

From Access To Action: How Technology Accessibility And Communication Quality Drive Agricultural Productivity In Serdang Bedagai

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Abstract

This research seeks to examine the impact of technology accessibility on agricultural output, mediated by the quality of communication in Serdang Bedagai Regency, North Sumatra Province. This research employed a quantitative methodology, utilizing a structured survey as the principal instrument for data collection. The target demographic comprised farmers engaged in agricultural training programs and extension services, with a sample size of 123 respondents who fulfilled the inclusion criteria. This criterion mandated that respondents be active farmers engaged in the utilization of agricultural technology within their farming methods. The reason for choosing this sample was that farmers who used technology were more likely to give useful information on how communication quality affects agricultural productivity. The findings indicated that technology accessibility enhanced agricultural productivity, with communication quality serving as a crucial intermediary in facilitating comprehension and successful application of technical information. Clear, open, and two-way communication was very important for helping people modify their behavior and adopt new ways of doing things in farming. These results show that agricultural development initiatives should put more emphasis on making technology more accessible, providing training based on requirements, and developing communication skills to help farmers become more productive and secure food supplies in the long term.

Keywords: *Technology Accessibility; Communication; Productivity; Serdang Bedagai*

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INTRODUCTION

The agricultural sector is very important to Indonesia's economy. The Central Statistics Agency (BPS) says that more over 29% of Indonesia's workforce works in this industry. In 2023, it will add about 12.98% to the country's Gross Domestic Product (GDP) (Jamil et al., 2023). Nonetheless, this industry continues to encounter numerous structural obstacles, including low labor productivity, restricted access to technology, and deficiencies in the agricultural extension system (Setiawan et al., 2024). To make the agricultural industry more competitive, we need to work on improving the quality of the workforce, bringing in new technologies, and making the current extension system stronger (Siregar et al., 2024).

To support modernization and national food security (Tirtayasa et al., 2024), one of the biggest problems that needs to be solved right away is how to make farmers more productive. North Sumatra is one of the most important areas for farming on the island of Sumatra. It has a lot of promise because it grows a lot of high-quality goods. Rice, corn, palm oil, rubber, coffee, cocoa, and horticultural items including chilies, shallots, and tropical fruits are some of the most important things that the province's farms grow. To get the most out of this immense potential, it needs to be managed well. North Sumatra's agricultural industry can help make the regional and national economy stronger and food security better if it is managed well.

One of the problems is that farmers don't use technology very much, which makes them less productive and efficient (Chancellor, 2023). Making technology available is thought to be a good way to get farmers more involved in planning, carrying out, and judging agricultural activities. This method not only makes farmers the focus of growth, but it also gives them a say in decision-making. This can lead to higher agricultural outputs and help the agricultural industry stay strong in the long run (Kwame, 2024).

Also, farmers need to keep learning and improving their abilities so that they can keep up with new technology and the changing needs of the market (Sethi et al., 2024). This training covers a lot of ground, from how to grow crops to how to run a business, which helps farmers learn how to use new technologies and run their farms more efficiently. Also, the quality of communication between farmers, extension workers, and other people involved is highly crucial for making sure that technology and training can be used properly (Mapiye et al., 2025). Effective communication will enhance the information dissemination process, expedite the adoption of innovations, and foster more collaboration among farmers. Nonetheless, the function of communication quality as a mediator in enhancing farmer production via technology accessible and ongoing training has not been well examined (Onyeneke et al., 2023).

This study seeks to address this deficiency by examining the impact of technology accessibility on farmer productivity, mediated by the quality of communication in Serdang Bedagai Regency, North Sumatra Province. This study aims to elucidate the interplay among technology, training, and communication quality, thereby enhancing understanding of their collective impact on agricultural productivity and the promotion of sustainable food security in the region.

METHOD

This study utilized a quantitative methodology, employing a structured survey as the principal instrument for data collection. The research was carried out in the Serdang Bedagai district. The target population comprised farmers engaged in agricultural training programs and extension services. The proposed sample technique was implemented, yielding a total of 123 respondents who satisfied the study's inclusion criteria. These requirements necessitated that respondents be active farmers engaged in the accessibility of agricultural technology within their farming methods. The reason for this choice was that farmers who work on making technology more accessible are more likely to have useful information about how the quality of communication affects agricultural productivity.

We used a questionnaire based on theoretical indicators for each construct in the research model to collect primary data. The questionnaire utilized a five-point Likert scale to assess replies, spanning from "strongly disagree" to "strongly agree." The following is a list of the variable measurement items:

Table 1. Variable Measurement Scale

Variables	Code	Sample Statement
Technology Accessibility (X)	AT1	I have easy access to use available agricultural technologies.
	AT2	The agricultural technology I use has been proven to increase efficiency in the production process.
	AT3	I feel helped by agricultural technology in increasing my crop yields.
	AT4	Access to modern agricultural technology tools makes it easier for me to manage my farmland.
	AT5	I can access agricultural technology at any time without any significant obstacles.
	AT6	The agricultural technology extension I received was very easy to access and understand.
	AT7	The agricultural technology I use is suited to the needs and conditions of my land.
	AT8	The access to agricultural technology provided by the government has been very helpful in optimizing my production.
Communication Quality (Z)	KK1	Agricultural extension workers provide clear and easy-to-understand information regarding the use of new technologies.
	KK2	I feel comfortable asking agricultural extension workers if there are any difficulties in implementing the technology.
	KK3	Agricultural extension workers regularly provide feedback on new farming techniques I try.
	KK4	Communication between me and the agricultural extension worker is open and two-way, making it easier for me to obtain information.
	KK5	I feel valued and listened to when I provide feedback or complaints regarding the use of technology.
	KK6	Agricultural extension workers can explain in detail the benefits of the technology I apply in agriculture.
	KK7	The information I received from the extension worker was easy to understand and relevant to my agricultural needs.
	KK8	Communication with agricultural extension workers is carried out periodically to ensure proper implementation of technology.

Agricultural Productivity (Y)	KK9	I feel that the extension workers are committed to helping me solve agricultural problems using technology.
	PP1	The use of agricultural technology has increased the amount of my harvest compared to before.
	PP2	I feel more efficient in managing time and resources in farming thanks to the application of technology.
	PP3	My agricultural productivity has increased with the adoption of more appropriate technology.
	PP4	With the technology used, my agricultural products are of higher quality and higher yield compared to the old method.
	PP5	The technology I implemented helped me to reduce operational costs in agricultural production.
	PP6	I was able to increase the diversification of agricultural products thanks to the application of more modern technology.
	PP7	My harvests have increased not only in quantity, but also in quality thanks to the technology I use.

We used Structural Equation Modeling with the Partial Least Squares (SEM-PLS) method to analyze the data. We picked this method because it can test complicated connections between latent variables and can work with small sample sizes and data distributions that aren't normal. SEM-PLS was employed to evaluate the direct impacts of participatory methods and ongoing training on agricultural productivity, with the mediating influence of communication quality in this context.

RESULTS AND DISCUSSION

Respondent Description

Table 2. Respondent Demographics

Variables	Category	N	Percentage (%)
Gender	Man	110	87%
	Woman	17	13%
Age	20-25 years	28	22%
	26-30 years	38	30%
	31-35 years	35	28%
	36-40 years	26	20%
Education	High School/Equivalent	32	25%
	Diploma (D3)	40	31%
	Bachelor degree)	45	35%
	Masters (S2)	10	9%

Source: Data processed by the author 2026

There were 127 people who took part in this study. They were farmers who were taking part in a sustainable extension and training program in Serdang Bedagai

Regency, North Sumatra Province. Respondents were chosen using a purposive sampling method, with the criteria being active farmers engaged in utilizing agricultural technology in their practices. The bulk of responders were male, with 110 individuals (87%) identifying as male and only 17 individuals (13%) identifying as female. This shows that more men than women in the area are taking part in agricultural extension and training programs. This could be because of the area's social or cultural traits.

Most of the persons who answered were in the productive age range. The biggest age group was 26 to 30 years old (38 people), followed by 31 to 35 years old (35 people), 20 to 25 years old (28 people), and 36 to 40 years old (26 people). This data suggests that the farmers participating in this study were primarily young to middle-aged people, who are generally more adaptable and receptive to the integration of technology in their agricultural practices. In terms of education, most of the people who answered had a high level of education. 45 people (35%) had a Bachelor's degree (S1), 40 people (31%) had a Diploma (D3), and 32 people (25%) had a High School/Equivalent. There were just 10 people (9%) who had a Master's degree (S2). This data suggests that the majority of farmers participating in this study have a comparatively advanced educational background, facilitating their adoption of new agricultural technologies and comprehension of their effects on productivity.

Measurement Model Analysis (Outer Model)

The measurement model (outer model) was analyzed using two primary tests: (1) reliability and construct validity tests, and (2) discriminant validity tests. The subsequent section delineates the outcomes of these two tests as a foundation for the viability of the research instrument.

Table 3. Outer Model Results

Variables	Indicator	Loading	CR (Composite Reliability)	Cronbach's Alpha	AVE (Average Variance Extracted)
Technology Accessibility (X)	AT1	0.81	0.851	0.811	0.621
	AT2	0.78			
	AT3	0.75			
	AT4	0.8			
	AT5	0.77			
	AT6	0.79			
	AT7	0.82			
	AT8	0.76			
Communication Quality (Z)	KK1	0.83	0.871	0.841	0.651
	KK2	0.85			
	KK3	0.81			
	KK4	0.78			
	KK5	0.79			
	KK6	0.77			
	KK7	0.8			
	KK8	0.76			

	KK9	0.82			
	PP1	0.88			
	PP2	0.86			
	PP3	0.84			
Agricultural Productivity (Y)	PP4	0.87	0.911	0.861	0.71
	PP5	0.83			
	PP6	0.85			
	PP7	0.82			

Table 3 above demonstrates that the outer model analysis shows that technology accessibility (X), communication quality (Z), and agricultural productivity (Y) all have indicator loadings above 0.7. This means that they are all solid examples of convergent validity. The highest loading value was in agricultural productivity (Y), with PP1 reaching 0.88. The next highest value was in technology accessibility (X), with AT1 reaching 0.811. All indications make a big difference in how each variable is measured. For reliability, Composite Reliability (CR) and Cronbach's Alpha both did very well. CR was over 0.85 for all three variables, while Cronbach's Alpha was over 0.80. This shows that the instrument employed in this study is quite consistent, therefore it can be trusted to measure the variables that were studied. The Average Variance Extracted (AVE) value for each variable is likewise more than 0.5. This means that the indicators employed are very good at measuring the construct they were meant to measure. The greatest AVE, 0.70, is for Agricultural Productivity (Y). This means that these indicators are useful and trustworthy.

Structural Model Analysis (Inner Model)

R-Square

Table 4. Determination Coefficient (R-Square)

Variable	R Square	R Square Adjusted
Communication Quality (Z)	0.70	0.68
Agricultural Productivity (Y)	0.75	0.73

The R-squared value for communication quality (Z) is 0.70, which means that 70% of the changes in communication quality can be explained by the model's independent variable, technological accessibility (X1). The other 30% of the change is caused by things that aren't in the model. This shows that how easy it is to use technology has a big effect on how well people communicate, but there are also other things that affect communication in the agricultural setting. The R-squared value for agricultural productivity (Y) is 0.75, which means that communication quality (Z) as a mediator variable can explain 75% of the changes in agricultural output. This shows that communication quality and agricultural productivity are strongly linked, which means that good communication is a big part of raising crop yields. The modified R-squared value of 0.73 further shows that this model is stable and

doesn't overfit. This means that this model can accurately describe how the mediator variable (communication quality) affects the outcome (agricultural productivity).

Hypothesis Testing

Table 5. Hypothesis Test Results

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values	Decision
Technology accessibility (X) -> Communication quality (Z)	0.72	0.70	0.12	6.01	0.000	Significant
Technology accessibility (X) -> Agricultural productivity (Y)	0.75	0.74	0.11	6.82	0.000	Significant
Communication quality (Z) -> Agricultural productivity (Y)	0.65	0.63	0.14	4.64	0.000	Significant
Technology accessibility (X) -> Communication quality (Z) -> Agricultural productivity (Y)	0.30	0.32	0.09	3.33	0.001	Significant

The Impact of Technology Accessibility on Communication Quality

The study's findings show that how easy it is for farmers in Serdang Bedagai Regency, North Sumatra Province, to use technology has a big effect on how well they can communicate. The findings of this study align with the research (Gyau et al., 2025), which indicates that simple access to information technology enables extension staff to connect more effectively with farmers, hence enhancing their comprehension of the agricultural technology in use. Also, mobile technology that farmers can use makes it easier for extension staff and farmers to talk to each other, allowing them to share information in real time and with accuracy (Al-ammary & Ghanem, 2026). Also, extension workers that utilize technology-based apps can provide farmers clearer instructions, which cuts down on mistakes while using technology (Sethi et al., 2024). Lastly, using technology to talk between extension staff and farmers helps close the information gap, make extension more useful, and speed up the usage of technology by farmers (Kwame, 2024).

The outcomes of this research indicate that enhancing communication quality between extension workers and farmers necessitates prioritizing access to technology, which includes the provision of sufficient infrastructure and digital skills training for farmers. Local governments and other relevant organizations need to create technology-based training programs that help farmers get the most out of

technology in their daily farming activities. Training in technology that works can speed up the use of agricultural technologies, which in turn leads to higher output. Also, agricultural extension workers need to keep improving their digital abilities so they can better engage with farmers and make sure that the information they give is clear and can be used in the right way in the local area.

The Influence of Technology Accessibility on Agricultural Productivity

The study's findings demonstrate that technological accessibility significantly impacts agricultural productivity in Serdang Bedagai Regency, North Sumatra Province. This conclusion corroborates prior research indicating that enhanced technological access helps expedite the adoption of novel agricultural technologies and augment farmers' comprehension of more efficient and ecologically sustainable agricultural practices (Mulungu et al., 2025). Not only does easy access to technology speed up communication between farmers and extension workers, but it also makes it easier for farmers to share information quickly and accurately (Huang & Wang, 2024). Farmers can more easily use new technologies, make farming practices better, and overall boost local agricultural productivity when communication is more open and information is easier to get (Bocean, 2024). Also, good communication makes ties between farmers stronger, which makes it easier for them to work together to find answers to common problems in agriculture (Kitole et al., 2024).

The outcomes of this research underscore the necessity of policies that facilitate technological accessibility within the agriculture industry. First, farmers and extension workers need to learn how to use digital tools so they can better comprehend and talk about agricultural technology. Second, it should be a top focus to make communication between farmers, extension workers, and farmers more efficient. Good communication will speed up the use of new technologies and make them work better in the field. Third, getting farmers involved in making decisions about agricultural policy can get them more involved and speed up the adoption of technology that are right for them. Fourth, using information technology, such mobile apps, can speed up the sharing of knowledge and make farming operations more efficient. These efforts are projected to permanently boost agricultural productivity, improve the lives of farmers, and make the agricultural sector in Serdang Bedagai Regency more resilient, which will make the whole agricultural sector stronger.

The Influence of Communication Quality on Agricultural Productivity

The study's findings demonstrate that the quality of communication significantly impacts agricultural productivity in Serdang Bedagai Regency, North Sumatra Province. Theoretically, the outcomes of this study align with other research that demonstrates effective communication is significantly impacted by message clarity, accessible communication channels, and constructive feedback (Ngulube, 2025). Farmers and extension workers who communicate well with each other are more likely to use new farming technology because they can share knowledge more clearly and quickly (Sisay et al., 2024). Open lines of communication can speed up the transfer of knowledge, which lowers mistakes in managing natural resources and leads to better crop yields (Sennuga et al., 2024). Good communication between people is also vital for helping farmers learn how to use new technologies and adapt to changes in the market and government policies more quickly (Onyeneke et al.,

2023). Also, good communication between farmers and extension workers helps farmers learn how to utilize pesticides and fertilizers that are good for the environment, which in the end leads to greater crops (Giulivi et al., 2023). Two-way communication among farmer groups significantly impacts collaboration, facilitating the exchange of information and solutions to address shared challenges (Chancellor, 2023).

This research finding in Serdang Bedagai Regency, North Sumatra Province, has managerial implications that include a number of strategic approaches to make communication and farming more productive. First, agricultural extension workers should be given the tools they need to communicate better so they can better grasp the requirements and problems that farmers confront. Second, farmers and extension workers should be able to talk to each other more easily by using information technology and having regular meetings to talk about the newest changes and improvements in farming. Third, it is vital to make farmer groups more structured and strong so that they may share information, experiences, and ways to solve difficulties that farmers have. Fourth, agricultural extension should be done in a way that lasts and is based on the specific needs of farmers in Serdang Bedagai Regency. This would make the extension more effective. These initiatives should help the region's agricultural sector grow into a more productive, efficient, and sustainable one by speeding up the use of agricultural technology, helping farmers understand it better, and supporting the growth of a more productive, efficient, and sustainable agricultural sector.

The Influence of Technology Accessibility on Agricultural Productivity Through Communication Quality

The analysis indicates that communication quality is a significant factor in mitigating the impact of technology accessibility on agricultural productivity in Serdang Bedagai Regency, North Sumatra Province. This finding aligns with prior studies highlighting that excellent communication might enhance the comprehension and adoption of novel agricultural technologies via technology accessibility (Mapiye et al., 2025). Good communication between farmers and extension workers speeds up the use of new farming technologies and makes it easier for farmers to work together to solve problems (Kwame, 2024). Farmers may learn about new technology and policies more quickly when there are open and two-way communication channels. This, in turn, leads to better agricultural yields and a more sustainable agricultural sector (Halim et al., 2023). Good communication in extension is also very important for helping farmers learn about new technologies, speeding up the adoption of new technologies, and increasing production (Shamshiri et al., 2024). Good communication between farmers and extension workers speeds up the use of new technologies, improves farming practices, and makes it easier for groups of farmers to use more efficient technologies (Chancellor, 2023). Good communication also helps farmers make decisions more quickly and learn more about government policies that affect them. This leads to higher crop yields and a more sustainable agricultural sector (Mulungu et al., 2025).

The managerial implications of this research conclusion in Serdang Bedagai Regency, North Sumatra Province, encompass strategic measures to enhance communication and agricultural productivity. First, agricultural extension workers

should be given more influence by being trained in how to communicate clearly and simply about new technologies and ecologically beneficial farming methods. Second, we need to make it easier for farmers and extension workers to talk to each other in both directions. Digital tools like mobile apps can help with this by making it easier for people to share information in real time. Third, mobile-based information technology should be promoted to speed up the use of agricultural technology, make the best use of natural resources, and boost production efficiency. Fourth, sustainable extension services should be tailored to the unique requirements of local farmers, considering the challenges encountered in each sub-district. These efforts should speed up the use of technology, help farmers understand it better, and lead to more effective and sustainable farming in Serdang Bedagai Regency.

CONCLUSION

This study demonstrates that technology accessibility positively influences agricultural productivity in Serdang Bedagai Regency, North Sumatra Province. The findings demonstrate that communication quality serves as a vital mediator connecting technology access to enhanced productivity. It has been proven that clear, transparent, and two-way communication between extension workers and farmers can help them comprehend agricultural technology better and speed up the adoption of new farming methods. So, good communication is an important part of making sure that farmers use technology to its fullest potential.

These results suggest that programs to help farmers in Serdang Bedagai Regency should focus on making technology easier for them to use. To make sure that farmers can get the information they need, there must be enough technological infrastructure, such as devices and a reliable internet connection. Also, farmer-based training programs that teach both technology and communication skills need to be improved. To make sure that farmers can understand the information better, agricultural extension personnel should get training in communication skills. This would make extension services more effective and speed up the process of adopting new technologies.

For future research, it is advisable to utilize a bigger sample size and incorporate regions beyond Serdang Bedagai Regency to enhance the generalizability of the results. Additional research could broaden the scope of investigated variables, including economic considerations, governmental regulations, or socio-cultural situations that might affect agricultural output. A mixed methods approach integrating quantitative and qualitative data may be employed to achieve a comprehensive understanding of the influence of technology accessibility and communication quality on agricultural output.

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