (2017). The differences and similarities between two-sample t-test and paired t-test. *Shanghai Archives of Psychiatry*, 29(3), 184–188. <https://doi.org/10.11919/j.issn.1002-0829.217070>
- Yundari, T., & Artati, D. (2021). Analisis Pengaruh Literasi Keuangan, Perilaku Keuangan dan Pendapatan terhadap Keputusan Investasi (Studi Kasus Pada Karyawan Swasta Di Kecamatan Sruweng Kabupaten Kebumen). *Jurnal Ilmiah Manajemen Keuangan*, 12(8), 1–19.