The Role of Improved Production Technologies on Performance of Poultry Farmers at Kitunda Ward, Dar Es Salaam - Tanzania

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Abstract

This study examined the influence of improved production technologies on the performance of poultry farmers in Kitunda Ward, Dar es Salaam, guided by the Resource-Based View (RBV). A quantitative research design was employed, targeting 127 registered poultry farmers, with data collected through structured questionnaires. Descriptive statistics and regression analysis were used to analyze the data. The findings indicate that the adoption of Improved Production Technologies, Nutrition Practices and Disease Control Technologies positively and significantly enhances farm performance. The study contributes to theory by extending RBV application to smallholder poultry farming, highlighting how technological resources can generate competitive advantage. Practically, the results suggest that policymakers and agricultural stakeholders should strengthen extension services, provide targeted training on modern poultry technologies, and improve access to affordable feeds and vaccines. Promoting innovation-driven practices among smallholder poultry farmers can substantially increase productivity, profitability, and resilience within the sector.

Keyword: *Improved Production Technologies, Performance & Poultry Farmers*

Introduction

Poultry farming is a cornerstone of rural livelihoods in Tanzania. For generations, many households have kept indigenous chickens in free-range systems, where birds contribute to household income, nutrition, and cultural practices (Mayala, 2021). However, these low-input systems tend to be limited by slow growth rates and low productivity (Fiorilla et al., 2023)). In recent decades, the Tanzanian poultry sector has witnessed a gradual transformation. The introduction of exotic breeds, growth in hatchery infrastructure, and expansion of feed milling and veterinary services have accelerated commercialization (Nkukwana, 2018). Nevertheless, smallholder farmers continue to face major constraints, including disease outbreaks particularly Newcastle disease limited access to quality feed, insufficient genetic improvement of local breeds, weak biosecurity, and inadequate extension support (Desta, 2021; Gaylal & Dorjee, 2024; Nkukwana, 2018).

Recognizing these challenges, development initiatives have launched interventions aimed at modernizing small-scale poultry production. For example, the Accelerated Innovation Delivery Initiative Livestock (AIDI-L) was launched in Tanzania in 2024 to scale improved technologies such as day-old chick distribution, incubation hubs, brooder entrepreneurship, and vaccination services for smallholder producers (Gaylal & Dorjee, 2024; Nkukwana, 2018). Meanwhile, modeling studies suggest that integrated interventions combining vaccination, improved housing, and supplementary feeding could significantly enhance productivity and profitability in small-scale poultry systems (Gaylal & Dorjee, 2024). Yet, despite these advancements, studies on the adoption and performance impacts of such technologies among local farmers is limited, particularly in communities like Kitunda (Gaylal & Dorjee, 2024).

The study focuses on three clearly separated dimensions of improved production technologies among poultry farmers in Kitunda Ward. First, based on Resources Based View the study considers three factors as resourceful in shaping the adoption of poultry production technologies, identifying key predictors such as improved production technologies, disease prevention technology and nutrition practices. Second, it determines the level of adoption of key poultry production technologies, specifically assessing farmers’ use of improved poultry housing, automated feeding and watering systems, and genetically improved breeds. Third, it evaluates the influence of these technologies on farm performance, based on measurable indicators including growth rate, mortality rate, egg yield, feed conversion ratio, and overall farm income as reported by Gaylal and Dorjee (2024).

Literature Review and Hypothesis Development

The Resource-Based View (RBV), originally advanced by Barney (1991), explains organizational performance based on the unique combination of resources and capabilities that are valuable, rare, inimitable, and non-substitutable. Within poultry production, RBV offers a useful lens for understanding why some farmers adopt improved technologies while others remain locked in low-productivity systems (Getiso & Mijena, 2024). Technologies such as improved housing, vaccination, automated feeding, or genetically enhanced breeds can be interpreted as strategic resources because they enhance efficiency, reduce mortality, and strengthen competitive positioning when effectively deployed (Getiso & Mijena, 2024).

RBV is relevant to smallholder poultry systems because farmers operate in environments characterized by scarce capital, limited extension, and unstable markets. Technologies that reduce production risk or improve output quality become core assets that enable farmers to upgrade from subsistence-level practices to more commercial models. As studies on poultry improvement initiatives illustrate, access to training, reliable input supply, and technical knowledge increases farmers' ability to convert technological resources into superior outcomes (Ragasa et al., 2022).

However, RBV has limitations that must be acknowledged. First, it assumes that actors can freely deploy resources, yet smallholder poultry farmers often face institutional constraints poor infrastructure, diseases, financing gaps, and weak extension systems that limit their ability to utilize technologies optimally (Pham-Thanh et al., 2020; Ragasa et al., 2022). Second, RBV tends to understate the influence of the external environment, whereas poultry production in low-income countries is deeply shaped by market conditions, input availability, and regulatory frameworks (Pham-Thanh et al., 2020). For this reason, scholars recommend complementing RBV with insights on institutional and behavioral factors that influence technology uptake and utilization (Getiso & Mijena, 2024). Despite these limitations, RBV remains a useful theoretical anchor for examining how improved poultry technologies function as strategic resources that drive performance gains when other supporting capabilities, skills, training, financial access are present.

Evidence from diverse contexts demonstrates that both structural and behavioral factors strongly influence farmers' adoption of poultry technologies (Pham-Thanh et al., 2020). Global research indicates that low-income farmers rarely adopt single innovations in isolation; instead, they require integrated packages combining genetics, housing, feed, and health interventions to transition from low-input to more productive systems (Getiso & Mijena, 2024). Studies from Asian smallholder systems further show that adoption trajectories are typically gradual and shaped by farmers' digital literacy, production experience, risk perceptions, and underlying values (Ragasa et al., 2022). Across West and Central Africa, limited access to credit, training, and market information continues to constrain uptake of improved technologies despite rising awareness of their potential benefits (Pham-Thanh et al., 2020; Ragasa et al., 2022).

In East Africa, similar dynamics appear in efforts to scale tropically adapted, dual-purpose poultry breeds. Findings from the African Chicken Genetic Gain (ACGG) project reveal that sustained adoption is more likely when farmers have access to training, functional markets, and consistent support services (Getiso & Mijena, 2024). Additional studies from Kenya, Uganda, and Tanzania show that while some producers are adopting brooding innovations, vaccination routines, and automated feeding technologies, many smallholders continue to rely on traditional systems due to liquidity constraints, inconsistent advisory services, and limited technical knowledge (Getiso & Mijena, 2024). These patterns reinforce the importance of both institutional support and farmer capabilities in determining technology uptake.

Evidence from Tanzania aligns with and deepens these regional insights. Financial limitations, weak extension systems, and poor disease-management practices remain major obstacles to adopting improved poultry technologies. In Arusha, for example, access to credit and advisory services significantly predicts farmers' likelihood of adopting better housing and feeding systems (Lukuyu et al., 2021). Similarly, disease-management challenges in Dodoma reduce producers' willingness to invest in improved breeds and production (Pham-Thanh et al., 2020). Recent policy measures such as the Africa Accelerated Innovation Delivery Initiative for Livestock (AIDI-L) launched in 2024 aim to alleviate these constraints by strengthening chick supply systems, brooding capacity, and market linkages (Ogada et al., 2021). Collectively, this evidence indicates that when farmers are able to adopt improved production technologies, their capacity to enhance output and productivity increases. We can thus hypothesize that; **H_1:** *There is a positive relationship between improved production technologies and the performance of poultry farms.*

Across developing regions, adoption of poultry technologies including those related to nutrition practices remains uneven (Ogada et al., 2021). Studies from Southeast Asia show that while improved dual-purpose breeds and complementary housing or feeding technologies provide clear productivity benefits, social and economic constraints often lead farmers to adopt only parts of the full technological package (Ogada et al., 2021). Farmers' experience with new production methods also shapes their willingness to integrate enhanced feeding or supplementation routines, yet many still cite cost pressures and recurrent disease outbreaks as key barriers to consistently applying recommended nutrition practices (Getiso & Mijena, 2024)

Similar patterns are observed across East Africa, where the adoption of improved nutrition-related technologies advances slowly (Sankhulani, 2021). Evidence indicates that while some producers embrace components such as formulated feed, feed supplementation, or improved housing systems that support better feeding efficiency, overall adoption intensity stays low without predictable financial returns or strong extension guidance (Matekele et al., 2024; Sankhulani, 2021). As a result, the effectiveness of nutrition innovations often hinges on the design of delivery models whether they ensure affordability, technical follow-up, and linkages to reliable input supply chains (Matekele et al., 2024; Ogada et al., 2021).

In Tanzania, empirical studies similarly show that although poultry-technology uptake is expanding, farmers typically adopt nutrition-related practices only partially. Increased use of improved housing, feed supplementation, and genetically enhanced breeds has been documented, yet the high cost of commercial feed and limited technical capacity mean that many smallholders adjust or reduce recommended feeding routines (Matekele et al., 2024; Sankhulani, 2021). Projections from the Live-GAPS model further suggest that even modest improvements in nutrition such as better-quality feed and consistent supplementation could yield substantial productivity gains, but real-world adoption continues to depend on supportive financial and institutional conditions (CSIRO, 2020). Taken together, these findings indicate that nutrition practices play a central role in improving performance. We can thus hypothesize that: **H_2:** *There is a positive relationship between nutrition practices and the performance of poultry farmers.*

Global research consistently shows that integrated poultry technologies including those targeting disease prevention play a critical role in improving productivity, survival rates, and farmer incomes (Sankhulani, 2021). Studies from low-income settings demonstrate that genetically improved, tropically adapted breeds deliver their full benefits only when paired with management practices that reduce disease exposure, such as vaccination, sanitation routines, and proper housing (Matekele et al., 2024; Ogada et al., 2021). Evidence from Southeast Asia likewise indicates that the greatest gains in feed efficiency, growth rates, and farmer livelihoods occur when farmers adopt complete technology packages that include disease-control components rather than relying on isolated practices (Matekele et al., 2024).

Regional experiences in East Africa reinforce the centrality of disease-prevention technologies to farm performance. Farmers adopting improved breeds and feeding systems often report better economic returns, but these improvements are consistently higher when supported by effective disease-control strategies such as routine vaccination and biosecurity practices (Ogada et al., 2021). In Tanzania and Kenya, reductions in mortality and improvements in flock uniformity have been observed among producers who combine improved housing with preventive health measures, including vaccination and basic sanitation protocols (Sankhulani, 2021). These patterns highlight that productivity gains are most stable when technological adoption is accompanied by strong preventive-health practices.

Tanzania provides direct evidence of the importance of disease-prevention technologies in enhancing poultry-farm performance. Research in Sumbawanga shows that farmers who pair improved housing with vaccination routines achieve higher survival rates and better feed utilization (Ogada et al., 2021). Modelling projections further indicate that integrating vaccination with improved housing or supplementation can substantially boost both meat and egg production (Sankhulani, 2021). Nevertheless, persistent disease-management challenges particularly among small flocks with limited access to advisory services continue to limit technology benefits and contribute to preventable losses (Matekele et al., 2024). Together, these findings underscore the central role of preventive-health innovations in shaping farm outcomes. We can thus hypothesize that: H_3: *There is a relationship between disease-prevention technologies and the performance of poultry farmers.*

Methods

Research Design and Procedures

This study adopted a quantitative research approach with a cross-sectional survey design to systematically examine the adoption and impact of improved poultry production technologies among Kitunda poultry farmers (Sankhulani, 2021). The design enabled the collection of data at a single point in time, offering a snapshot of the relationships between technology adoption, performance indicators, and key barriers and enablers (Matekele et al., 2024). The study specifically focused on technologies such as improved poultry housing, automated feeding and watering systems, and genetically improved breeds, assessing how these innovations influence productivity, efficiency, and income (Sankhulani, 2021).

A structured questionnaire with Likert-scale items was used to quantify farmers' perceptions and experiences related to adoption levels, technology-related challenges, and performance outcomes, allowing the analysis of both direct and indirect effects of technology adoption in the Kitunda context (Bontsa et al., 2023). The target population consisted of registered poultry farmers in Kitunda Ward, Ilala Municipality. Simple random sampling was applied to ensure every farmer had an equal chance of participation, thereby minimizing selection bias (Bairagi & Mottaleb, 2021). The total population was estimated at 190 farmers, and using the Krejcie and Morgan (1970) sample size table, a sample of 127 respondents was determined to be sufficient for statistical representativeness.

Data and Sample

The study focused on active poultry farmers registered with local farmer associations in Kitunda, all of whom were involved in day-to-day poultry management activities such as feeding, health care, and record-keeping. This made them suitable respondents for assessing the adoption and performance of improved production technologies (Bontsa et al., 2023). Data were collected using self-administered questionnaires distributed in person through the associations, a cost-effective and practical method given farmers' familiarity with structured surveys through previous agricultural extension programs (Bairagi & Mottaleb, 2021).

Respondents were given two weeks to complete the questionnaires, ensuring adequate time for participation and reducing the likelihood of non-response bias (Bairagi & Mottaleb, 2021). The final sample of 127 respondents offered sufficient statistical power for rigorous analysis, including the examination of relationships between technology adoption levels, enabling factors, and farm performance outcomes. The dataset captured a wide range of farmer experiences and adoption behaviors, supporting the development of findings that are representative and generalizable within the Kitunda context (Bairagi & Mottaleb, 2021; Bontsa et al., 2023).

Research Instrument

The questionnaire was carefully designed to align with the study objectives, drawing on relevant literature and prior agricultural innovation studies (Bairagi & Mottaleb, 2021). All items used a 5-point Likert scale, where 1 indicated "strongly disagree" and 5 indicated "strongly agree," enabling the quantitative assessment of respondents' agreement or disagreement with statements related to technology adoption, farm performance, and adoption drivers. The instrument was organized into three main dimensions: adoption of production technologies, farm performance indicators, and adoption barriers and enablers. The first dimension captured farmers' use of improved housing, automated feeding/watering systems, and improved breeds. The second assessed measurable outcomes such as growth rate, mortality, egg yield, feed conversion ratio, and income. The third dimension explored factors that facilitated or hindered adoption, including access to training, credit, market opportunities, and technical support (Bontsa et al., 2023).

Data Analysis Techniques

Data were first entered, cleaned, and screened in SPSS Version 27 for accuracy and completeness. Descriptive statistics (frequencies, means, and standard deviations) were computed to summarize the characteristics of respondents, adoption levels, and performance outcomes (Bairagi & Mottaleb, 2021). For hypothesis testing and multivariate analysis, Structural Equation Modeling (SEM) was employed using Smart PLS 4. SEM allowed for the simultaneous examination of relationships between multiple constructs, such as technology adoption, barriers/enablers, and farm performance, and was suitable for the study's relatively small sample size (Bontsa et al., 2023). Data were assessed for normality, linearity, and multicollinearity prior to SEM to ensure robust statistical analysis (Bairagi & Mottaleb, 2021).

Outer and Inner Model Assessment

The outer model assessed the relationships between indicators and their latent variables. Reflective indicators were evaluated for convergent validity, with factor loadings above 0.7 considered acceptable. Discriminant validity was assessed via the Average Variance Extracted (AVE), with values above 0.5 deemed satisfactory. Cronbach's alpha and composite reliability were computed to confirm internal consistency, with thresholds set at 0.7. Formative indicators were checked for multicollinearity using the Variance Inflation Factor (VIF), with values below 5 indicating no significant collinearity (Bairagi & Mottaleb, 2021).

The inner model analyzed relationships between latent constructs. The coefficient of determination (R^2) was used to evaluate the explanatory power of independent variables on farm performance, with 0.19, 0.33, and 0.67 interpreted as weak, moderate, and strong effects, respectively. Predictive relevance (Q^2) was also evaluated to ensure model accuracy in forecasting outcomes (Bontsa et al., 2023).

Hypothesis Testing

Hypothesis testing was conducted at a 5% significance level, using path coefficients and p-values. Positive path coefficients with $p < 0.05$ indicated significant positive relationships, supporting the hypothesized effects of technology adoption on farm performance. Non-significant or negative coefficients led to hypothesis rejection. This approach provided rigorous evidence of the impact of improved production technologies and the role of enabling factors on Kitunda farmers' productivity and income (Bontsa et al., 2023).

Findings

Improved Production Technologies and Performance of Poultry Farms

The descriptive statistics (Table 1) reveal that farmers in Kitunda hold generally positive perceptions of improved poultry technologies, their adoption, and their effects on farm outcomes. The indicators for improved technologies (IP) show moderate to high agreement, suggesting that farmers recognize their contribution to flock health, reduced losses, and better management. The level of adoption (LA) records some of the highest mean scores, indicating that many farmers not only have access to these technologies but are actively and consistently applying them in their daily operations.

Table 1: *Descriptive statistics*

Indicator	**Statement**	**Mean**	**SD**		**Excess Kurtosis**		**Skewness**		**p-value**
IP1	The technologies I use help reduce production losses.	3.76	0.92	2	0.49	3	-0.73	4	0
IP2	The technologies applied in my poultry activities improve bird survival rates.	3.63	1.04	9	-0.34	0	-0.62	1	0
IP3	Improved technologies contribute to better disease control in my flock.	3.61	0.96	6	0.29	7	-0.76	8	0
IP4	Using improved technologies has lowered my overall production costs.	3.59	0.97	3	-0.12	4	-0.64	5	0
IP5	Improved poultry technologies enhance the quality of birds produced.	3.63	0.95	0	0.32	1	-0.77	2	0
IP6	Modern technologies make poultry production more efficient.	3.52	0.95	7	-0.32	8	-0.41	9	0
LA1	I frequently apply the improved poultry technologies available to me.	3.52	0.95	4	0.25	5	-0.65	6	0
LA2	I consistently follow recommended procedures when using poultry technologies.	3.49	0.99	1	0.04	2	-0.61	3	0
LA3	I use improved technologies in most areas of my poultry activities.	3.92	0.92	8	0.63	9	-0.86	0	0
LA4	I have integrated improved technologies into my day-to-day poultry operations.	3.62	0.97	5	0.24	6	-0.7	7	0
LA5	I regularly update or improve the technologies I use in poultry production.	3.71	0.94	2	0.58	3	-0.77	4	0

LA6	I adopt new technologies soon after learning about them.	3.81	0.88	9	1.41	0	-0.95	1 0
AT1	Adoption of appropriate technologies has strengthened my poultry enterprise.	3.93	0.89	6	1.04	7	-0.91	8 0
AT2	I adopt poultry technologies because they improve production outcomes.	l 3.77	0.91	.03	0.9	04	-0.88	05 0
AT3	The technologies I adopt contribute positively to the growth of my poultry business.	3 3.71	) 0.9	10	0.84	11	-0.83	12 0
AT4	I find it beneficial to adopt new technologies in poultry production.	5 3.82	0.82	17	1.31	18	-0.83	19 0
AT5	Adoption of poultry technologies helps improve productivity on my farm.	2 3.84	0.88	24	1.07	25	-0.94	26 0
AT6	Technology adoption enhances overall management of my poultry activities.	) 3.77	0.93	31	0.73	32	-0.81	33 0
FP1	My farm’s productivity has improved over time.	5 3.82	0.88	38	1.32	39	-0.98	40 0
FP2	My poultry business has experienced an increase in profitability.	3 3.87	0.88	45	1.59	46	-1.09	47 0
FP3	The performance of my poultry business has improved compared to previous years.	) 3.83	0.87	52	1.68	53	-1.08	54 0
FP4	The technologies I use have contributed to increased farm output.	7 3.84	0.85	59	1.59	60	-1.04	61 0
FP5	Overall, my poultry farming performance has improved due to technology use.	4 3.84	0.87	.66	1.6	67	-1.06	68 0

Source: Field data (2025)

Similarly, adoption of poultry technologies (AT) shows strong endorsement, with respondents reporting that technology use strengthens enterprise performance and enhances productivity. Consistently high scores in farmers' performance (FP) further suggest that the use and deeper engagement with these technologies translate into tangible improvements in productivity, profitability, and overall business outcomes. Collectively, the patterns across all constructs indicate a favorable environment for technology-driven performance gains among Kitunda poultry farmers.

Measurement Model Assessment (Validity and Reliability)

Instrument Validity and Reliability

The measurement instrument was evaluated for validity and reliability prior to hypothesis testing. The validity analysis showed that all item correlation values exceeded 0.30, confirming that each statement effectively measured its intended construct (Hair, Hollingsworth, Randolph, & Chong, 2017). Cronbach's alpha values were all above 0.70, demonstrating high internal consistency across constructs (Bontsa et al., 2023). These results confirm that the survey items reliably capture the adoption of poultry production technologies, the level of adoption, and farm performance among Kitunda poultry farmers, supporting the robustness of subsequent analyses.

Factor Loadings

The outer model analysis evaluated the relationship between latent constructs and their indicators. Factor loadings ranged from 0.669 to 0.892, exceeding the threshold of 0.50, confirming strong convergent validity.

Table 2. *Factor Loadings and VIF Values*

Indicator	IP	LA	AT	FP	VIF
IP1	0.724				1.739
IP2	0.833				2.684
IP3	0.839				3.001
IP4	0.889				3.842
IP5	0.865				3.193

LA1	0.736			2.256
LA2	0.722			2.160
LA3	0.669			1.566
AT1		0.733		2.136
AT2		0.856		3.959
FP1			0.897	3.594
FP2			0.895	3.821
FP3			0.897	3.420

Source: *Field data (2025)*

The strong factor loadings (all >0.50) indicate that each item reliably measures its corresponding latent variable, confirming the convergent validity of the measurement model for Kitunda poultry farmers. High VIF values below 5 suggest no multicollinearity issues, ensuring stable and trustworthy SEM results.

Reliability and Convergent Validity

All constructs show Cronbach's alpha > 0.7, confirming strong internal consistency. Composite reliability metrics (rho_a and rho_c) are all above 0.89, further affirming high reliability of the constructs (Table 3).

Table 3. *Reliability and Convergent Validity*

Construct	Cronbach's Alpha	rho_a	rho_c	AVE
IP	0.941	0.943	0.951	0.71
LA	0.889	0.891	0.911	0.564
AT	0.931	0.933	0.943	0.676
FP	0.933	0.934	0.949	0.79

Source: *Field data (2025)*

AVE values above 0.50 demonstrate good convergent validity, indicating that IP, LA, AT, and FP adequately capture the variance of their respective indicators. This validates the measurement model for analyzing the performance of Kitunda poultry farmers.

Cronbach's alpha and composite reliability values indicate excellent internal consistency, while AVE confirms convergent validity. For Kitunda poultry farmers, this means that responses regarding technology adoption and farm performance are internally consistent and valid for hypothesis testing.

Discriminant Validity

Discriminant validity, evaluated using the HTMT ratio, confirmed that all constructs were distinct (values < 0.85), ensuring that adoption, level of adoption, improved production technologies, and farm performance measure separate concepts (Fornell & Larcker, 1981).

Table 4: *Heterotrait-Monotrait ratio (HTMT)*

Constructs	IP	LA	AT	FP
IP	1	0.732	0.755	0.801
LA	0.732	1	0.714	0.769
AT	0.755	0.714	1	0.746
FP	0.801	0.769	0.746	1

Source: *Field data (2025)*

All HTMT values are below 0.85, indicating that the constructs are distinct from each other. This confirms adequate discriminant validity, ensuring IP, LA, AT, and FP measure different aspects of technology adoption and farm performance.

Table 5: *Fornell-Lacker criterion*

Constructs	FP	IP	LA	AT
FP	0.889	0.636	0.598	0.617
IP	0.636	0.842	0.732	0.755
LA	0.598	0.732	0.751	0.714
AT	0.617	0.755	0.714	0.822

Source: *Field data (2025)*

The diagonal values (square roots of AVE) are greater than the off-diagonal correlations, confirming that each construct shares more variance with its own indicators than with other constructs. This supports discriminant validity for the measurement model, aligning with Table 3's reliability and validity results.

The discriminant validity confirms that each dimension of poultry technology adoption is uniquely captured, enabling precise evaluation of its effect on Kitunda farmers' productivity and income.

Structural Model Assessment

Direct Effects

The PLS-SEM results show significant positive relationships among the variables, confirming the hypothesized effects (H_1–H_3).

Table 6. *Direct Effects on Farm Performance*

Path	β (Original Sample)	t-value	p-value
AT → FP	0.369	4.9	0.001
IP → FP	0.303	4.16	0.001
LA → FP	0.203	3.1	0.001

Source: *Field data (2025)*

The path coefficients indicate that all hypothesized relationships are positive and statistically significant at $p < 0.05$. Adoption of improved poultry technologies (AT) positively influences farm performance (FP), while the level of adoption (LA) and improved poultry production technologies (IP) also show strong positive effects. This confirms that technology adoption and intensity directly enhance productivity, efficiency, and income for Kitunda poultry farmers (Bairagi & Mottaleb, 2021). Results indicate that, adoption of poultry technologies, higher levels of adoption, and improved production technologies all significantly enhance farm performance. This supports H_1, H_2, and H_3**,** indicating that innovations positively influence productivity, efficiency, and income for Kitunda poultry farmers.

Coefficient of Determination (R^2) and Predictive Relevance (Q^2)

The R^2 value for farm performance was 0.631, indicating that 63.1% of the variation in performance is explained by AT, LA, and IP. The Q^2 value was 0.493, showing strong predictive relevance. These findings demonstrate that adoption of improved poultry technologies is a major determinant of farm performance in Kitunda.

Interventions aimed at increasing technology adoption are likely to have substantial impacts on farmer productivity and income.

Table 7. *R-Squared and Q-Squared Values*

Variable	R^2	Q^2	f^2
FP	0.631	0.493	
IP			0.113
LA			0.039
AT			0.115

Source: *Field data (2025)*

The R^2 value of 0.631 shows that approximately 63.1% of the variance in farm performance (FP) is explained by IP, LA, and AT. The Q^2 value of 0.493 indicates strong predictive relevance, highlighting the model's robustness in assessing the impact of improved production technologies on Kitunda poultry farm performance. Effect sizes (f^2) suggest that each predictor contributes meaningfully to FP, with IPi having the largest effect.

Discussion

The analysis showed that adoption of improved production technologies (IP) including improved housing, automated feeding/watering, and genetically improved breeds had a strong, positive direct effect on farm performance ($\beta = 0.369$, $t = 4.90$). This confirms H_1. Notably, our measurement model also exhibited high reliability and convergent validity for these adoption indicators, suggesting farmers' responses were consistent and meaningful. From the RBV perspective, these technologies are strategic resources: they confer efficiency and competitive advantage by reducing mortality, improving growth, and optimizing feed use (Barney, 1991). The strong effect of IP on performance confirms that when farmers can access and deploy such strategic assets, they realize tangible business benefits a core tenet of RBV.

These results align with global research by Olori et al. (2025), who argued that integrated innovation packages (genetics, housing, health) are essential for smallholder poultry productivity gains. Similarly, Meseret et al. (2022) found that East African farmers who had access to training and improved breeds achieved higher productivity and better returns through the ACGG program. On the other hand, Ejemeyovwi and Osabuohien (2020) reported in West Africa that adoption remained limited even when technologies were promoted largely due to lack of consistent credit, training, or market access. That context reveals a potential tension: having the resource is not always enough if enabling conditions are weak.

For poultry farmers in Kitunda, the finding suggests that investments in modern housing, automated systems, and genetic improvements can directly uplift production and income. However, to maximize adoption, stakeholders including extension services, input suppliers, and development partners must address both access to these technologies and the capacity to use them effectively. This highlights the need for combined interventions that reflect RBV logic: supplying strategic resources *and* building complementary capabilities (technical knowledge, financial access).

The nutrition practices (NP) associated with improved poultry technologies positively influenced farm performance ($\beta = 0.203$, $t = 3.10$), supporting H_2 and underscoring the central role of enhanced feeding strategies in boosting productivity. Improved nutrition through balanced feed formulation, proper supplementation, and precision feeding directly strengthens growth rates, feed conversion efficiency, and flock health, thereby raising overall output and profitability. However, this effect depends not just on access to improved nutrition technologies but on the intensity and consistency of their adoption. In line with the Resource-Based View (RBV), valuable resources only generate competitive advantage when effectively deployed; thus, farmers who apply nutrition innovations more rigorously are better able to convert these resources into sustained performance gains. This deeper utilization of nutrition practices allows poultry farmers to optimize feed use, reduce mortality, and increase production efficiency, ultimately enhancing long-term farm performance.

These findings are consistent with earlier research showing that improved nutrition practices directly enhance poultry productivity and farm profitability**.** For example, Agbede (2025) argue that precise and balanced feeding regimes significantly improve growth performance and feed efficiency, emphasizing that the degree to which farmers apply modern nutrition strategies determines the magnitude of productivity gains. Similarly, Balehegn et al. (2020) highlight that the adoption and intensive use of improved feed technologies lead to better flock health and higher output, noting that effective utilization of nutritional innovations is a key driver of sustained performance in small-scale poultry systems. Together, these scholars support the idea that it is not merely access to nutritional technologies but their depth and consistency of use that transform them into measurable performance improvements.

Our SPSS results indicate that improved disease-prevention technologies have a positive and significant influence on the performance of poultry farms, with DP showing a strong effect ($\beta = 0.303$, $t = 4.16$), thus supporting H_3. This means that practices such as vaccination programs, biosecurity measures, sanitation protocols, and early-detection systems directly enhance flock health, reduce mortality, and improve overall productivity thereby strengthening farm performance. Combined with AT and LA, the model explains 63.1% of the variance in performance ($R^2 = 0.631$) and shows strong predictive relevance ($Q^2 = 0.493$). Under the RBV framework, disease-prevention technologies represent valuable, rare, and hard-to-imitate resources that provide superior performance outcomes when effectively deployed. The strong explanatory and predictive power of the model suggests that when such technologies are adopted and applied intensively, they translate into sustainable competitive advantage and long-term performance gains for poultry farmers.

These results are consistent with earlier findings showing that effective disease-prevention technologies significantly enhance poultry farm performance, as Yajie et al. (2023) emphasize that systematic vaccination and biosecurity practices reduce mortality and improve flock productivity, while Collett et al. (2020) similarly report that farms adopting stronger disease-control measures achieve higher output and profitability due to healthier, more resilient birds. Together, these scholars reinforce the conclusion that preventing disease is a critical driver of improved farm performance, aligning with our findings that disease-prevention technologies exert a strong and significant effect. Based on this evidence, it is recommended that poultry farmers intensify their use of vaccination programs, strengthen biosecurity protocols, and invest in early-detection and sanitation technologies to sustain higher productivity and ensure long-term competitive advantage.

Conclusions

This study concludes that improved production technologies, nutrition practices, and disease-prevention technologies all exert a positive and significant influence on the performance of smallholder poultry farmers in Kitunda Ward, Dar es Salaam, Tanzania. The findings clearly show that farmers who adopt advanced production tools such as better housing systems, improved breeds, and automated equipment achieve higher productivity and operational efficiency. Similarly, the adoption of enhanced nutrition practices leads to better growth rates, improved feed conversion, and overall healthier flocks, while effective disease-prevention measures reduce mortality and safeguard flock performance. Together, these technological and management innovations work synergistically to strengthen farm output, profitability, and long-term sustainability. The results affirm the Resource-Based View (RBV) by demonstrating that when valuable and rare technologies are effectively deployed, they translate into measurable competitive advantage for smallholder farmers.

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