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Assessment of Improved Poultry Technologies Adoption among Smallholder Broiler Farmers in Nassarawa Local Government Area of Kano State, Nigeria

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Abstract

This study assessed the adoption of improved poultry technologies among smallholder broiler farmers in Nassarawa Local Government Area, Kano State, Nigeria. The specific objectives were to describe the socio-economic characteristics of farmers, assess their awareness and adoption levels of improved poultry technologies, determine the factors influencing adoption decisions, and identify the major constraints to technology uptake. Primary data were collected from ninety-three (93) randomly selected broiler farmers using a structured questionnaire and analysed using descriptive statistics and logistic regression. Results revealed that respondents were predominantly young (mean age 35 years), male (75.3 %), and educated, with 65.6% having tertiary education. Most farmers (63.4 %) had between 1 and 5 years of experience and operated small to medium flocks averaging 229 birds. Awareness of improved poultry technologies was high, particularly for digital weighing scales (90.4 %) and solar-powered lighting systems (88.2 %). Adoption rates were also highest for these technologies, 75.3 % and 81.7 % respectively, while compost pits (24.7 %) showed a lower adoption level. The logistic regression analysis identified education level, farming experience, and flock size as significant determinants of adoption ($p < 0.05$). Major constraints to adoption included the high cost of technologies, lack of access to credit, insufficient government support, small farm size, and limited technical training. The study concludes that while awareness of improved poultry technologies is relatively high, actual adoption remains moderate due to financial and institutional barriers. It recommends enhancing farmers' access to affordable credit, training, extension services, and cooperative support to promote wider adoption and improve broiler production efficiency in the area.

Key words: Improved poultry technologies, technology adoption, broiler farming, awareness level, small-scale broiler farmers

1.0 Introduction

Poultry production is an important component of livestock farming and an essential part of agriculture, which significantly contributes to food security, poverty alleviation, job creation and animal protein production in Nigeria (Okonkwo & Akubuo, 2018). In Nigeria, poultry contributes about 25% of the total agricultural GDP and more than 40% of the livestock sub-sector (National Bureau of Statistics [NBS], 2020). This is because it is a very significant industry for Nigerian diets. Nigeria has various poultry production systems, from small-scale backyard operations to large commercial scale (Wilson, 2021).

Among the poultry production systems, broiler farming is especially prominent. Broiler production involves the keeping of chickens bred for the purpose of getting good-quality meat products, usually sold live or processed from five weeks of age (Isiaka et al., 2023). Small-scale farmers in developing countries, especially in Nigeria, rely on small-scale broiler production as a reliable source of income, employment, and food security for their rural economies (Bamidele & Amole, 2021). Small-scale enterprises provide a significant amount of Nigeria's chicken output, making poultry farming one of the nation's most prominent agricultural industries (Girei, 2020). Moreover, broiler production is expanding quickly in both rural and urban settings due to its commercial viability and relatively quick turnaround time. Broilers are typically reared under intensive systems, either in deep litter or battery cages, with a strong emphasis on feed efficiency, growth rate, and market weight (Olomu, 2019). Broiler production will greatly enhance people's income source, strengthen food security and improve nutrition status (Ahungwa, Badamasi & Abdulkarim, 2018). However, farming methods are still largely traditional, partly because farmers lack finance, modern agricultural technology and know-how to inject into their farming-related activities. Traditional poultry farming relies heavily on manual oversight and intuition, often leading to inefficiencies and high operational costs. Challenges such as overfeeding, underfeeding, disease outbreaks, and suboptimal environmental conditions have historically limited productivity and profitability (Smith & Johnson, 2019).

Recently, a new class of improved poultry technologies has emerged globally, including digital tools (mobile record-keeping apps, digital thermometers, electronic weighing scales, SMS-based extension alerts) and solar-powered innovations (solar lighting, solar brooders, and solar water pumps). These technologies are particularly relevant for peri-urban and off-grid farming systems, where erratic electricity supply increases operational risks (Oladele, 2020). Improved Poultry Technologies refer to the integration of advanced tools, equipment, and digital platforms into poultry production systems to enhance efficiency, productivity, and sustainability. These technologies include digital thermometer, digital weighing scale, mobile record-keeping apps, compost pits, and low-cost solar-powered lighting (Oladele, 2020).

The selection of these five specific technologies for this study is not arbitrary but is grounded in the unique constraints and opportunities of peri-urban broiler farming in Nassarawa LGA. First, digital thermometer and digital weighing scale address the problem of imprecision in traditional broiler management. In Nassarawa LGA, where night-time temperatures fluctuate and market demands specific weight grades, farmers who rely on intuition often experience higher mortality and receive lower prices. These low-cost digital tools enable real-time monitoring, reducing guesswork. Second, the mobile record-keeping app directly tackles information fragmentation. Many smallholder farmers in the study area lack written records, leading to poor feed inventory management and undetected mortality trends. A simple mobile app (usable on basic smartphones) can improve traceability and decision-making. Third, low-

cost solar-powered lighting addresses the chronic and unpredictable electricity supply in peri-urban Kano. Broilers require extended daylight hours for optimal feeding; grid outages disrupt growth cycles. Solar lighting provides a reliable, one-time investment solution that reduces dependence on expensive and polluting kerosene or diesel generators. Fourth, compost pits solve a pressing peri-urban waste problem. Unlike rural areas where manure can be spread on open fields, Nassarawa LGA's high population density means poultry waste generates odour complaints, attracts flies, and risks environmental health violations. Compost pits offer a low-cost, on-farm waste management solution that produces valuable organic fertilizer for sale or household use. Collectively, these five technologies are affordable, scalable, and directly responsive to the specific technical, informational, energy, and environmental constraints documented among smallholder broiler farmers in peri-urban Nassarawa LGA.

Despite the recognized potential of improved poultry technologies to transform smallholder broiler production in Nigeria, adoption rates remain low and productivity lags behind national demand. Existing adoption studies in Kano State have focused on rural LGAs (e.g., Danbare, Doka, Kwami) and conventional technologies such as feed, vaccines, and housing (Abdullahi & Dankoli, 2022). Similar patterns of technology adoption have been documented in rural communities across Plateau State (Vihi et al., 2025), and Ebonyi State (Ume et al., 2018), where adoption remains largely concentrated on basic poultry management practices rather than advanced or climate-smart technologies. This low adoption directly translates into productivity constraints. Without digital thermometers and weighing scales, farmers cannot monitor broiler health or growth accurately, leading to higher mortality and suboptimal market weights. Without mobile record-keeping apps, poor feed inventory management and undetected mortality trends persist. Without solar-powered lighting, erratic grid electricity disrupts feeding cycles, reducing growth rates. Without compost pits, waste accumulation creates environmental hazards and neighbour complaints. Collectively, these constraints limit flock performance, increase production costs, and reduce profitability for smallholder broiler farmers in peri-urban Nassarawa LGA.

These productivity constraints have clear policy relevance. Nassarawa LGA supplies a significant portion of broiler meat to the Kano metropolis, where demand for affordable protein is rising. Persistent low adoption among smallholder farmers threatens urban food supply, perpetuates household poverty, and undermines state-level agricultural development targets. However, no empirical study exists for Nassarawa LGA which is a distinct peri-urban zone characterised by high population density, unreliable electricity, fragmented land, and unique waste management pressures. Findings from rural LGAs cannot be generalized here. Furthermore, no study has quantified awareness, adoption rates, or determinants for the five specific technologies—digital thermometer, digital weighing scale, mobile record-keeping app, low-cost solar-powered lighting, and compost pits. Without location-specific evidence, agricultural development programmes (KNARDA, NAERLS) cannot design targeted interventions for peri-urban farmers.

Therefore, this study answers: *What is the level of awareness, adoption rate, and determinants of adoption of the five technologies (digital thermometer, digital weighing scale, mobile record-keeping app, low-cost solar-powered lighting, and compost pits) among smallholder broiler farmers in peri-urban Nassarawa LGA, Kano State?* This provides the first empirical baseline on digital/solar technology adoption in a metropolitan-peri-urban poultry system. The study provides vital information on the awareness and adoption of improved poultry technologies among smallholder broiler farmers in the study area. The

findings will guide farmers, extension agents and policymakers in improving poultry productivity, income generation and effective technology dissemination.

1.1 Objectives of the Study

The broad objective of this study was to assess the adoption of improved poultry technologies among smallholder broiler farmers in Nassarawa Local Government Area of Kano State, Nigeria. The specific objectives were to:

i. describe the socio-economic characteristics of smallholder broiler farmers in the study area;
ii. assess smallholder broiler farmers' awareness of five specific improved poultry technologies, namely: digital thermometer, digital weighing scale, mobile record-keeping app, low-cost solar-powered lighting, and compost pits;
iii. determine the rate of adoption of each of the five improved poultry technologies (digital thermometer, digital weighing scale, mobile record-keeping app, low-cost solar-powered lighting, and compost pits) among smallholder broiler farmers;
iv. determine the factors influencing smallholder broiler farmers' decisions to adopt the five improved poultry technologies and
v. identify the constraints faced by farmers in adopting these improved poultry technologies in the study area.

2.0 Materials and Methods

2.1 The Study Area

The study was conducted in Nassarawa Local Government Area, which is one of the urban LGAs that make up Kano metropolis in Kano State, Nigeria, as shown in Figure 2.1. The administrative headquarters of Nassarawa LGA is located in the Bompai area of Kano city. Geographically, Nassarawa lies between latitude 11.97° to 11.99° North and longitude 8.56° to 8.58° East, it covers a relatively small area compared with rural LGAs approximately 34 km² (see Figure 2.1), and is densely populated due to its urban-adjacent location (City Population Project, 2022). According to national census data and official population projections, Nassarawa LGA had a population of about 596,000 at the 2006 census and state-level projections estimate the population to be approaching one million inhabitants in recent years (City Population Project, 2022). Because Nassarawa LGA is part of the Kano metropolis, land use is predominantly residential, commercial and industrial with limited but important peri-urban agricultural pockets. These peri-urban areas commonly host intensive smallholder agricultural activities (vegetable gardening, small ruminant rearing and poultry production) that supply city markets (National Bureau of Statistics, 2020). The Sudan Savannah agro-ecological conditions (seasonal rainfall, warm temperatures) favour short-season cereal cropping and intensive vegetable and poultry production practices when water and space are available). Studies of Kano metropolis have documented active participation in poultry farming across gender and scale categories, with many producers operating small (50–500 birds) and medium (500–1,000 birds) broiler units that supply local markets (Sulaiman et al., 2023). Nassarawa LGA provides an ideal peri-urban context for assessing adoption of improved poultry technologies among smallholder broiler producers. Therefore, investigating farmers' awareness, availability, accessibility, perceived usefulness, and constraints within Nassarawa LGA will illuminate how peri-urban dynamics influence technology adoption among smallholder broiler producers.

2.2 Sampling Procedure and Sample Size

The first stage involved a purposive selection of Nassarawa Local Government Area (LGA) due to its high concentration of broiler farmers compared to other LGAs in Kano State. The

second stage involved a purposive selection of five (5) communities within Nassarawa LGA (see Table 2.1), also based on the high level of broiler farming activity in those communities. This purposive approach was necessary to ensure an adequate sample size for analysis, given that broiler farming is not uniformly distributed across all communities in the LGA. The authors acknowledge that purposive selection introduces potential selection bias, as the LGA and communities were not randomly chosen. Consequently, the findings may not be fully generalizable to all areas within Nassarawa LGA or to other peri-urban locations in Kano State. Readers and policymakers should consider this limitation when interpreting and applying the results of this study. The third stage involved proportionate selection of respondents from each of the selected communities. This resulted in a total of 93 respondents as the sample size. The sample size was determined using Yamane's (1967) formula. This provides an optimal sample size based on the population of broiler farmers in the areas. Bowley's proportionate allocation method as employed by Adamu *et al.* 2025) was then used to distribute the sample across each community under study.

The Yamane's formula is expressed as:

$$n = \frac{N}{1+N(e)^2} \quad \text{Equation 2.1}$$

Where:

n = sample size
N = sample frame
e = (0.05 margin of error or precision)

Bowley's formula is expressed as:

$$ni = n\frac{Ni}{N} \quad \text{Equation 2.2}$$

Where:

ni = Sample size for each community
n= total sample size
Ni = population of the community
N = Total Population of all communities

Table 2.1: Sampling frame and sample size for the study

Community	Sampling Frame	Sampling Size
Hotoro North	24	18
Kawaji	21	16
Giginyu	25	19
Dakata	23	18
Hotoro South	29	22
Total	**122**	**93**

Source: Survey, 2025

2.3 Method of Data Analysis

Data for the study were analysed using descriptive and inferential statistical tools. The descriptive statistical tools, such as frequency, percentage, mean, and Likert scale, were used to describe the socio-economic characteristics and constraints faced by the farmers in adopting the improved poultry technologies. The binary logistic regression model was used to determine the factors influencing smallholder broiler farmers' decisions to adopt improved poultry technologies.

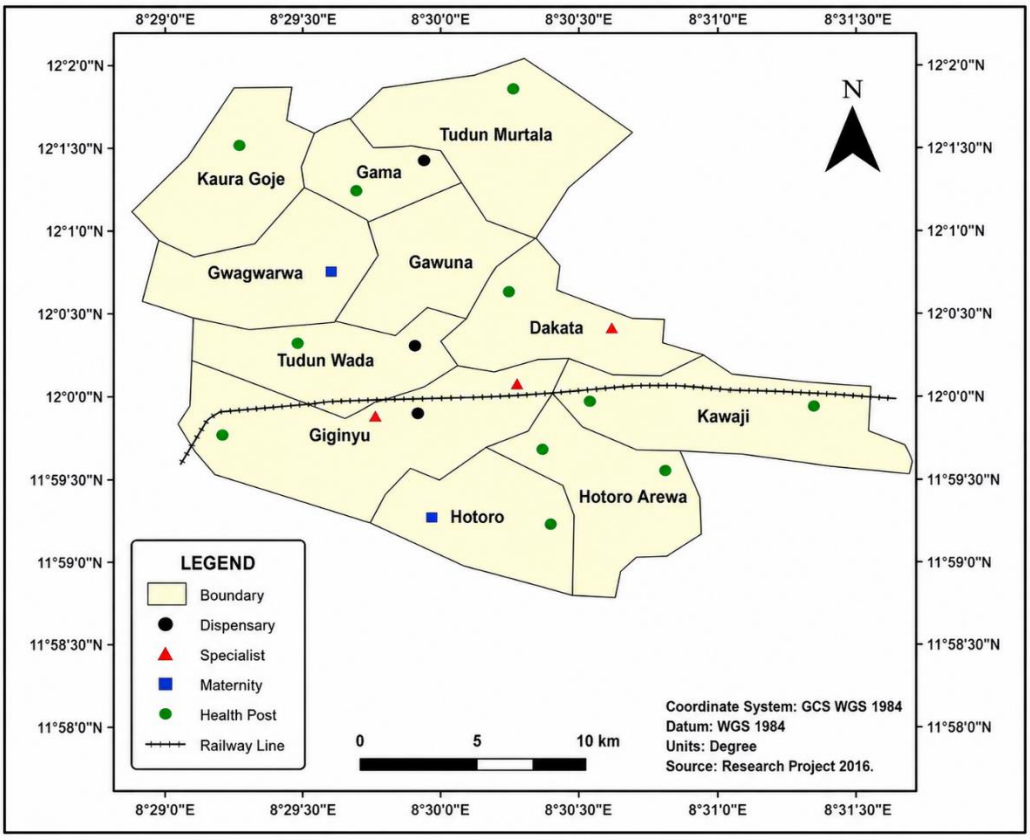


Figure 2.1: Map of Nassarawa Local Government showing the study areas

Adapted from: *Universal GIS* (2016). *Kano, Nassarawa Local Government Health Facilities Map*. Enhanced using GIS by the author (2026).

2.3.1 Binary Logistic Regression Model

To determine the factors influencing smallholder broiler farmers' decisions to adopt improved poultry technologies, the relationship between explanatory variables and the adoption decision was modelled using binary logistic regression, following the approach of Gama et al. (2025).

The dependent variable was coded as a binary outcome:

Adoption = 1 if a farmer adopted at least one of the five improved poultry technologies under consideration.

Adoption = 0 if a farmer adopted none of the five technologies.

Farmers who adopted more than one technology were still classified as adopters (1), as the objective was to model the decision to adopt any improved technology rather than the intensity or number of technologies adopted. This coding aligns with the study's focus on factors influencing the initial adoption decision.

The binary logistic regression model is expressed as:

$$In\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots . \beta_k X_k + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{Equation 2.3}$$

Where:

$\ln\left(\frac{p}{1-p}\right)$= log-odds (logit)
P= probability that the outcome occurs (e.g. adoption = 1)
1-P = probability that the outcome does not occur (o)
β_0 = intercept,
$\beta_1, \beta_2, \ldots\ldots, \beta_k$ = coefficients to be estimated
$X_1, X_2, \ldots\ldots, X_k$ = independent (explanatory) variables.

The definitions and units for all explanatory variables included in the model are clearly presented in Table 2.2.

Table 2.2: Definition and measurement of explanatory variables used in the binary logistic regression model

Variable	Definition	Measurement unit/ coding
Age	Age of the farmer	Years
Educational Level	Highest level of formal education attained	1 = formal education, 0 = no formal education
Farming Experience	Number of years the farmer has been engaged in broiler production	Years
Estimated Annual Income	Total annual income derived from broiler farming and other sources	Nigerian Naira (₦) per year
Access to Credit	Whether the farmer has access to formal or informal credit for poultry farming	1 = access, 0 = no access
Total Flock Size	Number of broiler birds raised per production cycle	Number of birds
Access to Extension	Whether the farmer has access to agricultural extension services	1 = access, 0 = no access

Sampling limitations are acknowledged. The study uses a cross-sectional design and a convenience sample of smallholder broiler farmers, which may limit generalizability to all broiler farming systems. Findings are therefore interpreted as associative rather than causal, and caution is advised when extending results to broader populations.

3.0 Results and Discussion

3.1 Socio-economic Characteristics of the Farmers

Survey results from Table 3.1 show that the mean age of broiler farmers was 35 years, ranging from 20 to 58 years. Less than half (47.3%) of the farmers were between 20–30 years, followed by those aged 31–40 years (39.8%), 41–50 years (10.8%), and above 50 years (2.2%). This suggests that the majority of broiler farmers were young and within the economically active age group. The predominance of youth may be associated with greater likelihood of adopting innovations and new technologies in poultry farming. This finding is consistent with research by Ojo & Popoola (2021), who reported that poultry enterprises tend to attract younger farmers in Nigeria seeking income opportunities.

The mean household size was 5 persons which is similar to the findings in Antia-Obong et al. (2021) among smallholder poultry farmers in Akwa Ibom State. Most farmers (62.4%) had 1–5 household members, followed by 6–10 (20.1%) and 11–15 members (7.5%). This suggests that most farmers have moderate family sizes, which could provide labour for farm

activities while maintaining manageable household expenses. These findings are similar to those of Adeyemi et al. (2024), who reported ample availability of family labour for farming activities.

The mean farming experience was 6 years. Most respondents (63.4%) had 1–5 years of experience, with fewer having 6–10 years (29.0%) or 11–15 years (7.5%). This indicates that most farmers were relatively new entrants into broiler production. Although most farmers are new, their youthfulness and education may compensate for limited experience by enhancing adaptability and learning. This finding contrasts with that of Popoola (2022), who reported that farming experience tends to be positively associated with output and profitability in poultry farms. While limited experience can increase risk and reduce productivity, the youthfulness and higher education levels observed among respondents may offset some of those disadvantages.

The mean flock size was 229 birds, ranging from 50 to 2000. More than half (53.8%) of farmers kept 100–200 birds, followed by 201–300 birds (29.0%) and fewer than 100 birds (8.6%). This indicates that most farmers operate at a small to medium scale. The relatively small flock size may be associated with limited capital, space constraints, or challenges in accessing inputs such as feed and vaccines. This finding is similar to that of Chiekezie et al. (2022), who reported that most broiler farmers operate at a small scale.

The mean annual income was ₦154,527. More than half of the farmers (53.8%) earned between ₦100,000 and ₦200,000, while fewer earned below ₦100,000 (36.6%) or above ₦200,000 (9.7%). This suggests that broiler farming provides a meaningful source of income for smallholders, although returns vary depending on scale of operation, management practices, and market conditions. The income level observed is consistent with small-scale commercial poultry systems in developing regions. However, Olasunkanmi and Olorunsanya (2016) found higher average earnings (>₦300,000) among medium-scale poultry farmers, which they attributed to economies of scale. The FAO (2021) similarly notes that income can vary widely depending on market and production conditions. Thus, while the present findings reflect typical small-scale operations, income levels are not uniform across all regions.

The results in Table 3.2 revealed that the majority of respondents were male (75.3%), while fewer were female (24.7%). This indicates a male dominance in broiler production within the study area. This finding is consistent with the research of Adeyonu et al. (2023), which reported that commercial poultry enterprises are more male-led, possibly due to greater access to capital, decision-making power, and market linkages for men. The results also show that almost equal proportions of farmers were single (49.5%) and married (47.3%), while 3.2% were divorced. This near balance suggests that both single and married individuals actively engage in broiler farming. Married farmers may view poultry production as an avenue to supplement family income, while single farmers may see it as an opportunity for self-employment. In contrast, Adebayo and Adeola (2020) and Musa and Haruna (2022) reported higher proportions of married farmers (70–80%) in other regions, indicating that marital composition may vary geographically.

The results in Table 3.2 show that most respondents had tertiary education (65.6%), with fewer having secondary education (31.2%) or primary/no formal education (3.3%). This suggests that broiler production in the study area is dominated by relatively educated individuals, who may possess better management skills and greater openness to improved farming practices. This finding is similar to research which reported that higher education

levels are positively associated with technical efficiency and better farm management in poultry enterprises (Ezekiel et al., 2024; Adeyonu et al., 2023).

Table 3.1: Quantitative socioeconomic characteristics of the smallholder broiler farmers (n= 93)

Variables	Frequency	Percentage (%)	Mean	Min	Max
Age (years)			35	25	58
20-30	44	47.3			
31-40	37	39.8			
41-50	10	10.8			
Above 50	2	2.2			
Household size			5	1	15
1-5 persons	58	62.4			
6-10 persons	28	20.1			
11-15 persons	7	7.5			
Farming experience			6	1	15
1-5 years	59	63.4			
6-10 years	27	29.0			
11-15 years	7	7.5			
Flock size			229	50	2000
Below 100 birds	8	8.6			
100-200 birds	50	53.8			
201-300 birds	27	29.0			
301-400 birds	5	5.4			
Above 400 birds	3	3.2			
Income (₦)			154527	15000	1500000
Below 100000	34	36.6			
100000-200000	50	53.8			
200001-300000	6	6.5			
300001-400000	3	3.2			

Source: Field Survey, 2025

The results for primary occupation show that nearly half of the respondents (49.5%) identified farming as their primary occupation, while others identified trading (36.6%), civil service (11.8%), and other activities (2.2%). This suggests that broiler farming serves not only as a full-time occupation but also as a complementary income source for individuals in other professions. By contrast, Oladimeji et al. (2021) and Ogunlade and Adebisi (2017) reported higher percentages (65–75%) of full-time poultry farmers in other studies, highlighting that the role of poultry as a primary occupation can vary regionally.

The results in Table 3.2 further indicate that the majority (71.0%) of respondents did not belong to any farmers' association, while a minority (29.0%) were members. This low participation rate in cooperative or association networks may limit farmers' access to collective benefits such as training, credit facilities, bulk input purchase, and marketing support. In contrast, Musa and Haruna (2022) observed higher association membership (~60%) in areas with active donor or government support programs, suggesting that participation varies with the presence of interventions.

Table 3.2: Qualitative socioeconomic characteristic of the smallholder broiler farmers (n=93)

Variables	Frequency	Percentage (%)
Sex		
Male	70	75.3
Female	23	24.7
Marital status		
Single	46	49.5
Married	44	47.3
Divorced	3	3.2
Education level		
No formal education	1	1.1
Primary	2	2.2
Secondary	29	31.2
Tertiary	61	65.6
Primary occupation		
Farming	46	49.5
Trading	34	36.6
Civil servant	11	11.8
Others	2	2.2
Membership to association		
No	66	71.0
Yes	27	29.0

Source: Field Survey, 2025

3.2 Level of Awareness of Existing Improved Poultry Technologies of the Farmers

Table 3.3 presents the level of awareness of existing improved poultry technologies among farmers. Results indicate that the majority of respondents were aware of digital weighing scales (90.4%), low-cost solar-powered lighting (88.2%), mobile record-keeping applications (75.3%), and digital thermometers (65.6%). However, awareness was relatively lower for compost pits (29.0%). These findings point to a relatively high level of awareness of modern poultry technologies among respondents, particularly those directly linked to production efficiency and management convenience. The high awareness of digital weighing scales and solar lighting is consistent with findings by Ayanda et al. (2020), who reported that solar and digital technologies were among the most recognised innovations among poultry farmers in Nigeria. Similarly, Adenuga et al. (2019) found that over 70% of farmers were aware of digital tools that enhanced record keeping and feed efficiency. Conversely, the low awareness of compost pits suggests limited attention to waste management innovations among the sampled poultry farmers. This finding is consistent with Okorie et al. (2021), who observed that most poultry farmers prioritised production-enhancing technologies over waste recycling methods.

Table 3.3: Level of awareness on improved poultry technologies (n = 93)

Improved Technologies	Aware	Percentage (%)	Not aware	Percentage (%)
Digital thermometer	61	65.6	32	34.4
Digital weighing scale	84	90.4	9	9.6
Mobile record-keeping app	70	75.3	23	24.7
Low cost solar-powered lighting	82	88.2	11	11.8
Compost pits	27	29.0	66	71.0

Source: Field Survey, 2025

3.3 Adoption Rate of Farmers on Improved Poultry Technologies

As shown in Table 3.4, adoption rates were highest for low-cost solar-powered lighting (81.7%) and digital weighing scales (75.3%), followed by mobile record-keeping applications (65.6%) and digital thermometers (35.5%). Meanwhile, compost pits (24.7%) had the lowest adoption rates. The high adoption of solar-powered lighting can be attributed to its direct effect on reducing production costs and improving energy reliability, especially in rural areas with unstable electricity. This finding supports the conclusions of Nnadi and Akwiwu (2018), who reported that the adoption of renewable energy technologies was significantly associated with perceived cost reduction and productivity gains. The present result, therefore, indicates that while awareness may exist, infrastructure and digital literacy remain barriers to effective adoption. Similarly, the low adoption of compost pits highlights the continued neglect of sustainable waste management practices. This aligns with Nkegbe and Shankar, (2019), who found that farmers perceived waste management technologies as less critical compared to feeding and housing innovations.

Table 3.4: Adoption rate on improved poultry technologies (n = 93)

Improved technologies	Adopted	Percentage (%)	Not adopted	Percentage (%)
Digital thermometer	33	35.5	60	64.5
Digital weighing scale	70	75.3	23	24.7
Mobile record-keeping app	61	65.6	32	34.4
Low cost solar-powered lighting	76	81.7	17	18.3
Compost pits	23	24.7	70	75.3

Source: Field Survey, 2025

3.4 Factors Influencing Smallholder Broiler Farmers' Decisions to Adopt Improved Poultry Technologies (Logistic Regression Results)

Logistic regression was used to examine the factors associated with broiler farmers' decisions to adopt improved poultry technologies in the study area. The results are presented in Table 3.5. The model shows moderate but meaningful explanatory power. The −2 Log Likelihood value of 100.980 suggests a reasonable fit in explaining farmers' adoption decisions. The Cox and Snell R^2 value of 0.267 indicates that approximately 26.7% of the variation in adoption is explained by the socioeconomic and institutional factors included in the model. Similarly, the Nagelkerke R^2 value of 0.356 suggests that about 35.6% of the variation in adoption is accounted for by the variables in the model (see Table 3.5). This indicates that while the included factors play an important role, other unobserved factors may also influence farmers' decisions to adopt improved technologies. The model estimation terminated at iteration number six, indicating convergence and stability (Hosmer, Lemeshow, & Sturdivant, 2013).

As shown in Table 3.5, educational level was positively associated with adoption likelihood. The odds ratio indicates that a one-unit increase in education level is associated with a 2.609 fold increase in the odds of adoption ($Exp[\beta] = 2.609$; $p = 0.036$). This means that farmers with higher educational attainment have more than two and a half times greater odds of adopting improved technologies compared to their less educated counterparts. This finding is consistent with existing literature reporting that education enhances a farmer's capacity to understand, evaluate, and effectively apply new technological information (Emaikwu et al., 2011; Aminu & Hassan, 2020). By improving information processing skills and technical comprehension, education appears to be an important correlate of innovation uptake, a pattern confirmed by the present analysis.

Farming experience was also positively associated with adoption. Each additional year of experience was associated with a 23.2% increase in the odds of adoption (Exp[β] = 1.232; p = 0.027). Accumulated practical experience may strengthen a farmer's confidence, technical competence, and ability to manage perceived risks associated with new technologies. This result is consistent with previous research; for instance, Williams and Ajayi (2020) found that experienced farmers demonstrate greater willingness to adopt innovations due to their reservoir of tacit knowledge. Furthermore, Teklewold et al. (2006) reported that experience improves farmers' evaluation of the potential benefits of an innovation. The agreement between these studies and the current findings underscores the potential role of experiential knowledge in shaping adoption behaviour.

In contrast, income derived from broiler farming showed a negligible and statistically non-significant association with adoption (β = 0.000; p = 0.630). This suggests that, within this context, higher farm income is neither positively nor negatively associated with the propensity to adopt improved technologies. This finding implies that greater income does not automatically translate into reinvestment for technological upgrading. While some studies have identified income as a positive correlate, arguing that wealthier farmers possess greater financial capacity to afford necessary inputs (Ogunniyi & Ajao, 2011), others have observed no direct effect when additional income is diverted toward pressing household needs rather than farm investment (Ojo et al., 2013). The present findings support this latter interpretation, indicating that income level was not a decisive factor in the adoption decision for this farmer cohort.

Access to credit was positively and statistically significantly associated with adoption. Farmers with access to credit had nearly four times greater odds of adopting improved poultry technologies compared to those without access (Exp[β] = 3.901; p = 0.064).

Flock size showed a significant positive association with adoption. The odds ratio (Exp[β] = 1.010; p = 0.006) indicates that each additional bird is associated with a 1.0% increase in the odds of adoption. Although the effect per single bird is small, it becomes more meaningful when considering moderate increases (e.g., 50 or 100 birds). This suggests that farmers operating at a larger scale are more likely to adopt practices that may improve efficiency and profitability. Ali et al. (2023) examined that the adoption of improved technologies enhanced optimal utilisation of key production inputs, particularly for larger-scale poultry farmers who operate with larger flock sizes and commercial production objectives.

3.5 Constraints Faced by Farmers in Adopting Improved Broiler Poultry Technologies

Table 3.6 presents the constraints faced by farmers in adopting improved poultry technologies in the study area, as ranked by respondents based on the reported severity of each problem.

The constraints reported as most severe were: high purchase cost (62.4% severe, 24.7% very severe), lack of government support (59.1% very severe), small farm size (48.4% severe, 22.5% very severe), and lack of access to credit or loans (47.3% severe, 38.7% very severe).

Other constraints reported as moderate to severe included lack of awareness (46.2% severe), limited technical skill (41.9% severe), and poor market availability of equipment (48.4% severe). These findings are broadly consistent with previous studies. Kisku et al. (2019) reported that lack of vaccination, information, and feed availability were major constraints for rural women engaged in backyard poultry in Jharkhand, India. Similarly, Kushwah et al.

(2016) found that high input costs, lack of veterinary aids, and financial constraints were major barriers to adoption in Bihar.

Table 3.5: Factors influencing smallholder broiler farmers' decision to adopt improved poultry technologies

Variables	β	S.E.	Sig. level	Exp (β)	–2 Log Likelihood	Cox & Snell R^2	Nagelkerke R^2
Age	-0.017	0.047	0.710	0.983	100.980	0.267	0.356
Educational Level	0.959	0.457	0.036**	2.609			
Farming Experience	0.209	0.094	0.027**	1.232			
Estimated Income	0.000	0.000	0.630	1.000			
Access to Credit	1.361	0.735	0.064*	3.901			
Total Flock Size	0.010	0.004	0.006***	1.010			
Access to Extension	1.581	1.599	0.323	4.860			
Constant	-7.710	2.887	0.008	0.000			

Source: Field Survey, 2025

****significant at 1% level, **significant at 5% level, *significant at 10% level*

Note: Odds ratios are interpreted as multiplicative changes in the odds of adoption, not as changes in probability. For small odds ratios close to 1.00 (e.g., 1.010), the percentage change in odds is approximately 1.0% per unit increase in the predictor.

The lack of access to government support and credit facilities observed in the current study mirrors findings by Abadi et al. (2018), who reported that extension contact, access to training, and availability of breeds and credit services significantly influenced adoption of improved poultry breeds in Ethiopia.

Additionally, Birhanu, Kassie, and Dessie (2024) emphasized that discontinuation or non-adoption of improved chicken breeds is often linked to financial limitations, gender barriers, and insufficient access to training and markets factors that resonate strongly with the findings of the present study.

Table 3.6: Constraints faced by farmers in adopting improved poultry technologies

Constraints	Not a constraint	Slightly constraint	Moderate	Severe	Very severe
High purchase cost	1 (1.1)	3 (3.2)	8 (8.6)	58 (62.4)	23 (24.7)
Lack of awareness / information	0 (0)	3 (3.2)	35 (37.7)	43 (46.2)	12 (12.9)
Limited technical skill/ training	1 (1.1)	7 (7.5)	38 (40.9)	39 (41.9)	8 (8.6)
Poor availability of equipment in the market	1 (1.1 %)	11 (11.8 %)	28 (30.1 %)	45 (48.4 %)	8 (8.6 %)
Lack of government support	1 (1.1)	2 (2.2)	3 (3.2)	32 (34.4)	55 (59.1)
Lack of access to credit/ loan	3 (3.2)	4 (4.3)	6 (6.5)	44 (47.3)	36 (38.7)
Small farm size	2 (2.2)	6 (6.5)	19 (20.4)	45 (48.4)	21(22.5)

Source: Field Survey, 2025

4.0 Limitations of the Study, and Areas for Future Research

This study has several limitations. First, the cross-sectional design captures adoption decisions at a single time point, so findings are interpreted as associations rather than causal effects. Second, convenience sampling was used due to the lack of a comprehensive sampling frame, which may limit generalizability to other regions or farming systems. Third, the study focused on five specific technologies; findings may not extend to other innovations such as automated feeders or improved breeds. Fourth, the model explained only 35.6% of adoption variation (Nagelkerke $R^2 = 0.356$), indicating that unobserved factors (e.g., risk preferences, social networks, digital access) also matter. Fifth, self-reported data may introduce recall or social desirability bias. Finally, the constraints analysis reflects perceived rather than objectively measured barriers.

Based on these limitations, future research should:

1. Longitudinal designs: Employ quasi-experimental methods (e.g., difference-in-differences) to establish causality and track adoption dynamics over time.
2. Broader geographic coverage: Conduct random-sample studies across multiple Nigerian states (e.g., Kaduna, Plateau, Oyo) to improve generalizability.
3. Psychological and social factors: Incorporate risk perception, innovation attitudes, social networks, digital literacy, and trust in extension agents to improve explanatory power.
4. Technology-specific analysis: Disaggregate adoption by individual technology types and examine adoption intensity rather than binary adoption.
5. Intervention evaluation: Assess the effectiveness of subsidy programs, credit-linked technology bundles, farmer field schools, and mobile advisory services.
6. Gender-disaggregated studies: Examine barriers faced by female farmers (given 75.5% male dominance) and pathways to improve women's access to credit and extension.
7. Economic impact assessment: Measure productivity outcomes (mortality, feed conversion) and household income effects of technology adoption.
8. Waste management technologies: Investigate barriers to adoption of compost pits and other recycling technologies given notably low awareness (29.8%).

5.0 Conclusion and Recommendations

The study concludes that adoption of improved poultry technologies among smallholder broiler farmers in Nassarawa L.G.A. is moderate, characterized by high awareness but uneven usage across different technologies. Socio-economic factors, including education, experience, and flock size significantly influence adoption decisions. Despite the potential of these technologies to enhance productivity and sustainability, farmers face persistent constraints, particularly financial and institutional barriers. Strengthening access to credit, targeted training, and extension services will be essential to increase adoption rates and improve broiler production efficiency in the area.

Based on the major findings of this study, the following recommendations are proffered:

1. Enhance Farmer Training and Extension Services: Government and NGOs should intensify extension programs and organise regular training workshops to increase farmers' technical capacity in using improved poultry technologies.
2. Improve Access to Affordable Credit: Financial institutions should design flexible and low-interest loan schemes specifically targeted at smallholder poultry farmers to enable them to acquire necessary equipment and inputs.

3. Promote Cooperative Membership: Farmers should be encouraged to form or join cooperative societies to strengthen collective bargaining power, access to inputs, training, and credit facilities.
4. Subsidize the Cost of Improved Technologies: Government and development partners should provide subsidies or financial incentives to reduce the high purchase cost of essential technologies such as digital weighing scales, solar-powered lighting, and mobile record-keeping devices.
5. Encourage Public-Private Partnerships: Collaboration between the public and private sectors can help in the local manufacture, distribution, and maintenance of affordable poultry technologies suitable for smallholder farmers.

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