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FARMER'S DECISIONS IN SELECTING SUPERIOR SHALLOT SEEDS IN SOLOK REGENCY WEST SUMATRA

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Abstract

Background: Shallots are a commodity that is exceptionally strategic and economical regarding farming profits. One way that farmers can increase production results is by adopting technology, such as using superior seeds.
Purpose: This research aims to describe the implementation of the SOP for SS Sakato red onion farming, identify factors that influence farmers using superior SS Sakato seeds, and analyze differences in performance between shallot farmers who use SS Sakato seeds and Non SS Sakato seeds.
Design/methodology/approach: The methods used are qualitative and quantitative analysis, logit regression analysis, and propensity score matching (PSM) analysis.
Findings/Result: The results show that the SOP adoption rate for shallots is 82%, with the highest SOP adoption being plant maintenance and the lowest SOP adoption rate determining when to plant. Factors significantly influencing farmers' decisions to use superior SS Sakato seeds in Sungai Nanam are farmer education, farmer income, access to production facilities, agricultural extension, land area, and seed resistance to pests and diseases. The use of superior SS Sakato seeds significantly positively impacts shallot production and farmer profit in shallot farming. The use of superior SS Sakato seeds can increase the income of shallot farmers even though the costs of farming are higher. The use of superior seeds should be able to reduce the costs that farmers have to pay, but in this study, the costs incurred by farmers remained high.
Conclusion: Increasing the productivity of shallots can be achieved by using quality seeds, using shallot varieties that are highly productive, adaptive, and resistant to pests and diseases, and improving cultivation techniques according to SOP. Farmers who use superior SS Sakato seeds should comply with the Standard Operating Procedure (SOP) to maximize shallot production. With an emphasis on increasing production, there should be support for farmers from seed breeding institutions to innovate in order to be able to provide superior seeds, support from technology-producing institutions, and support from extension services both from the government and the private sector.
Originality/value (State of the art): This study describes that the use of superior seeds will impact the production and productivity of shallots, costs incurred by farmers, and farmer profits. Technology is an essential factor in influencing the production function; utilizing technology will have implications for increasing efficiency. Superior seeds are a technology that can have a long-term impact.

Keywords: binary logit regression, propensity score matching (PSM), shallots, standard operating procedures (SOP), superior seeds

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INTRODUCTION

Shallots are a commodity that is quite strategic and economical regarding farming profits. Shallot is a strategic commodity in Indonesia so the government should pay its attention to this commodity (Rahmawati et al. 2018). The development of shallot farming in Indonesia is directed at increasing yields, production quality, and income, as well as improving farmers' standard of living (Asih, 2009). Farmers can increase production yields by adopting technology, such as using superior seeds. According to Syamsiah et al. (2015), the main factor that is taken into consideration in developing superior rice varieties in an area is the attitudes and preferences of farmers in selecting and using appropriate superior seeds. Hopefully, this new variety will increase production results, which can also increase income and farmer welfare.

Shallots are cultivated throughout much of Indonesia, with West Sumatra being the country's third-largest producer, following Central Java and East Java (BPS, 2023). Among the regions in West Sumatra, Solok Regency is the leading contributor. According to BPS (2023), shallots are the predominant crop in Solok Regency, which produced a total of 188,515 tons in 2023.

To increase the production of shallots in Indonesia, the Tropical Horticulture Study Center (PKHT) Team from IPB University has developed shallot varieties to overcome the challenges of shallot supply in Indonesia. They succeeded in developing the SS Sakato variety. The research team consisted of Prof. Awang Maharijaya, Prof. Sobir, Prof. MA Chozin, and Dr. Heri Harti. According to Maharijaya, the critical point that influences shallot agribusiness activities is the provision of superior varieties and quality seeds from these superior varieties. The technology produced by research institutions has, to a certain degree, been created and developed in the regions. However, the effectiveness of this technology has not been optimal in increasing the competitiveness of agricultural commodities, as indicated by the large number of farmers who do not know or do not apply technological innovations resulting from research (Budiarti et al. 2023). By using superior seeds, the benefits obtained are in the form of high production results (Ferdinand et al. 2018; Winarso, 2014), high profits (Ferdinand et al. 2018; Hidayat et al. 2019; Winarso, 2014), seeds that are resistant to pests and diseases (Syahri dan Somantri 2016), and increased productivity (Akrab, 2022).

The introduction of new shallot varieties does not guarantee immediate adoption by farmers. According to Rogers (2003), the acceptance of new innovations typically occurs gradually, involving several stages before full adoption. This phenomenon is evident in Sungai Nanam, Solok Regency, where not all shallot farmers have embraced the SS Sakato variety. The slow uptake of innovation is a common issue, often due to farmers' concerns that the new shallots may not meet their expectations, as well as their belief in their own experience with traditional cultivation methods. Many farmers continue to practice traditional farming techniques, with only a few adopting modern technologies (Purnaningsih et al. 2006). The adoption of technology is influenced by various factors, including individual assessments of the technology's benefits, capabilities, social norms, and environmental conditions. There is a complex interplay between the environment, behavior, and personal characteristics (Bakti et al. 2017).

The process of cultivating shallots has a standard operating procedure that must be adhered to by farmers so that production results are high and the environment is maintained. Standard Operating Procedure (SOP) is a way of implementing agricultural crop cultivation (food, fruit, and vegetables) and plantations properly, correctly, and appropriately; with the implementation of Standard Operating Procedures in cultivation activities, it is expected to be able to produce quality products that are guaranteed quality and safe from residues of hazardous materials when consumed later (Rafi'i et al. 2021). Horticultural damage can be accelerated if handling during harvest or after harvest is poor (Epa et al. 2022). Therefore, farmers need to adhere to a standard that improves the quality of shallots. This study aims to answer whether using superior seeds in shallot farming will increase productivity to achieve the desired production level. By researching income and decision factors for farmers to use superior seeds and adopt SOP. This study provides insight into shallot production and productivity using superior seeds.

The hypothesis in this study is that using superior varieties in shallot farming and meeting the SOP in farming will increase farmers' income and standard of living. Based on what has been described, the objectives of this study are to evaluate the implementation of the SOP for SS Sakato shallot farming, to analyze the decision factors of farmers to choose SS Sakato seeds, and to analyze the differences in performance between farmers who use SS Sakato and Non SS Sakato seeds.

METHODS

This research uses primary data that was obtained from direct interviews with SS Sakato and Non SS Sakato shallot farmers in Sungai Nanam Village, Solok Regency, using a questionnaire that had been provided previously. The primary data obtained from farmers relates to farmer characteristics, methods of cultivating SS Sakato shallots, the cost structure used by farmers, revenue and income from farming, and adoption of standard operating procedures for SS Sakato shallots. The probability sampling method was used in this research, this method is a sampling method in which the sampling is carried out using mathematical guidance based on the theory of probability, where the chance of each unit being selected as a sample is known (Morissan, 2017). In this research two groups were taken: farmers who used superior SS Sakato seeds, as many as 70 sample farmers, and farmers who used Non SS Sakato seeds, as many as 70 sample farmers. The total sample used in this research was 140 people. The sampling technique uses the Lemeshow (1990) formula.

The analysis to measure the conformity to operational standards for SS Sakato shallot planting procedures uses quantitative analysis, which will calculate whether or not the standards that have been set are actual in the field. Cultivation activities are in accordance with Standard Operating Procedures (SOP), which were established by the Directorate General of Horticulture, Vegetable Cultivation and Biopharmaceuticals (2020). The SOPs that are looked at are selecting a location, determining planting time, preparing seeds, preparing land, planting, fertilizing, watering, maintaining plants, controlling plant pest organisms, determining when to harvest, and harvesting. The assessment was conducted by evaluating the extent of farmers' adoption of the technology, as detailed in Table 1.

The decision of shallot farmers to use SS Sakato superior seeds or not for farming activities uses a binary logit regression model. The binary logit regression aims to analyze the factors that influence farmers' decisions in choosing SS Sakato onion seeds, where the decision to use SS Sakato shallot seeds is a binary form with values 0 and 1. If these variables are thought to influence farmers' decisions to use SS Sakato shallot seeds, it has a value of (1), and if this variable is thought not to influence farmers using SS Sakato shallot seeds, it has a value of (0). The logit function model for estimating this model has the following general form according to Hosmer et al. (2013), which is described as follows:

$$g(x) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + ... + \beta_{10}X_{10} + \varepsilon$$

Information: g(x) (The farming decision to use SS Sakato seeds has a value of (1), and using Non SS Sakato seeds has a value of (0)), β_0 (constant/intercept), β_1 (Regression Coefficient), X_1 (Age (years)), X_2 (Farming experience (years)), X_3 (Education level (years)), X_4 (Number of dependents in the family (people)), X_5 (Farmer's income (rupiah)), X_6 (Land ownership (dummy, own = 1)), X_7 (Access to production facilities (dummy, easy = 1)), X_8 (Counseling (dummy, received counseling =1)), X_9 (Land area (ha)), X_{10} (Seed resistance to pests and diseases (dummy, resistance = 1)), ε (random variable).

Coefficient interpretation in logistic regression uses the odds ratio association measure to interpret the odds of a possibility (Dunn and Clark, 2009). If the odds ratio value is <1, the association is negative, which means the farmer's opportunity to use superior seeds decreases due to a variable. If the odds ratio value is >1, the association is positive, which means the farmer's opportunity to use superior seeds increases due to a variable.

Comparison of shallot farming using SS Sakato and Non SS Sakato shallot seeds using propensity score matching (PSM) analysis is an alternative method for estimating the impact of a treatment on a particular subject. The analysis of observations was divided into two groups, namely the group that received treatment and the control group that did not receive treatment. In this study, the treatment group in question is shallot farmers who use SS Sakato seeds, while the control group is farmers who do not use SS Sakato shallot seeds.

Table 1. Adoption of standard operational procedures for planting SS Sakato shallots

SOP	Actual	Score
Location Selection	All SOP's are fulfilled	100
Determining Planting Time	Three SOP's fulfilled	75
Seed Preparation	Two SOP's fulfilled	50
Land Preparation	One SOP fulfilled	25
Planting	No SOP's fulfilled	0
Fertilization		
Irrigation		
Plant Maintenance		
Control of Plant Pest Organisms (OPT)		
Determining When to Harvest		
Harvest		

The estimation model to see the average value of the impact of using SS Sakato superior seeds uses the Average Treatment Effect on the Treated (ATT) approach (Feryanto and Rosiana, 2021; Mawarni, 2021). ATT is the impact calculated from the outcome variables (production, productivity, and revenue) estimated from the total farmers who use SS Sakato seeds, namely E [Y1i|Di = 1] minus the total farmers who do not use SS seeds Sakato, namely E [Y0i|Di = 0]. ATT is used to estimate the average value of potential outcomes for farmers who use SS Sakato seeds. The ATT model, according to Khandker et al. (2010) can be written as follows:

$$ATT = E[Y1i \mid Di = 1] - E[Y0i \mid Di = 0]$$

Information: ATT (Impact resulting from farmers choosing SS Sakato seeds); E[Y1i | Di=1] (Farmers who use SS Sakato); E[Y0i | Di=0] (Farmers who use Non SS Sakato).

The rationale for this research can be seen in Figure 1. Increasing shallot production yields apart from cultivation in accordance with the SOP, of course, by increasing productivity by using superior seeds. The superior seeds currently being developed by PKHT IPB University are SS Sakato shallot seeds. However, currently, not many farmers have chosen to plant these seeds. So researchers are interested in studying farmers' decision factors to use SS Sakato seeds and analyzing the income of farmers who use SS Sakato shallot seeds. This research hypothesizes that using superior SS Sakato red onion seeds will increase production yields and farmers' income. Factor analysis of farmers' decisions to choose SS Sakato shallots using binary logit regression analysis. Propensity Score Matching (PSM) analysis compares farmer income.

RESULTS

Adoption and level of suitability of SS Sakato's shallot farming SOP

The adoption process for using SS Sakato seeds certainly goes through the introduction stage by extension workers to farmers. Next, there is the adoption stage introduced by Roger (2003), the first stage is that farmers gain knowledge about the newest onion seeds, namely SS Sakato, in the second stage, farmers are persuaded by extension workers to use the newest onion seeds, the third stage farmers are faced with the choice of using or not using new onion seeds, the fourth stage is that farmers implement new onion seeds on their land, the final stage is farmer confirmation of the adoption of the latest innovation, namely using the latest shallot seeds.

The decree of the Minister of Agriculture of the Republic of Indonesia, number 071/Kpts/SR.120/D.2.7/7/2017, contains a description of SS Sakato shallots. SS Sakato Shallots are local shallots from Solok Regency, West Sumatra, which were researched and selected by the PKHT IPB research team until they were successfully released in 2016. This shallot is one of the superior varieties, and its production yield is high. The area where SS Sakato onions are grown is located in Sungai Nanam, Solok Regency. This area is suitable for the onion's adaptation, namely in the highlands.

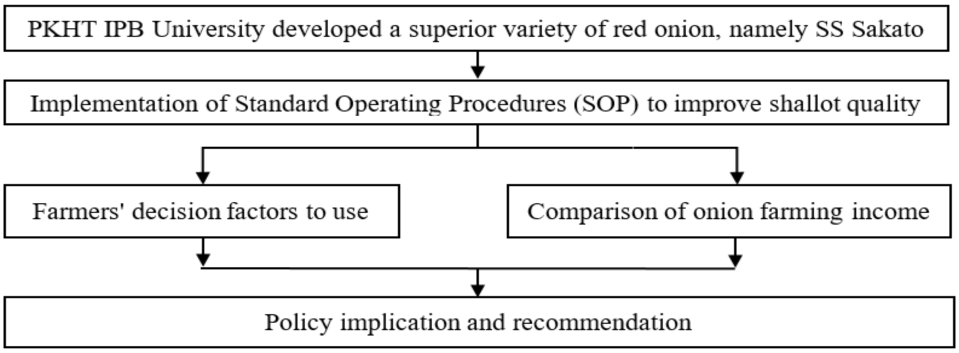

Figure 1. Research framework

The interview results indicated that 82% of farmers were able to adopt the Standard Operating Procedures (SOPs). This is due to the lack of intensive outreach activities regarding the standards that must be carried out by shallot farmers regarding shallot farming.

Of the eleven existing SOPs, 100% were implemented in the form of plant maintenance SOPs. Plant maintenance SOPs can be implemented perfectly because this is an activity that farmers must carry out, the existing standards include whether farmers carry out soil irrigation to repair the weirs and weeding in the form of cleaning the planting area from growing weeds.

The lowest adoption rate of SOPs is in determining the planting time, with farmers implementing only 63% of the prescribed procedures. This is because, in the research area, farmers do not consider weather conditions or the timing of potential pest attacks when planning their planting schedules.

Factors influencing farmers' decisions to choose superior SS Sakato seeds

Factors thought to influence farmers' decisions to choose SS Sakato red onions in Sungai Nanam Alahan Panjang, Lembah Gumanti District, Solok Regency are age, farming experience, level of education, number of dependents, land ownership, access to production facilities, counseling, land area, and resilience—seeds against pests and diseases. The analysis used for factors influencing farmers' decisions to choose SS Sakato shallots is logistic regression with Stata 16.1 software, the result is presented in Table 2.

The age factor has a negative effect on the chances of farmers using superior SS Sakato seeds in shallot farming, but is not significant. his result can be attributed to the fact that older farmers are less likely to use superior SS Sakato seeds. The younger the farmer, the more responsive they are to innovations, and the higher the chances of farmers using superior SS Sakato seeds. Several studies have stated that age does not have a significant effect on the selection of superior seeds (Kadar et al. 2016; Ristianingrum, 2016; Noer et al. 2020; Az-zammy et al. 2022; Nugraheni et al. 2022).

Farming experience does not significantly affect farmers' decisions to use superior SS Sakato seeds. Farmers who have experience certainly prefer seeds that can increase their income. This result is in line with research where farming experience does not have a significant effect on farmers' decisions to use superior seeds (Noer et al. 2020; Az-zammy et al. 2022; Nugraheni et al. 2022; Sarki et al. 2022).

The education factor positively and significantly affects the chances of farmers implementing superior varieties in shallot farming. This result can be explained that the higher the education of farmers, the higher the chances of implementing superior varieties. This study is in line with several studies where education has a significant effect (Ningsih, 2014; Ristianingrum, 2016; Harianja, 2020; Noviyanti et al. 2020; Nabil, 2021; Permatasari and Rondhi, 2022; Sarki et al. 2022; Wangi, 2023).

The number of dependents in the family has a positive and insignificant effect on farmers' chances of applying superior seeds to shallot farming. The number of dependents in the family can be a consideration for farmers when choosing to use superior SS Sakato seeds. This is in line with research by Novianti et al. (2020), Nugraheni et al. (2022), Mita et al. (2018), Rochdiani et al. (2019), and Sarki et al. (2022) where the number of dependents does not significantly affect farmers in choosing superior seeds.

Table 2. Results of analysis of factors that influence farmers' decisions to use superior seeds

Variable	Coef	Std. Err.	P>|z|	Odds Ratio
Age	-0.021	0.024	0.396	0.979
Experience	0.021	0.023	0.351	1.022
Education	0.237**	0.080	0.003	1.267
Dependents	0.371	0.247	0.134	1.449
Income	1.210**	4.660	0.009	1.000
Land Ownership	0.480	0.510	0.347	1.616
Access Production Facilities	0.896*	0.498	0.072	2.452
Counseling	1.007*	0.475	0.034	2.739
Land area	-1.498*	0.739	0.043	0.223
Seed Resistance	1.755**	0.554	0.002	5.786
_cons	-6.821	1.915	0.000	0.001

Information: ***significant at the real level α=1%; **significant at the real level α=5%; *significant at the real level α=10%

The income factor has a significant and positive effect on the opportunity for farmers to use superior SS Sakato seeds in shallot farming. This can be explained by the fact that the higher the farmer's income, the more excellent the opportunity to adopt the latest technology. This study's results align with Udin's research (2023) where income significantly affects the selection of superior seeds.

Shallot farmers' land ownership positively affects farmers' decision to use superior SS Sakato seeds, but it is not significant. Theresia et al. (2016) and Nugraheni et al. (2022) found in their research that lands ownership status was significantly significant in the selection of superior seeds by farmers.

The variable of access to production facilities shows that has a significant effect on farmers' decisions to use superior SS Sakato seeds, with a positive and natural effect. This shows that the decision to use superior SS Sakato seeds depends on the ease of farmers' access to production facilities. This is in line with the research of Noer et al. (2020) and Novianti et al. (2020), which states that access to production facilities influences farmers' decisions when choosing superior seeds.

The extension variable shows that extension significantly affects farmers' decisions to use superior SS Sakato seeds. This shows that the decision to use superior SS Sakato seeds or non-SS Sakato seeds depends on whether or not farmers participate in extension activities. The results of this study are in line with the research of Az-zammy (2022), Kadar et al. (2016), Noer et al. (2020), Umah et al. (2022), and Zahara et al. (2017) where extension has a significant effect on the selection of superior seeds.

The land area factor has a negative effect and significantly affects farmers using superior SS Sakato seeds in shallot farming. The results of this study indicate that the land area factor has a negative effect. Farmers are suspected to want to increase production, but land is limited, so using superior seeds is one of the solutions farmers use. The results of this study are in line with several studies where land area has a significant effect on the decision to use superior seeds (Mita et al. 2018; Noer et al. 2020; Silvia and Susilowati, 2021; Sarki et al. 2022; Khoirrinabila and Sayekti, 2023).

The logit regression analysis results showed that seed resistance to pests and diseases had a negative and significant effect on the implementation of superior seeds in shallot farming. The negative coefficient results suggest that farmers only care a little about seeds that are resistant to pests and diseases. The results of this study are in line with several studies where seed resistance to pests and diseases has a significant effect on farmers' decisions to use superior seeds (Kadar et al. 2016; Sativa, 2019; Nabil, 2021; Wangi, 2023; Umah et al. 2022).

Comparison of shallot farming performance

The differences in the structure of costs incurred in shallot farming activities are differentiated by the use of seeds in production input, namely SS Sakato and Non SS Sakato varieties of shallot seeds. Costs incurred in farming activities consist of cash costs and non-cash costs. Cash costs are costs incurred by farmers directly, either in cash or goods. In this research, cash costs include seeds, fertilizer, pest poisons, land rent, labor, and taxes. Meanwhile, non-cash costs are a type of cost where, in reality, farmers do not spend money or other means of payment to make payments for this type of cost. In this research, non-cash costs include depreciation costs for goods, land rental, equipment rental, and family labor. The costs of farming SS Sakato and Non SS Sakato shallot seeds is presented in the Table 3.

Revenue is a reflection of production performance and price dynamics, meaning that the amount of revenue is determined by two aspects, namely the production aspect and the price aspect, in other words, revenue can increase if production increases even though prices remain the same, or prices increase, and production remains the same or both aspects increase (Razzianto et al. 2021). Farmers then obtain results called income from the use of production facilities and costs incurred for farming activities. Revenue obtained by farmers can be in the form of cash and non-cash receipts (Soekartawi et al. 1986). The difference revenue from shallot farming using superior SS Sakato and non SS Sakato seeds is presented in the Table 4.

Income is a measure used to describe the rewards farmers receive for the production factors spent by farmers. Knowing the income from shallot farming is necessary to analyze farmer income. This income analysis describes the average income, costs, profits, compensation for resources used in shallot farming, compensation for capital, and compensation for labor per hectare. The cash income of shallot farming using SS Sakato seeds is greater than that of farmers using Non SS Sakato seeds (Table 5). This is because the cash cost component incurred for shallot farming is smaller than the non-cash costs. Analysis of farming income can illustrate the high profits shallot farmers receive per hectare.

Table 3. Structure of onion farming costs per hectare

Cost Component	SS Sakato Seeds		Non SS Sakato Seeds	
	Mean (IDR)	(%)	Mean (IDR)	(%)
Cash Fees				
Seed	30,848,355	50.26	29,848,736	47.09
Fertilizers and OPT Poisons				
Organic fertilizer	1,143,591	1.86	1,510,415	2.38
SP Fertilizer	5,432,783	8.85	6,222,845	9.82
NPK Fertilizer	4,070,739	6.63	5,175,666	8.16
Fungicide Poison	983,190	1.60	1,347,753	2.13
Insecticidal Poison	1,045,657	1.70	1,233,960	1.95
Land lease	58,929	0.10	91,071	0.14
Workers outside the family	7,328,294	11.94	7,851,262	12.39
Tax	16,671	0.03	15,814	0.02
Total Cash Costs	50,928,211	82.98	57,297,533	84.08
Non-Cash Fees				
Shrinkage				
Mulch	6,358,714	10.36	6,284,714	9.91
Hoe	21,943	0.04	23,543	0.04
Hand sprayer	54,857	0.09	23,543	0.04
Sickle/Machete	8,717	0.01	54,857	0.09
Land Rent (Own)	316,071	0.51	283,929	0.45
Equipment Rental (Own)	447,871	0.73	208,413	0.33
Workers inside the family	3,238,141	5.25	3,215,159	6.07
Total Non-Cash Costs	10,446,314	17.02	10,094,158	15.92
Total cost	61,374,525	100	67,391,691	100

Table 4. Revenue from shallot farming per hectare

Component	SS Sakato Seeds		Non SS Sakato Seeds	
	Mean (IDR)	(%)	Mean (IDR)	(%)
Cash Receipts	183,412,857	85.23	169,579,286	83.23
Non-Cash Acceptance	31,791,429	14.77	34,178,571	16.77
Total Acceptance	215,204,2986	100	203,757,857	100

Table 5. Red onion farming income per hectare

Component	SS Sakato Seeds (IDR)	Non SS Sakato Seeds (IDR)
Cash Receipts	83,412,857	169,579,286
Imputed Receipts	31,791,429	34,178,571
Total Receipts	215,204,286	203,757,857
Cash Fees	50,928,211	57,297,533
Calculated Costs	10,446,314	10,094,158
Total cost	61,374,525	67,391,691
Income on Cash Fees	132,484,646	112,281,753
Revenue over Total Costs	21,345,114	24,084,414
R/C Ratio on Cash Costs	4,23	3,56
R/C Ratio of Total Costs	3,51	3,02

The effect of using SS Sakato superior seeds in shallot farming on shallot farming income can be measured by total revenue, total costs, total income, and r/c ratio using the Propensity Score Matching (PSM) analysis tool using Stata 16.1 software. This PSM analysis tool can eliminate bias in outcomes. This PSM method will produce an Average Treatment Effect on the Treated (ATT) value for the treated group and the control group (Table 6).

The study's results showed that the use of superior SS Sakato seeds significantly impacted shallot production. This can be seen in Table 6, where the t-statistic value of the ATT production variable at a fundamental level of 1% is 2.69 (t-stat ≥ 2.35). Shallot farmers who use superior SS Sakato seeds have an average production difference of up to 2.520 kg from farmers who use Non SS Sakato seeds. The average production of shallots by farmers who use superior SS Sakato seeds is 8.748 kg, while the average production of non SS Sakato seeds is only 6.228 kg. This aligns with several studies where production increases by using superior seeds (Basuki, 2010; Purba, 2014; Sayaka and Hestina, 2016; Syahri and Somantri, 2016; Winarso, 2014).

Based on the research results, the use of superior SS Sakato seeds did not significantly affect the productivity of shallot farming. Shallots using superior SS Sakato seeds had productivity of 9.062 kg/ha, while shallots using Non SS Sakato seeds had a productivity of 8.575 kg/ha. Hence, the difference in shallot productivity between the treated and control groups was only 486 kg/ha. Andini's (2012) research aligns with this research, where using superior seeds can increase productivity. In contrast to the research of Akbar et al. (2023) and Winarso (2014), where the use of superior seeds did not significantly affect the use of superior seeds.

The benefits obtained by farmers affect the use and selection of inputs in farming. Large farmer profits will allow farmers to use better inputs or adopt the latest technology to increase production results. In the results of this study, the use of superior SS Sakato seeds had a significant effect on farmer profits at the 10% level, namely 1.40 (t-stat ≥ 1.28). The average profit of farmers using superior SS Sakato seeds is IDR145,391,203 and farmers using Non SS Sakato seeds is IDR104,887,209 with a difference of IDR40,503,993. This study aligns with several other studies where using superior seeds will increase farmers' profits (Kusrini et al. 2009; Basuki, 2010; Purba, 2014; Ernia et al. 2021; Akbar et al. 2023).

Table 6. Results of PSM analysis using superior SS Sakato seeds and non SS Sakato seeds

Variable	Sample	Treated (SS Sakato Seeds)	Control (Non SS Sakato Seeds)	Difference	T-stat
Production	Unmatched	8.748	8.264	484	0.84
	ATT	8.748	6.228	2.520	2.69***
Productivity	Unmatched	9.062	8.174	887	2.66***
	ATT	9.062	8.575	486	0.81
Income	Unmatched	145,391,203	127,184,734	18,206,469	1.53*
	ATT	145,391,203	104,887,209	40,503,993	1.40*

Information: *** significant at the real level α=1% |t| ≥ 2.35; ** significant at the real level α=5% |t| ≥ 1.65; * significant at the real level α=10% |t| ≥ 1.28

Managerial Implication

Increasing shallot productivity can be achieved through the use of quality seeds, the use of shallot varieties that are high productivity, adaptive, and resistant to pests and diseases, and improvements in cultivation techniques according to SOP. The use of superior seeds in shallot farming increases shallot production. Farmers who use superior SS Sakato seeds should comply with Standard Operating Procedures (SOP) to maximize shallot production results. With an emphasis on increasing production yields, the government should provide superior seeds at low prices so farmers can use them without thinking about expensive seed prices.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The adoption and level of conformity to standard operating procedures (SOP) in shallot farming in Sungai Nanam is only 82%; the highest SOP adoption is plant maintenance and the lowest level of SOP adoption is determining when to plant. Factors significantly influencing farmers' decisions to use superior SS Sakato seeds in Sungai Nanam are farming experience, farmer education, number of dependents in the family, land ownership status, access to production facilities, and seed resistance to pests and diseases. The use of superior SS Sakato seeds has a significant impact shallot production and farmer profit in shallot farming.

Recommendation

When carrying out red onion farming activities for superior or new varieties, assistance should be provided by extension workers or related agencies up to the harvest stage so that the adoption of standard operating procedures can be carried out well. Farmers should take part in extension activities held by the government because these activities can increase farmers' knowledge, which has an impact on increasing production results in their farming business and can increase farmers' income.

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