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The Effect of Extension Agent's Performance and Competition on the Adoption 0f Integrated Cattle and Corn Farming Technology in Kabangka Subdistrict Muna Regency

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ABSTRACT

This study aims to analyze the effect of agricultural extension workers' performance and competence on the adoption of integrated beef cattle and corn farming technology in Kabangka Subdistrict, Muna Regency. The study was conducted in Kabangka Subdistrict, Muna Regency, Southeast Sulawesi, from March to May 2026. The study population consisted of 102 farmers who cultivated corn and raised beef cattle; a sample of 81 farmers was selected using the Slovin formula, with 8 extension workers serving as supporting respondents. Data were collected using a 1–5 Likert-scale questionnaire and structured interviews. Data analysis was performed using Structural Equation Modeling-Partial Least Squares (SEM-PLS). The results of the study indicate that: (1) extension workers' performance has a positive and significant effect on technology adoption; (2) extension workers' competence does not have a significant effect on technology adoption; (3) farmers' behavior mediates the effect of extension workers' performance on technology adoption; (4) farmers' behavior mediates the effect of extension workers' competence on technology adoption; and (5) extension workers' performance and competence simultaneously contribute to technology adoption through farmers' behavior, with an R^2 of 0.996. It is concluded that farmers' behavior is a key factor that bridges the influence of extension quality on the successful adoption of integrated beef cattle and corn farming technology in Kabangka Subdistrict, Muna Regency.

INTRODUCTION

The agricultural sector plays a very strategic role in Indonesia's economic development. Besides serving as the main provider of food for the community, this sector also plays an important role in absorbing labor, increasing rural income, and driving economic activity in rural areas. In the national economic structure, the agricultural sector is one of the sectors that is relatively resilient in facing various economic dynamics, including economic crises and changes in global conditions. Therefore, agricultural development continues to be a government priority in order to achieve national food security and improve farmers' welfare.

In the era of globalization and increasingly complex climate change, the agricultural sector faces various challenges, such as limited productive land, shifting seasonal patterns, rising food demand, and the need for efficiency in resource use. These conditions call for increasing agricultural productivity through the use of innovative technology and boosting human resource capacity in the agricultural sector. According to Soekartawi (2022), improving agricultural productivity is not only determined by the availability of natural resources but is also greatly influenced by farmers' ability to access and adopt technology innovations that are relevant to local conditions. In this process,

the presence of agricultural extension workers is very important because they act as change agents who bridge the gap between technology innovation sources and farmers as technology users.

One of the strategic commodities that continues to be developed in national agricultural development is yellow corn (Zea mays L.). Corn plays an important role not only as an alternative food ingredient but also as the main raw material for the livestock feed industry. The national demand for corn keeps rising along with the growth of the livestock industry, especially poultry and beef cattle farming. Therefore, increasing corn production and productivity has become one of the main focuses in national agricultural development policy.

In Southeast Sulawesi, corn is one of the leading commodities that continues to be developed by the local government. Statistics show that the corn harvest area in Southeast Sulawesi Province increased from around 18,943 hectares in 2022 to 19,881 hectares in 2023, and then rose again to about 20,135 hectares in 2024, with production reaching more than 79 thousand tons. Even though the harvest area and production have increased, corn productivity in this region is still below the national average of around 5.2 tons per hectare. This indicates that there is still quite a big potential to boost corn productivity through the application of better cultivation technology.

Besides being a food and feed commodity, corn plants also produce a fairly large amount of biomass waste in the form of stalks, leaves, and cobs. This plant waste has great potential to be used as livestock feed, especially for beef cattle. According to Haryanto (2020), corn plant waste can be used as animal feed through various processing technologies like silage or fermentation, which can improve the nutritional value and storage life of the feed. Using corn plant waste as livestock feed is one way to integrate crop farming and animal husbandry, which can increase the efficiency of using agricultural resources.

The crop-livestock integration system is one approach to sustainable agricultural development that is increasingly being developed in various countries. This system allows for mutually beneficial interactions between crop and livestock activities, which can improve resource use efficiency, reduce dependence on external inputs, and enhance the sustainability of farming systems. According to Devendra and Thomas (2002), integrating crops and livestock can increase land productivity, improve nutrient cycles in farming systems, and boost the economic resilience of farming households.

However, various research findings show that implementing crop-livestock integration systems at the farmer level still faces several challenges. A study conducted by Estin et al. (2025) on cattle feed sources in Duruka District, Muna Regency, showed that most farmers still rely on natural forage like field grass, gamal, and lamtoro as animal feed. The use of agricultural crop waste as feed is still relatively limited, so the potential for crop-livestock integration hasn’t been fully utilized.

The differences in the level of technology adoption show that the process of agricultural innovation diffusion hasn't been running evenly among farmers. In the innovation diffusion theory proposed by Rogers et al. (2014), the adoption of innovation is influenced by various factors such as the characteristics of the innovation, the socio-economic conditions of users, the communication system, and the role of change agents like agricultural extension workers. In the context of agricultural development, extension workers play an important role in conveying technology information, guiding farmers in applying new technologies, and encouraging changes in farmers' behavior towards more productive and sustainable farming practices.

In the context of this research, farmers' behavior is suspected to act as a mediating variable that bridges the relationship between the performance and competence of extension workers and the level of adoption of cattle and corn integration technology. Extension workers with good performance and competence are expected to be able to improve farmers' knowledge and positive attitudes toward agricultural integration technology, thereby encouraging farmers to adopt this technology in their farming activities.

METHODS

This research was carried out in Kabangka District, Muna Regency, Southeast Sulawesi from March to May 2026 using a quantitative approach. The study population consisted of 102 farmers who cultivate yellow corn and also raise beef cattle, and who are members of farmer groups guided by field agricultural extension officers (PPL). The sample was determined using Slovin's formula with a 5% margin of error, resulting in 81 main farmer respondents selected through purposive sampling based on certain criteria, as well as 8 PPL officers as supporting respondents. Primary data were collected through closed questionnaires with a 1-5 Likert scale and structured interviews, while secondary data were obtained from Muna Regency BPS and related agencies. The research variables include extension worker performance (X1) with indicators like preparation, implementation, evaluation, and reporting; extension worker competence (X2) which covers technical, managerial, and socio-cultural competencies; farmer behavior (Z) as a mediating variable measured through aspects of knowledge, attitude, and action; and adoption of integrated technology (Y) consisting of livestock feed processing, organic fertilizer processing, corn waste utilization, and implementation of an integrated farming system. Data analysis was carried out using Structural Equation Modeling-Partial Least Square (SEM-PLS), including evaluation of the outer model through tests of convergent validity, discriminant validity, and construct reliability, as well as testing the inner model through the coefficient of determination (R^2), effect size (f^2), and hypothesis testing with bootstrapping to analyze direct, indirect, and simultaneous effects between variables

RESULTS AND DISCUSSION

Convergent Validity

Table 1. Results of Convergent Validity Testing Based on Loading Factor

	AT	Extension Worker Performance (X1)	Extension Competencies (X2)	Behavior
AT1	0.934			
AT2	0.856			
AT3	0.927			
AT4	0.859			
AT5	0.953			
AT6	0.923			
AT7	0.838			
AT8	0.873			
AT9	0.942			
Kin.P1		0.914		
Kin.P2		0.949		
Kin.P3		0.957		
Kin.P4		0.867		
Kin.P5		0.851		
Kin.P6		0.932		
Kin.P7		0.950		
Kin.P8		0.849		
Kin.P9		0.943		
Com.P1			0.939	
Com.P2			0.833	
Com.P3			0.932	

	AT	Extension Worker Performance (X1)	Extension Competencies (X2)	Behavior
Com.P4			0.946	
Com.P5			0.974	
Com.P6			0.869	
Com.P7			0.799	
Com.P8			0.900	
Com.P9			0.910	
PP1				0.948
PP2				0.810
PP3				0.938
PP4				0.912
PP5				0.933

Based on the results of the convergent validity test, all indicators on the Technology Adoption (AT) variable, Extension Performance (X1), Extension Competence (X2), and Farmer Behavior have loading factor values above 0.70. The highest loading factor value was found in the Kom.P5 indicator at 0.974, while the lowest value was found in the Kom.P7 indicator at 0.799. Since all indicators have loading factor values greater than 0.70, it can be concluded that all indicators are able to explain the constructs they measure well and have met the convergent validity criteria. Therefore, all indicators are considered valid and suitable for further analysis.

Discriminant Validity

Table 2. Results of Discriminant Validity Test Based on Fornell-Larcker Criteria

Variabel	AT	Extension Worker Performance (X1)	Extension Competencies (X2)	Behavior
AT	**0,901**			
Extension Worker Performance (X1)	0,996	**0,913**		
Extension Competencies (X2)	0,992	0,994	**0,902**	
Behavior	0,971	0,959	0,964	**0,909**

From the data management on the table above, it was found that some of the loading factor values for each indicator of the respective variables already have loading factors that are not the highest compared to the loading values when linked with other variables. This means that each variable has good discriminant validity, where some variables still have measures that are highly correlated with other constructs.

Construct Reliability and Validity

Table 3. Results of Construct Reliability and Validity Testing

Variabel	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	AVE
AT	0,971	0,972	0,975	0,813
Extension Worker Performance (X1)	0,976	0,977	0,978	0,834
Extension Competencies (X2)	0,971	0,973	0,975	0,813
Behavior	0,947	0,951	0,960	0,827

From the data management results in the table above, the composite reliability test showed satisfying results, meaning all variables are reliable because all latent variable values have good composite reliability, or the questionnaire used in this study is reliable and consistent. Also, the average variance extracted values are higher than the correlations between the constructs in the model. So, the average variance extracted values meet the requirement to proceed to the next test.

Coefficient of Determination (R^2)

Tabel 4. Nilai Koefisien Determinasi (R-Square)

Variabel Endogen	R-Square	R-Square Adjusted
Adopsi Teknologi (AT)	0,996	0,996
Perilaku	0,930	0,928

The R-Square value for the Technology Adoption (TA) variable is 0.996. This shows that 99.6% of the variation in technology adoption can be explained by the Extension Performance, Extension Competence, and Farmer Behavior variables, while the remaining 0.4% is explained by other factors outside the research model.

F Square Value

Table 5. Effect Size (F-Square) Test Results

AT	AT	Extension Worker Performance (X1)	Extension Competencies (X2)	Behavior
Extension Worker Performance (X1)	2.086			0.001
Extension Competencies (X2)	0.011			0.130
Behavior	0.695			

Hypothesis Test

Table 6. Results of Hypothesis Testing of the Structural Model

No.	Hubungan Variabel	Original Sample/O	Sampel (M)	Standar Deviasi (STDEV)	T Statistik	P Value
1	Kinerja Penyuluh (X1) ⟶ Adopsi Teknologi (AT)	0,870	0,883	0,114	7,637	0,000
2	Kinerja Penyuluh (X1) ⟶ Perilaku	0,059	0,118	0,351	0,169	0,866
3	Kompetensi Penyuluh (X2) ⟶ Adopsi Teknologi (AT)	-0,067	-0,052	0,120	0,555	0,579
4	Kompetensi Penyuluh (X2) ⟶ Perilaku	0,905	0,848	0,364	2,490	0,013
5	Perilaku ⟶ Adopsi Teknologi (AT)	0,201	0,173	0,047	4,306	0,000

Based on the hypothesis testing results, the relationship between Extension Officer Performance and Technology Adoption has a T-Statistic of 7.637 and a P-Value of 0.000, meaning it has a positive and significant effect. Extension Officer Competence on Behavior also has a positive and significant effect with a T-Statistic of 2.490 and a P-Value of 0.013. Furthermore, Behavior on Technology Adoption shows a positive and significant effect with a T-Statistic of 4.306 and a P-Value of 0.000.

Discussion

The Influence of Extension Workers' Performance on the Adoption of Beef Cattle and Corn Integration Technology in Kabangka District, Muna Regency

Table 7. Test Results of the Influence of Extension Workers' Performance on Technology Adoption

Variable Relationships	Original Sample (O)	T Statistics	P Value	Remarks
Extension Performance (X1) → Technology Adoption (AT)	0,870	7,637	0,000	Signifikan

Based on the results of hypothesis testing using the Structural Equation Modeling-Partial Least Square (SEM-PLS) approach, we obtained a path coefficient of 0.870 with a t-statistic of 7.637 and a p-value of 0.000. These results indicate that extension worker performance has a positive and significant effect on the adoption of technology for integrating beef cattle and corn in Kabangka District, Muna Regency. What we found is that the hypothesis proposed in this study can be accepted. This finding suggests that improving the performance of extension workers will be followed by an increase in the level of technology adoption by farmers. Conversely, low performance of extension workers has the potential to hinder the process of acceptance and implementation of technological innovations at the farmer level.

A good extension worker's performance is reflected in their ability to transform information and knowledge to farmers so that they can improve their capacity to understand, evaluate, and apply an innovation. From the perspective of modern agricultural extension theory put forward by Romadi & Warnaen (2021), the success of extension work is not only determined by the intensity of information delivery but also by the extension worker's ability to build participatory communication, develop farmers' capacities, and create a learning environment that supports behavioral change.

The Influence of Extension Officers' Competence on the Adoption of Technology for Integrating Beef Cattle and Corn in Kabangka District, Muna

Table 8. Test Results of the Influence of Extension Workers' Competence on Technology Adoption

Variable Relationships	Original Sample (O)	T Statistics	P Value	Remarks
Extension Competencies (X2) → Technology Adoption (AT)	-0,067	0,555	0,579	Insignificant

Based on the results of hypothesis testing using SEM-PLS, we got a path coefficient of -0.067, a t-statistic of 0.555, and a p-value of 0.579. A p-value higher than 0.05 shows that the competence of extension agents doesn't have a significant effect on the adoption of beef cattle and corn integration technology in Kabangka District, Muna Regency. So, the hypothesis that claims the competence of extension agents affects technology adoption can't be accepted.

The competency of extension workers reflects their ability to master the technical, methodological, and social aspects needed in the extension process. Competent extension workers are expected to enhance farmers' knowledge and understanding of an innovation. However, this study shows that the competencies of extension workers haven't directly encouraged farmers to adopt the technology for integrating beef cattle and corn. This suggests that the decision to adopt technology is not just determined by the quality of information sources, but

also influenced by various practical considerations faced by farmers.

The Role of Farmers' Behavior Mediation in the Relationship between Extension Workers' Performance and the Adoption of Integrated Beef Cattle and Corn Farming Technology in Kabangka District, Muna Regency

Table 9. Results of the Indirect Effect of Extension Workers' Performance on Technology Adoption through Farmers' Behavior

Influence Path	Path Coefficients
Performance of Behavioral ⟶ Extension Workers	0,059
Technology Adoption ⟶ Behavior	0,201
Indirect Influence	0,012

Research results show that farmer behavior plays a role as a mediating variable in the relationship between extension workers' performance and the adoption of integrated beef cattle and corn farming technology in Kabangka District, Muna Regency. These findings indicate that the influence of extension workers' performance on technology adoption doesn't just happen through providing information and technical assistance, but also through changes in farmer behavior that develop during the extension process. So, the better the performance of the extension workers, the more positive the farmers' behavior toward innovation, which ultimately boosts technology adoption.

Based on these results, it can be understood that the success of extension work is not only determined by the extension worker's ability to convey information, but also by their ability to shape farmers' behavior to be more adaptive to innovation. Therefore, extension activities need to focus on approaches that can encourage behavioral change through training, field demonstrations, intensive mentoring, and participatory learning, so that the adoption of integrated beef cattle and corn technology can increase sustainably.

The Role of Farmers' Behavioral Mediation in the Relationship between Extension Workers' Competence and the Adoption of Beef Cattle and Corn Integration Technology in Kabangka District, Muna Regency

Table 10. Results of the Indirect Effect of Extension Agent Competence on Technology Adoption through Farmer Behavior

Influence Path	Path Coefficients
Competencies of Extension ⟶ Behavior	0,905
Technology Adoption ⟶ Behavior	0,201
Indirect Influence	0,182

The study results show that farmer behavior acts as a mediating variable in the relationship between extension workers' competence and the adoption of beef cattle and corn integration technology in Kabangka District, Muna Regency. This finding suggests that the competence of extension workers does not directly influence farmers' decisions to adopt the technology, but first shapes farmer behavior, which then encourages the implementation of the technology. In other words, the effect of extension workers' competence on

technology adoption happens through changes in farmer behavior as an intermediate mechanism.

This finding shows that farmers' behavior is a key factor that bridges the relationship between the extension workers' competence and technology adoption. Farmers who have good knowledge, attitudes, and skills tend to accept and implement innovations more easily compared to those who still have doubts about the benefits of technology. Therefore, the competence of extension workers will have a greater impact if it can create positive behavioral changes in farmers.

The Simultaneous Influence of Performance and Competence of Extension Workers on the Adoption of Integrated Beef Cattle and Corn Technology Mediated by Farmer Behavior in Kabangka District, Muna Regency

Table 11. Results of the Determination Coefficient (R^2)

Variable endogenous	R-Square	Category
Technology Adoption	0,996	Very Powerful
Farmer Behavior	0,930	Very Powerful

The research results show that the performance and competence of extension workers simultaneously contribute to increasing the adoption of integrated beef cattle and corn farming technology through farmers' behavior as a mediating variable. This finding indicates that the success of technology adoption is not solely determined by the quality of extension workers as change agents, but is more influenced by how well their performance and competence can encourage the formation of positive farmer behavior toward innovation. Thus, farmer behavior becomes a strategic mechanism that bridges the influence of extension workers' performance and competence on technology adoption decisions..

The results of this study show that farmers' behavior is a more immediate factor when it comes to adoption decisions compared to the performance or competence of extension workers. In other words, farmers don't just adopt technology because the extension workers are skilled; it's because those skills help change farmers' perspectives, understanding, and readiness to implement innovations. This aligns with the Theory of Planned Behavior, which explains that a person's actions are strongly influenced by their attitudes, beliefs, and perceived behavioral control over a certain action (Maullah & Rofiuddin, 2021). In the context of this study, farmers' behavior is the main determinant linking the quality of extension to the decision to adopt integrated technology.

CONCLUSION

The performance of extension workers has a positive and significant effect on the adoption of beef cattle and corn integration technology in Kabangka District, Muna Regency. This shows that the better the extension workers perform their extension functions, the higher the level of technology integration adoption by farmers.

The competence of extension workers does not have a significant effect on the adoption of beef cattle and corn integration technology in Kabangka District, Muna Regency. This result shows that the competence of the extension workers is not yet able to directly encourage farmers to adopt the beef cattle and corn integration technology.

Farmer behavior acts as a mediating variable in the relationship between extension workers' performance and the adoption of integrated beef cattle and corn farming technology in Kabangka District, Muna Regency. Good performance by extension workers can shape more positive farmer behavior towards innovation, thus encouraging increased technology adoption.

Farmer behavior acts as a mediating variable in the relationship between extension agents' competence and the adoption of beef cattle and corn integration technology in Kabangka District, Muna

Regency. The competence of extension agents influences technology adoption through changes in farmer behavior, including aspects of knowledge, attitude, and skills in accepting innovations.

The performance and competence of extension workers simultaneously contribute to increasing the adoption of integrated beef cattle and corn technology through farmers' behavior as a mediating variable. The study found that farmers' behavior is an important factor that bridges the influence of the quality of extension services on the success of adopting integrated beef cattle and corn technology in Muna Regency.

Recomendation

For Agricultural Extension Workers

Agricultural extension workers need to keep improving the quality of their extension activities through more intensive guidance, field demonstrations, and the use of participatory extension methods.

For Farmers

Farmers are expected to be more active in participating in extension activities, training, and mentoring organized by agricultural extension agents. Increasing openness to innovation and the willingness to try new technologies needs to keep being developed so that the benefits of integrating beef cattle and corn technology can be felt optimally in improving farm productivity and income.

For Local Governments and Related Agencies

Local governments and related agencies need to strengthen agricultural extension programs by improving the capacity of extension workers, providing supporting facilities and infrastructure, and developing technology demonstration programs for integrating beef cattle and corn.

For Agricultural Extension Agencies

Extension agencies need to develop continuous competency development programs for extension workers, not just on technical aspects but also on communication skills, community empowerment, and farmer group facilitation.

For Future Researchers

Future research is suggested to expand the research area to other districts or provinces so that the research results have a broader level of generalization.

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