

Agricultural Extension Performance in Remote and Indigenous Communities: Lessons from Teluk Bintuni, West Papua

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ABSTRACT

Agricultural extension services play a crucial role in supporting agricultural development, particularly in remote and indigenous communities where access to information, technology, and institutional support remains limited. This study aimed to examine the influence of internal and external factors on the performance of Agricultural Extension Workers (AEWs) in Teluk Bintuni Regency, West Papua, Indonesia. A quantitative survey was conducted involving 78 extension workers, consisting of civil servant and contract-based personnel. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate the relationships between external factors, internal factors, and three dimensions of extension performance: preparation, implementation, and evaluation-reporting activities. The results revealed that external factors significantly and positively influenced preparation ($\beta = 0.340$; $p < 0.001$), implementation ($\beta = 0.826$; $p < 0.001$), and evaluation-reporting performance ($\beta = 0.628$; $p < 0.001$). Internal factors significantly affected preparation ($\beta = 0.628$; $p < 0.001$) and evaluation-reporting performance ($\beta = 0.303$; $p = 0.001$), but showed no significant effect on implementation performance. The model demonstrated strong explanatory power, with R^2 values ranging from 0.805 to 0.905. These findings highlight the critical role of institutional support, infrastructure, and organizational conditions in improving extension effectiveness in remote indigenous regions. Strengthening extension systems and human resource capacity is essential for enhancing agricultural development outcomes in frontier areas

INTRODUCTION

Agricultural extension services play a pivotal role in facilitating agricultural transformation, improving farm productivity, and enhancing rural livelihoods worldwide (Sukhna et al. 2022; Singh et al. 2010; Kabir and Islam 2023). As an essential component of agricultural innovation systems, extension services function as a bridge between scientific knowledge, technological advancements, and farming communities. Effective extension systems contribute significantly to the adoption of improved agricultural practices, capacity building, and sustainable resource management, particularly in developing countries where agriculture remains the primary source of income and food security (Tanziha et al. 2023; Ferdous et al. 2016; Yiridoe and Anchirinah 2005). The performance of agricultural extension workers is therefore a critical determinant of the effectiveness of agricultural development programs and rural transformation initiatives.

In Indonesia, agricultural extension has long been recognized as a strategic instrument for achieving national food security and rural development goals (Rahim et al. 2021; Arifin, Kusumaningrum, and Widiyantono 2021; Windari and Gunawan 2019). However, the effectiveness of extension services varies considerably across regions due to differences in geographical conditions, institutional capacities, resource availability, and socio-cultural contexts. These challenges are particularly evident in eastern Indonesia, where remote and indigenous communities often face limited access to infrastructure, public services, agricultural markets, and technological innovations. In such settings, agricultural extension workers are expected not only to transfer knowledge but also to act as facilitators, motivators, mediators, and agents of social change within diverse cultural environments (Mangkuprawira 2016; IFAD 2019; Munthe 2007).

The challenges become even more pronounced in indigenous regions such as West Papua, where agricultural development is influenced by complex interactions among traditional knowledge systems, customary land tenure arrangements, environmental constraints, and socio-economic disparities (Supriadi 2008; Ngabalin, Adi, and Tampake 2024). Indigenous communities often rely on subsistence agriculture and natural-resource-based livelihoods, making agricultural extension services an important mechanism for improving productivity and resilience while respecting local cultural values. Consequently, understanding the factors that influence extension worker performance in indigenous contexts is essential for designing effective agricultural development policies and interventions.

West Papua is characterized by vast geographical areas, scattered settlements, limited transportation infrastructure, and significant ecological diversity (BalitbangdaPB and Econusa 2019; Feneteruma 2023; Pentury 2023). Among its administrative regions, Teluk Bintuni Regency represents one of the largest and most geographically challenging districts. Covering approximately 18,600 km², the regency consists of coastal areas, mangrove ecosystems, tropical forests, river systems, and remote inland communities. Agricultural activities are primarily dominated by smallholder farming systems involving food crops,

horticulture, livestock production, and fisheries. Despite considerable agricultural potential, farmers frequently encounter constraints related to technology adoption, market access, extension support, and institutional services.

The agricultural extension system in Teluk Bintuni operates through a combination of civil servant extension workers and contract-based extension personnel. These extension workers are responsible for serving farmers across widely dispersed villages and indigenous communities under difficult logistical conditions. Recent assessments indicate that extension performance is influenced by multiple internal and external factors, including technical competence, motivation, experience, institutional support, infrastructure availability, transportation facilities, operational funding, and organizational coordination. Empirical evidence from the present study indicates that external factors explain a substantial proportion of extension performance, particularly in the implementation phase of extension activities, while internal factors mainly influence preparation and evaluation functions.

Globally, studies have demonstrated that extension worker performance is closely associated with human capital attributes, organizational support systems, access to resources, and socio-environmental conditions (Mangkuprawira 2016; Jackson et al. 2012; Quisumbing 1996). Nevertheless, evidence from indigenous and geographically isolated regions remains relatively limited. Most extension performance studies have been conducted in densely populated agricultural regions with relatively developed infrastructure and institutional arrangements, leaving significant knowledge gaps regarding extension effectiveness in remote indigenous communities.

Previous studies on agricultural extension performance have predominantly focused on factors such as competency development, training effectiveness, organizational commitment, motivation, and technology adoption among extension personnel (Adejuwon, Ilori, and Taiwo 2016; Ngaiwi et al. 2023; Adnan et al. 2019). While these studies have provided valuable insights into extension effectiveness, they often overlook the unique challenges faced by extension workers operating in remote indigenous territories. Furthermore, many existing studies emphasize either internal characteristics of extension workers or institutional factors separately, without examining their simultaneous influence on different dimensions of extension performance.

Another important limitation concerns geographical representation. Empirical studies from Papua and other indigenous regions of Indonesia remain scarce compared with research conducted in Java, Sumatra, and other more developed agricultural regions. Consequently, the applicability of existing extension performance models to remote indigenous contexts remains uncertain. There is still limited understanding of how institutional support, environmental conditions, and individual capacities interact to influence extension outcomes in culturally diverse and geographically constrained settings.

Moreover, few studies have adopted a multidimensional approach to extension performance encompassing preparation, implementation, and evaluation-reporting activities simultaneously (Deutsch et al. 2020; Somech and

Drach-Zahavy 2000; Dong 2023). Given that extension performance is a complex construct involving multiple functional responsibilities, a comprehensive assessment is required to capture the diverse factors influencing extension effectiveness. Therefore, research focusing on agricultural extension performance in indigenous and remote communities can contribute significantly to both theoretical advancement and evidence-based policymaking.

This study aims to evaluate the performance of agricultural extension workers operating in remote and indigenous communities of Teluk Bintuni Regency, West Papua, Indonesia. Specifically, the study seeks to analyze the influence of external factors on the preparation, implementation, and evaluation-reporting performance of agricultural extension workers. Examine the influence of internal factors on the preparation, implementation, and evaluation-reporting performance of agricultural extension workers. Identify the dominant factors affecting extension performance in geographically isolated and indigenous agricultural communities. Develop an empirical model of agricultural extension performance that can support policy formulation and institutional strengthening of agricultural extension services in remote regions. The findings are expected to contribute to the growing literature on agricultural extension systems in indigenous territories and provide practical recommendations for improving extension effectiveness, strengthening rural institutions (Jelsma et al. 2017; Martin et al. 2015; Castellanos-Navarrete, de Castro, and Pacheco 2021), and promoting sustainable agricultural development in Papua and other frontier regions of Indonesia.

LITERATURE REVIEW

Agricultural Extension and Rural Development

Agricultural extension is widely recognized as a critical component of agricultural innovation systems and rural development (Hayer 2016; Windari and Gunawan 2019; Arifianto, Satmoko, and Setiyawan 2017; Lindung 2020). Extension services facilitate the transfer of knowledge, technologies, and management practices from research institutions to farming communities, thereby improving productivity, sustainability, and rural livelihoods. According to extension theory, agricultural extension functions not only as a mechanism for technology dissemination but also as a process of education, empowerment, and capacity building among rural households. Effective extension systems contribute to increased agricultural productivity, enhanced food security, and improved socio-economic welfare of farming communities.

In developing countries, agricultural extension workers play multiple roles as educators, facilitators, communicators, coordinators, and agents of change. Their effectiveness significantly influences farmers' adoption of innovations and participation in agricultural development programs. Consequently, evaluating extension worker performance has become an important area of research within agricultural development studies.

Agricultural Extension Performance

Performance refers to the degree to which individuals successfully accomplish assigned tasks and organizational objectives. Within agricultural extension systems, performance is generally assessed through the quality and

effectiveness of planning, implementation, monitoring, evaluation, and reporting activities conducted by extension personnel.

Performance theories (Janssen 2001) suggest that employee performance results from the interaction between individual capabilities, motivation, organizational support, and environmental conditions. In extension services, performance is often reflected in the ability of extension workers to prepare extension programs, conduct field activities, facilitate farmer participation, and evaluate program outcomes. Therefore, extension performance is a multidimensional construct encompassing technical, managerial, and social competencies.

Several studies have reported that high-performing extension workers contribute significantly to agricultural modernization, technology adoption, and institutional strengthening among farmer groups. Conversely, poor extension performance may limit farmers' access to information, reduce technology adoption rates, and weaken rural development initiatives.

Human Capital Theory and Internal Factors

Human Capital Theory (Becker 1993; Surya 2013) provides an important framework for understanding employee performance. The theory argues that individuals' knowledge, skills, experience, competencies, and motivation constitute valuable assets that enhance productivity and organizational effectiveness. Investments in education, training, and professional development increase human capital and subsequently improve work performance.

In the context of agricultural extension, internal factors include technical competence, educational attainment, communication skills, work experience, motivation, commitment, and self-efficacy. These factors influence extension workers' ability to identify farmers' needs, disseminate agricultural innovations, solve technical problems, and support community development.

Previous empirical studies consistently demonstrate positive relationships between competence, motivation, and extension effectiveness. Extension personnel possessing strong technical knowledge and high motivation tend to perform better in planning extension programs, delivering advisory services, and evaluating extension outcomes.

Institutional Theory and External Factors

Institutional Theory emphasizes the role of organizational structures, policies, resources, and governance systems in shaping individual behavior and performance (Martin et al. 2015). Institutions create formal and informal rules that influence how employees perform their duties and interact with stakeholders.

Within agricultural extension systems, external factors include organizational support, infrastructure availability, transportation facilities, communication technologies, operational funding, government policies, supervision mechanisms, and stakeholder collaboration. These institutional conditions determine the extent to which extension workers can effectively carry out their responsibilities.

Research indicates that adequate institutional support significantly improves extension effectiveness. Access to transportation, extension materials,

digital technologies, operational budgets, and organizational coordination enables extension personnel to reach remote communities and provide timely advisory services. Conversely, inadequate institutional support often constrains extension activities, particularly in geographically isolated regions.

Agricultural Extension in Indigenous and Remote Communities

Agricultural extension in indigenous communities differs substantially from conventional extension approaches applied in more developed agricultural regions. Indigenous societies often possess unique cultural values, traditional ecological knowledge, customary institutions, and resource management practices that influence agricultural decision-making (Kabir and Islam 2023; Singh et al. 2010; Sukhna et al. 2022).

In remote indigenous regions, extension workers face additional challenges, including limited transportation networks, poor communication infrastructure, dispersed settlements, linguistic diversity, and restricted access to markets and public services. Consequently, extension personnel must possess not only technical competence but also cultural sensitivity, social adaptability, and participatory facilitation skills.

Studies from indigenous communities worldwide suggest that successful extension interventions depend on the integration of scientific knowledge with local knowledge systems. Participatory approaches, community engagement, and culturally responsive extension strategies have been identified as key determinants of extension effectiveness in indigenous settings.

Conceptual Framework

This study adopts an integrated framework combining Human Capital Theory and Institutional Theory to explain agricultural extension performance. Human Capital Theory explains the influence of internal factors, whereas Institutional Theory explains the role of external factors in shaping extension outcomes.

Internal Factors consist of technical competence, knowledge and skills, work motivation, experience, and professional commitment. External Factors, i.e. Institutional support, Organizational coordination, Infrastructure availability, Transportation facilities, Operational resources, and Government policies. Extension Performance is defined as Preparation of extension activities, Implementation of extension programs, and Evaluation and reporting.

The framework assumes that both internal and external factors contribute to agricultural extension performance. However, in remote and indigenous regions such as Teluk Bintuni, external factors are expected to exert stronger influences due to geographical isolation, logistical constraints, and institutional challenges.

Hypothesis Development

Based on the theoretical framework and previous empirical findings, the following hypotheses are proposed: H1: External factors positively and significantly influence extension preparation performance. H2: External factors positively and significantly influence extension implementation performance. H3: External factors positively and significantly influence extension evaluation and reporting performance. H4: Internal factors positively and significantly influence extension preparation performance. H5: Internal factors positively and

significantly influence extension implementation performance. H6: Internal factors positively and significantly influence extension evaluation and reporting performance.

METHODOLOGY

Study Area

This study was conducted in Teluk Bintuni Regency, West Papua Province, Indonesia. The regency is one of the largest administrative regions in West Papua, characterized by extensive tropical forests, coastal ecosystems, indigenous settlements, and geographically isolated rural communities. Agricultural activities in the region are primarily dominated by smallholder farming systems, livestock production, fisheries, and subsistence agriculture. The geographical complexity and limited accessibility of many villages make agricultural extension services particularly important for supporting rural livelihoods and agricultural development.

Teluk Bintuni was selected as the study area because it represents a unique case of agricultural extension implementation in remote and indigenous communities where extension workers operate under challenging environmental, institutional, and socio-cultural conditions. The findings are therefore expected to provide valuable insights into extension performance in frontier agricultural regions.

Research Design

This study employed a quantitative survey approach to investigate the influence of internal and external factors on the performance of agricultural extension workers. A cross-sectional research design was adopted, whereby data were collected at a single point in time using structured questionnaires. The study aimed to examine causal relationships among latent variables through Partial Least Squares Structural Equation Modeling (PLS-SEM).

The research framework consisted of two exogenous constructs, namely Internal Factors and External Factors, and three endogenous constructs representing Agricultural Extension Performance, namely Preparation, Implementation, and Evaluation-Reporting.

Population and Sampling

The target population consisted of all agricultural extension workers operating in Teluk Bintuni Regency (Table 1). The population included both civil servant extension workers (PNS) and contract extension workers (honorary extension personnel) assigned to various Agricultural Extension Working Areas (WKPP).

The study involved a census approach, whereby all available extension personnel were included as respondents. A total of 78 agricultural extension workers participated in the survey.

Table 1. Agricultural Extension Workers Participators

Category	Number of Respondents
Civil Servant Extension Workers (PNS)	45
Contract Extension Workers (Honorary)	33

Total	78
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The census approach was employed to maximize representativeness and capture the diversity of extension experiences across different districts and indigenous communities

Data Collection

Primary data were collected through structured questionnaires administered directly to agricultural extension workers. The questionnaire was developed based on relevant literature concerning agricultural extension performance, organizational behaviour, human capital theory, and institutional support systems.

Respondents were asked to evaluate various statements using a five-point Likert scale (Table 2).

Table 2. Statements Using a Five-Point Likert Scale

Scale	Description
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

Secondary data were obtained from government reports, statistical publications, agricultural extension agencies, previous studies, and institutional documents relevant to agricultural development and extension services in West Papua.

Measurement of Variables

The study consisted of five latent constructs measured by reflective indicators; i.e. external factors represent institutional and environmental conditions supporting extension activities. Indicators include availability of facilities and infrastructure, Institutional support, Organizational coordination, Accessibility and transportation, Extension operational resources, and External working conditions. Internal factors represent individual characteristics of extension workers, including technical competence, Knowledge and skills, Work motivation, Professional commitment, Personal capability. Agricultural Extension Performance. Performance was operationalized through three dimensions, i.e. Preparation Performance (Y1), Program planning, Preparation of extension materials, and activity preparation.

Implementation Performance (Y2), consisted of Extension delivery, Farmer assistance, Technology dissemination, Field implementation activities. Evaluation and Reporting Performance (Y3), i.e. Monitoring activities, Evaluation processes, and Reporting and documentation

Data Analysis

The study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS software. PLS-SEM was selected because it is suitable

for exploratory studies, complex causal relationships, relatively small sample sizes, and non-normal data distributions.

The analysis was conducted in two stages. Measurement Model Assessment (Outer Model). The outer model was evaluated using: Indicator Reliability (Outer Loadings ≥ 0.70). Internal Consistency Reliability, i.e. Cronbach's Alpha ≥ 0.70 , and Composite Reliability ≥ 0.70 . Convergent Validity is analysed using Average Variance Extracted (AVE) ≥ 0.50 . While, Discriminant Validity is used Fornell-Larcker Criterion and Cross Loadings. Indicators with low factor loadings were removed through model respecification to improve construct validity and reliability.

The structural model was evaluated using Path Coefficients (β), Bootstrapping Procedures, T-statistics (>1.96), P-values (<0.05), and Coefficient of Determination (R^2). The significance of relationships among constructs was determined using a bootstrapping procedure with 5,000 resamples (Santoso and Indrajaya 2023; Ali, Ramayah, and Cheah 2021).

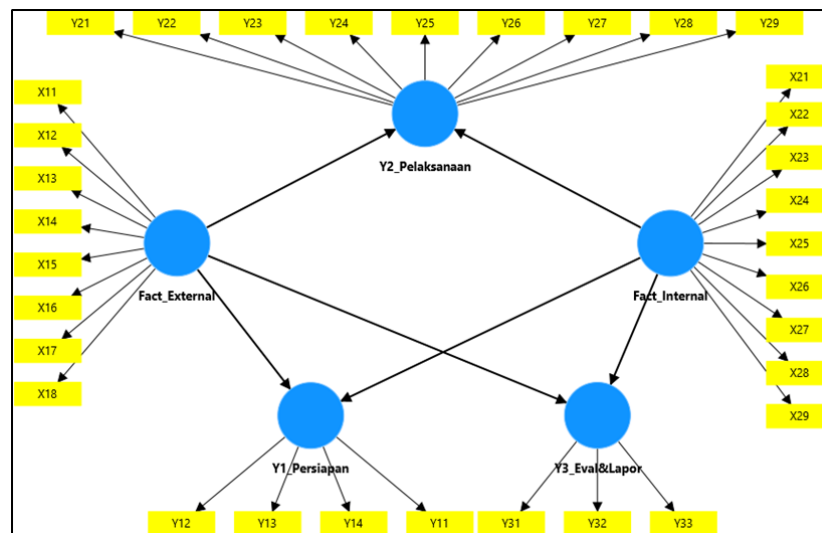


Figure 1. Model developed to analyse Agricultural Extension Performance using PLS-Sem

Research Hypotheses

The following hypotheses were tested: H1: External factors positively and significantly influence preparation performance. H2: External factors positively and significantly influence implementation performance. H3: External factors positively and significantly influence evaluation and reporting performance. H4: Internal factors positively and significantly influence preparation performance. H5: Internal factors positively and significantly influence implementation performance. H6: Internal factors positively and significantly influence evaluation and reporting performance.

Conceptual Model

The structural model of the study can be expressed as follows: $Y_1 = \beta_1(\text{Fact_External}) + \beta_2(\text{Fact_Internal}) + \varepsilon_1$, $Y_2 = \beta_3(\text{Fact_External}) + \beta_4(\text{Fact_Internal}) + \varepsilon_2$, $Y_3 = \beta_5(\text{Fact_External}) + \beta_6(\text{Fact_Internal}) + \varepsilon_3$, where: Y_1

= Preparation Performance, Y_2 = Implementation Performance, Y_3 = Evaluation and Reporting Performance, β = Structural Path Coefficients, and ε = Error Term.

This model evaluates the direct effects of internal and external factors on the multidimensional performance of agricultural extension workers operating in remote indigenous communities (Snedecor and Cochran 1989; Edition 2008; Ali, Ramayah, and Cheah 2021).

RESULTS AND DISCUSSION

Characteristic of Agricultural Extension Workers

Agricultural extension workers in Teluk Bintuni Regency are distributed across multiple districts and Agricultural Extension Working Areas (WKPP), including Sumuri, East Bintuni, West Bintuni, Manimeri, Tembuni, Merdey, Tomu, Kamundan, Babo, Aroba, Tuhiba, North Moskona, and Wamesa. Several extension personnel also serve as heads of Agricultural Extension Centers (BPP), including those in Sumuri, Manimeri, and Babo. This distribution indicates that extension services have reached most of the major agricultural production centers throughout the regency.

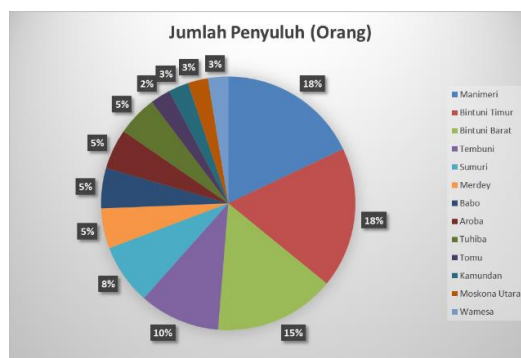


Figure 2. Distribution of Agricultural Officer (PNS) in Teluk Bintuni

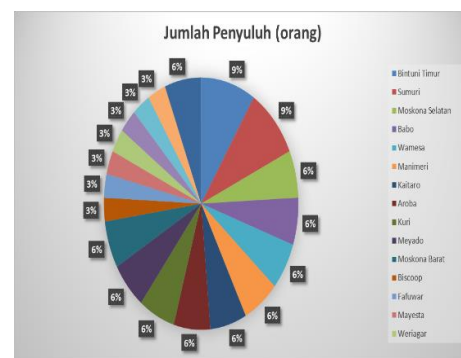


Figure 3. Distribution of Agricultural Officer (Honorer) in Teluk Bintuni

The distribution pattern reveals that the largest concentration of extension workers is found in Manimeri and East Bintuni Districts, each accounting for seven extension workers (17.95%), followed by West Bintuni with six extension workers (15.38%) and Tembuni with four extension workers (10.26%). Other districts such as Sumuri, Merdey, Babo, Aroba, and Tuhiba are served by fewer personnel, while remote districts including Tomu, Kamundan, North Moskona, and Wamesa have only one extension worker each. A similar pattern is observed among honorary extension workers, who are distributed across newly established and geographically isolated districts. These findings suggest that extension personnel are concentrated in areas with relatively intensive agricultural activities and larger numbers of farmer groups, whereas more remote regions continue to face limitations in extension service coverage.

Regarding demographic characteristics, most extension workers were born between 1968–1979 and 1980–1989, indicating that the majority belong to the late productive-age group and are approaching retirement. Many extension personnel have substantial professional experience, with most having been appointed between 2005 and 2015. The extension system in Teluk Bintuni

comprises 45 civil-service extension personnel, including 41 Agricultural Extension Field Officers (91.11%) and 4 Agricultural Extension Specialists (8.89%). Most are classified within grade II/b and have more than ten years of professional experience. While this accumulated experience represents an important asset for agricultural development, the aging workforce highlights the urgent need for extension worker regeneration, capacity enhancement, and strategic human resource planning to ensure the long-term sustainability of agricultural extension services in remote and indigenous communities (Arifianto, Satmoko, and Setiyawan 2017; Suranti and Sari 2018; Sarvina and Surmaini 2020; Lainawa and Lenzun 2022; Sapar and Butami 2017; Sarvina and Surmaini 2020).

Measurement Model Assessment: Outer Loadings

The measurement model was evaluated by examining the outer loadings of each indicator on its respective latent construct (Table 3). Outer loadings indicate the extent to which individual indicators represent the underlying latent variables. According to Hair et al. (2022), indicator loadings above 0.70 are considered strong, while loadings between 0.40 and 0.70 may be retained depending on their contribution to construct reliability and validity.

The results indicate that the External Factors (Fact_External) construct was represented by six indicators, with loading values ranging from 0.153 to 0.906. Indicator X11 exhibited the highest loading (0.906), indicating a very strong contribution to the construct. Indicators X18 (0.664), X14 (0.645), and X13 (0.566) showed moderate associations with the latent variable. However, indicators X15 (0.280) and X17 (0.153) demonstrated relatively weak loadings, suggesting limited explanatory power in representing external factors. Despite their lower contributions, these indicators were retained during model refinement because the overall construct reliability remained acceptable.

Table 3. Outer Loading Values of Measurement Model Indicators

Construct	Indicator	Outer Loading
External Factors	X11	0.906
External Factors	X13	0.566
External Factors	X14	0.645
External Factors	X15	0.280
External Factors	X17	0.153
External Factors	X18	0.664
Internal Factors	X22	0.853
Internal Factors	X23	0.845
Internal Factors	X28	0.318
Internal Factors	X29	0.444
Preparation Performance	Y12	0.951
Preparation Performance	Y13	0.941
Implementation Performance	Y21	0.814
Implementation Performance	Y22	0.502
Implementation Performance	Y24	0.682

Implementation Performance	Y25	0.694
Implementation Performance	Y26	0.907
Implementation Performance	Y29	0.574
Evaluation and Reporting Performance	Y31	0.844
Evaluation and Reporting Performance	Y32	0.888

Source: PLS-SEM Analysis Results (2026)

The Internal Factors (Fact_Internal) construct was primarily explained by indicators X22 (0.853) and X23 (0.845), both of which exhibited strong loadings and substantial contributions to the latent construct. In contrast, indicators X28 (0.318) and X29 (0.444) displayed relatively low loading values, indicating weaker relationships with the internal factors construct. The results suggest that the internal dimension was largely driven by the components represented by X22 and X23, while the contribution of X28 and X29 was comparatively limited. For the agricultural extension performance dimensions, the Preparation Performance (Y1) construct demonstrated exceptionally high indicator reliability. Indicators Y12 (0.951) and Y13 (0.941) exceeded the recommended threshold and strongly reflected the preparation dimension. Similarly, the Implementation Performance (Y2) construct was represented by several indicators with satisfactory loadings, including Y26 (0.907), Y21 (0.814), Y25 (0.694), and Y24 (0.682). Indicators Y29 (0.574) and Y22 (0.502) showed moderate contributions but remained within acceptable ranges for exploratory studies. Meanwhile, the Evaluation and Reporting Performance (Y3) construct exhibited strong indicator reliability, with Y32 (0.888) and Y31 (0.844) demonstrating substantial loadings on the latent variable. Overall, the measurement model revealed that most retained indicators adequately represented their respective constructs. The strongest indicators were X11 for External Factors, X22 and X23 for Internal Factors, Y12 and Y13 for Preparation Performance, Y26 and Y21 for Implementation Performance, and Y31 and Y32 for Evaluation and Reporting Performance. These findings indicate that the refined measurement model achieved acceptable indicator reliability and provided a satisfactory basis for subsequent reliability, validity, and structural model assessments.

Reliability and Validity Assessment

The reliability and validity assessment indicates that the measurement model demonstrates generally acceptable psychometric properties. The constructs External Factors and Internal Factors achieved Composite Reliability (ρ_c) values of 0.726 and 0.728, respectively, indicating satisfactory internal consistency. However, their Average Variance Extracted (AVE) values of 0.350 and 0.435 remain below the recommended threshold of 0.50, suggesting that convergent validity is still moderate and could be improved through further refinement of measurement indicators.

Table 4. Reliability and Validity Assessment

Construct	Cronbach's Alpha	Composite	Composite	Average Variance	Interpretation
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		Reliability (ρ_a)	Reliability (ρ_c)	Extracted (AVE)	
External Factors (Fact_External)	0.546	0.727	0.726	0.350	Reliable; convergent validity remains moderate
Internal Factors (Fact_Internal)	0.518	0.693	0.728	0.435	Reliable; acceptable convergent validity
Preparation Performance (Y1)	0.883	0.887	0.944	0.895	Highly reliable and highly valid
Implementation Performance (Y2)	0.790	0.821	0.853	0.502	Reliable and valid
Evaluation and Reporting Performance (Y3)	0.670	0.680	0.858	0.751	Reliable and highly valid

In contrast, the agricultural extension performance constructs exhibited strong reliability and validity. Preparation Performance (Y1) achieved a Cronbach's Alpha of 0.883, Composite Reliability of 0.944, and AVE of 0.895, indicating excellent reliability and convergent validity. Similarly, Implementation Performance (Y2) demonstrated acceptable reliability ($\rho_c = 0.853$) and adequate convergent validity (AVE = 0.502), while Evaluation and Reporting Performance (Y3) showed strong measurement quality with a Composite Reliability of 0.858 and an AVE of 0.751.

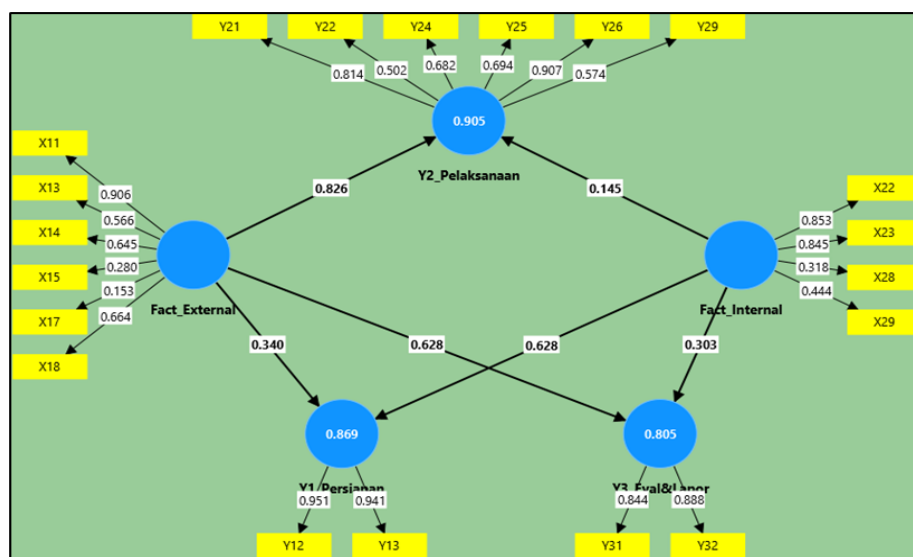


Figure 4. Final model of analyses using PLS-Sem

In general, the results suggest that the performance-related constructs are highly reliable and valid measures of agricultural extension performance, whereas the External and Internal Factors constructs remain reliable but exhibit only moderate convergent validity (Figure 4). Nevertheless, the overall measurement model satisfies the minimum reliability requirements and is considered suitable for subsequent structural model analysis.

Structural Model and Hypothesis Testing

The structural model assessment (Table 5) revealed that external factors exerted a positive and statistically significant influence on all dimensions of agricultural extension performance. External factors significantly affected Preparation Performance ($\beta = 0.340, p < 0.001$), Implementation Performance ($\beta = 0.826, p < 0.001$), and Evaluation and Reporting Performance ($\beta = 0.628, p < 0.001$). Among these relationships, the strongest effect was observed between external factors and implementation performance, indicating that institutional support, infrastructure, operational resources, and organizational conditions play a critical role in determining the effectiveness of extension activities in remote and indigenous communities.

The results further showed that internal factors significantly influenced preparation and evaluation-reporting performance. Internal factors had a strong positive effect on Preparation Performance ($\beta = 0.628, p < 0.001$) and a moderate positive effect on Evaluation and Reporting Performance ($\beta = 0.303, p = 0.001$). These findings suggest that individual attributes such as competence, motivation, professional commitment, and technical capacity contribute substantially to extension workers’ ability to plan extension activities and conduct monitoring, evaluation, and reporting tasks (Sunandar 2019; Arifin, Kusumaningrum, and Widiyantono 2021; Simanjuntak 2015; Bahua 2010; Lindung 2020).

Table 5. Structural Model and Hypothesis Analysis

Relationship Between Variables	Path Coefficient (β)	t-Statistic	p-Value	Decision
External Factors → Preparation Performance (Y1)	0.340	4.275	0.000	Supported
External Factors → Implementation Performance (Y2)	0.826	7.581	0.000	Supported
External Factors → Evaluation and Reporting Performance (Y3)	0.628	6.922	0.000	Supported
Internal Factors → Preparation Performance (Y1)	0.628	8.245	0.000	Supported

Internal Factors → Implementation Performance (Y2)	0.145	1.191	0.234	Not Supported
Internal Factors → Evaluation and Reporting Performance (Y3)	0.303	3.311	0.001	Supported

However, the relationship between internal factors and implementation performance was not statistically significant ($\beta = 0.145$, $t = 1.191$, $p = 0.234$). This result indicates that although extension workers may possess adequate skills and motivation, the successful implementation of extension activities in geographically isolated areas depends more heavily on external support systems than on individual characteristics alone. Consequently, the study highlights the dominant role of institutional and environmental conditions in shaping extension performance within remote agricultural settings.

Overall, five out of six proposed hypotheses were supported. The findings demonstrate that external factors are the most influential determinants of agricultural extension performance in Teluk Bintuni, while internal factors contribute primarily to preparation and evaluation functions. These results underscore the importance of strengthening institutional support, operational facilities, transportation access, and organizational capacity (McDermott 2009; IFAD 2019) to improve the effectiveness of agricultural extension services in indigenous and remote communities.

Coefficient of Determination (R²) Analysis

The coefficient of determination (R²) was used to evaluate the explanatory power of the structural model. According to Hair et al. (2022), R² values of 0.75, 0.50, and 0.25 can be interpreted as substantial, moderate, and weak, respectively (Table 6). The results indicate that all endogenous constructs achieved R² values above 0.80, demonstrating a very high level of explanatory power.

The Preparation Performance (Y1) construct achieved an R² value of 0.869 and an adjusted R² of 0.866, indicating that approximately 86.9% of the variance in preparation performance is explained by the combined effects of external and internal factors. Similarly, Implementation Performance (Y2) recorded the highest explanatory power with an R² of 0.905 and an adjusted R² of 0.902, meaning that 90.5% of the variation in implementation performance can be explained by the predictor variables included in the model. This finding suggests that the model is particularly effective in explaining the implementation dimension of agricultural extension performance.

Table 6. Coefficient of Determination (R²) of the Structural Model

Endogenous Variable	R-Square	Adjusted R-Square	Interpretation
Preparation Performance (Y1)	0.869	0.866	Very Strong
Implementation Performance (Y2)	0.905	0.902	Very Strong

Evaluation and Reporting Performance (Y3)	0.805	0.800	Very Strong
Average	0.860	0.856	Very Strong Model

Source: PLS-SEM Analysis Results (2026)

The Evaluation and Reporting Performance (Y3) construct obtained an R² value of 0.805 and an adjusted R² of 0.800, indicating that 80.5% of its variance is accounted for by external and internal factors. Although slightly lower than the other dimensions, this value still falls within the substantial category. Overall, the model achieved an average R² of 0.860, confirming that the proposed framework possesses excellent explanatory capability and strong predictive power. These findings demonstrate that the combination of institutional conditions and individual characteristics provides a robust explanation of agricultural extension performance in remote and indigenous communities of Teluk Bintuni, West Papua.

CONCLUSIONS AND RECOMMENDATIONS

This study aimed to examine the effects of external and internal factors on the performance of Agricultural Extension Workers (AEWs) in Teluk Bintuni Regency, West Papua, Indonesia. Extension performance was assessed through three key dimensions: preparation, implementation, and evaluation-reporting activities. Using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach, the findings revealed that the proposed model demonstrated excellent explanatory power, as indicated by the high R-square values across all endogenous constructs. External and internal factors jointly explained 86.9% of the variance in preparation performance, 90.5% of the variance in implementation performance, and 80.5% of the variance in evaluation and reporting performance. These results indicate that the model possesses strong predictive capability in explaining agricultural extension performance in Teluk Bintuni Regency.

The hypothesis testing results revealed that external factors exerted positive and statistically significant effects on all dimensions of extension performance, namely preparation, implementation, and evaluation-reporting activities. The strongest effect was observed in the relationship between external factors and implementation performance ($\beta = 0.826, p < 0.001$), suggesting that successful implementation of extension activities is highly dependent on institutional support, government policies, infrastructure availability, accessibility, organizational arrangements, and other supporting resources. These findings highlight that the effectiveness of agricultural extension systems is determined not only by the capabilities of individual extension workers but also by the broader institutional environment in which they operate.

Furthermore, the study found that internal factors had positive and significant effects on preparation and evaluation-reporting performance but did not significantly influence implementation performance. This finding suggests that extension workers' competencies, motivation, professional experience, and

work commitment play important roles in enhancing work readiness and evaluation capabilities. However, internal factors alone are insufficient to ensure successful implementation of extension activities in the absence of adequate external support. Therefore, the hypothesis proposing that external factors influence extension performance was fully supported, whereas the hypothesis concerning the influence of internal factors was only partially supported because no significant relationship was found with the implementation dimension of extension performance.

FURTHER STUDY

This research still has limitations, so further research is needed on the topic of Agricultural Extension Performance in Remote and Indigenous Communities: Lessons from Teluk Bintuni, West Papua in order to perfect this research and increase insight for readers.

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