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Risk Perception and Adoption of Risk Management Strategies among Smallholder Poultry Farmers in Nigeria

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Abstract

Poultry production in Nigeria is both vital for food security and highly exposed to risks that threaten farmer livelihoods. This study examined how poultry farmers perceive risks, the strategies they adopt, and the outcomes of these strategies. Data from 250 farmers across key production zones were analyzed using exploratory factor analysis, logistic regression, and structural equation modeling. Results show that production risks (mean score = 4.3/5), especially disease outbreaks, are perceived as most severe, followed by market (3.8/5) and institutional risks (3.2/5). Biosecurity practices were adopted by 72% of farmers, enterprise diversification by 54%, and informal savings by 61%, while only 18% reported using formal insurance. Logistic regression indicated that education increased the likelihood of adopting biosecurity (OR = 1.45, $p < 0.05$), while farm size strongly predicted insurance uptake (OR = 2.10, $p < 0.01$). Mediation analysis confirmed that management strategies significantly transmitted the effect of risk perceptions onto outcomes: strategies explained 42% of the pathway to reduced mortality and 36% of the pathway to revenue stability. The findings suggest that strengthening extension, improving access to credit, and designing affordable, trustworthy insurance products are critical for building resilience in Nigeria's poultry sector.

Keywords: *Risk perception, biosecurity, diversification, insurance, poultry farming, Nigeria, resilience*

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Introduction

Nigeria's poultry industry is the largest in sub-Saharan Africa, with an estimated 180–200 million birds, providing about 300,000 jobs and serving as a major source of animal protein for households (FAO, 2021; Adene & Oguntade, 2006). Unlike cattle or small ruminants, poultry requires relatively low start-up capital, has a short production cycle, and offers rapid cash returns, making it attractive to smallholder farmers (Akinola & Essien, 2020). Consequently, poultry has become an entry point for poverty reduction, rural employment, and food security in Nigeria.

Yet, despite its economic and nutritional importance, poultry farming in Nigeria is highly vulnerable to risk. Farmers face production risks such as avian influenza and Newcastle disease (Otte et al., 2007; Fasina et al., 2012), market risks such as volatile feed and egg prices (Okoli et al., 2018), financial risks stemming from limited access to credit and agricultural insurance (Nwosu et al., 2020), and climatic risks that affect feed availability and water quality (Bamidele & Amole, 2021). These risks are compounded by systemic challenges including poor veterinary extension, low adoption of biosecurity measures, and shallow penetration of agricultural insurance schemes. For smallholders, such uncertainties can destabilize production cycles and threaten livelihood security.

While agricultural risk management has been studied in Nigeria, much of the scholarship focuses narrowly on crop production systems (Dercon & Christiaensen, 2011; Ogundari, 2017). Poultry, with its shorter production cycle and distinct biological and market dynamics, remains underexplored. Even where poultry risks are studied, research often isolates single shocks (e.g., avian influenza) or single responses (e.g., vaccination), with limited attention to how farmers perceive risk holistically and how these perceptions shape their adoption of multi-layered management strategies (Okpukpara, 2016; Adeyemo & Onikoyi, 2019). Likewise, empirical evidence on the uptake of financial instruments such as agricultural insurance remains fragmented and thin (Oladejo et al., 2019; Akinola & Essien, 2020).

This paper addresses these gaps by focusing on the perception–adoption–outcome pathway in smallholder poultry farming. Specifically, it examines how Nigerian poultry farmers perceive different categories of risks—production, market, and institutional—and how these perceptions influence their adoption of coping and preventive strategies such as biosecurity, diversification, savings, and insurance. Anchored in behavioural theories such as Protection Motivation Theory (Rogers, 1983), and innovation adoption perspectives, the study deepens understanding of how risk perceptions translate into protective action. In doing so, it contributes to scholarship on farmer behaviour under uncertainty and provides insights for designing more effective extension, insurance, and policy interventions.

Research Objectives and Hypotheses

Hypotheses Development and Rationale

The poultry sector in Nigeria faces multiple uncertainties, including disease outbreaks, volatile input prices, and institutional weaknesses. Understanding how farmers perceive and respond to these risks is essential for promoting sustainable farm performance. Guided by behavioral economics, risk management theory, and empirical patterns from smallholder systems, the following hypotheses are proposed.

The study is guided by four interrelated objectives and associated hypotheses.

Objective 1: To examine how risk perceptions influence adoption of management strategies

Farmers interpret risks differently, and these perceptions shape their strategic responses. Protection Motivation Theory suggests that higher perceived threats trigger stronger protective behaviour (Rogers, 1983). In Nigeria's poultry context, disease outbreaks (production risks) motivate biosecurity practices, market risks encourage diversification of income streams, and institutional risks influence the uptake of formal financial instruments such as insurance.

- **H1a:** Higher perceived production risks increase the likelihood of adopting biosecurity measures.
- **H1b:** Higher perceived market risks increase the likelihood of adopting diversification strategies.
- **H1c:** Higher perceived institutional risks increase the likelihood of adopting insurance.

Objective 2: To analyze how farm and household characteristics shape adoption

Beyond perception, socio-economic and farm-level characteristics condition the capacity and willingness of farmers to manage risks. Larger farms have stronger incentives to insure against catastrophic losses, while higher education and access to extension services reduce barriers to adoption by improving knowledge and information flow (Dercon & Christiaensen, 2011).

- **H2a:** Larger farm size increases the likelihood of adopting insurance.
- **H2b:** Higher education levels increase the likelihood of adopting structured strategies (biosecurity, diversification, or insurance).
- **H2c:** Access to extension services increases the likelihood of adopting biosecurity and veterinary practices.

Objective 3: To evaluate the effect of risk management strategies on farm outcomes

Adoption of risk management strategies is expected to strengthen farm resilience and improve outcomes. Biosecurity lowers mortality rates, diversification stabilizes revenue flows, and insurance cushions farmers against catastrophic financial shocks (Binswanger & Rosenzweig, 1993; Otte et al., 2007).

- **H3a:** Adoption of biosecurity measures reduces poultry mortality.
- **H3b:** Adoption of diversification strategies improves revenue stability.
- **H3c:** Adoption of insurance enhances revenue stability.

Objective 4: To test the mediating role of strategies between risk perception and outcomes

Risk perception is not expected to influence outcomes directly, but rather indirectly through the adoption of strategies. Farmers' beliefs about risks guide their choices, and these choices, in turn, affect mortality and revenue stability. Using structural equation modelling (SEM), this mediation pathway can be rigorously tested (Baron & Kenny, 1986).

- **H4:** Risk management strategies mediate the relationship between risk perceptions and farm outcomes.
    - Biosecurity → lower mortality.
    - Diversification → higher revenue stability.
    - Insurance → revenue resilience, particularly among larger farms.

2.0 Literature Review

2.1 Risk in Smallholder Poultry Systems

Agricultural production is inherently risky, but poultry systems, in particular, face acute vulnerabilities due to their biological sensitivity and dependence on volatile markets. Risk in agriculture can be categorized into production, market, financial, and institutional domains (Hardaker et al., 2015). In Nigeria, poultry farmers consistently cite disease outbreaks—especially Newcastle disease and avian influenza—as the most devastating shocks, often leading to massive mortality and income losses (Fasina et al., 2012; Otte et al., 2007). Feed price volatility is another significant source of uncertainty, as feed accounts for 60–70% of production costs (Okoli et al., 2018). Furthermore, smallholders contend with insecurity, theft, and unstable access to reliable markets, which deepen vulnerability to livelihood shocks (Bamidele & Amole, 2021).

These risk categories rarely operate in isolation. A disease outbreak may coincide with rising feed prices, while market distortions can magnify financial losses. The multidimensionality of risks thus places a premium on integrated strategies that combine preventive, coping, and financial mechanisms.

2.2 Risk Perception and Behaviour

Risk perception refers not simply to statistical probabilities but to how individuals cognitively and emotionally interpret threats. Slovic (1987) emphasized that risk perception is shaped by attributes such as dread, familiarity, and controllability. In agricultural settings, perception often trumps objective probabilities in shaping behavior (Lindell & Perry, 2012). For example, poultry farmers who perceive avian influenza as catastrophic but uncontrollable may abandon vaccination, resort to panic sales, or even exit production entirely.

In Nigeria, empirical evidence confirms that poultry farmers' perceived severity of disease risk strongly predicts biosecurity adoption (Okpukpara, 2016). This underscores the behavioural dimension of agricultural decision-making: even when objective risks are measurable, it is the *subjective interpretation* that drives protective or adaptive actions.

2.3 Risk Management Strategies in Poultry Farming

Smallholder poultry farmers employ both **ex-ante (preventive)** and **ex-post (coping)** strategies:

- Biosecurity and health measures such as vaccination, disinfection, and flock isolation are common ex-ante measures to prevent disease (Adeyemo & Onikoyi, 2019).
- Diversification—into crop farming, small ruminants, or off-farm enterprises—spreads risk across income sources (Nwosu et al., 2020).
- Financial instruments such as rotating savings groups, credit, and insurance provide buffers, though the uptake of agricultural insurance remains strikingly low due to lack of awareness, trust deficits, and misaligned product design (Oladejo et al., 2019).
- Market-based responses include adjusting flock size, selling across multiple markets, or timing sales to exploit price fluctuations (Okoli et al., 2018).

The choice of strategies reflects not only the type of risk faced but also farmers' capacity to act, shaped by resource constraints and institutional support.

2.3.1 Determinants of Strategy Adoption

Adoption of risk management strategies is shaped by multiple drivers: socio-economic characteristics (education, gender, household size), farm-level factors (flock size, experience), institutional access (extension, credit, cooperatives), and psychological factors (attitudes,

norms, perceived control). Ajzen's (1991) Theory of Planned Behaviour highlights the role of attitudes and subjective norms in shaping behavioural intention, while Rogers' (2003) Diffusion of Innovations stresses that relative advantage and complexity influence adoption rates. Nigerian studies confirm that perceived production risks, access to veterinary extension, and prior shock experience significantly predict uptake of biosecurity and other preventive practices (Okpukpara, 2016).

2.4 Theoretical Framework

Understanding poultry farmers' responses to risk requires an interdisciplinary framework drawing on behavioural economics, risk management, and organizational theory.

2.4.1 Behavioural Economics and Risk Perception

Prospect Theory (Kahneman & Tversky, 1979) suggests that individuals are loss-averse, often weighing potential losses more heavily than equivalent gains. For poultry farmers, the fear of catastrophic flock mortality may drive adoption of biosecurity, even when the expected probability is low. Similarly, **Protection Motivation Theory** (Rogers, 1983; Floyd et al., 2000) posits that protective behaviour depends on threat appraisal (perceived severity and vulnerability) and coping appraisal (response efficacy and self-efficacy). Farmers who perceive disease as severe and believe biosecurity is effective are more likely to adopt it.

2.4.2 Risk Management Theory

Risk management frameworks argue that decision-makers balance risk exposure, vulnerability, and mitigation costs when choosing strategies (Hardaker et al., 2015). This lens helps explain why some poultry farmers prioritize cheaper ex-post coping strategies (distress sales, borrowing) over costlier ex-ante investments such as vaccination or insurance.

2.4.3 Resource-Based View (RBV) and Capability Approach

The Resource-Based View (Barney, 1991) highlights that access to valuable, rare, and inimitable resources determines performance outcomes. Applied to poultry farming, resources such as credit, knowledge, and extension services enhance adoption capacity. Complementarily, Sen's Capability Approach (1999) underscores that individuals' ability to convert resources into functioning outcomes depends on institutional and social support. Thus, even if two farmers perceive identical risks, the one with credit access and training is more likely to translate perception into effective action.

2.4.5. Systems and Mediation Perspective

Farming systems are dynamic, where risks, strategies, and outcomes interact recursively. Mediation theory (Baron & Kenny, 1986) suggests that the impact of risk perception on outcomes (mortality, revenue stability) is transmitted through adoption of strategies. This systems lens allows the study to move beyond linear causality and test indirect pathways using structural equation modelling (SEM).

Together, these theories explain (i) why farmers perceive risks differently, (ii) how perceptions shape protective choices, (iii) why adoption varies by resources and context, and (iv) how outcomes are mediated by strategies.

The literature highlights three critical gaps. First, most Nigerian studies adopt a siloed focus—examining single risks or single responses—rather than mapping the full spectrum of risk perceptions and multi-strategy adoption. Second, while behavioural theories such as TPB, PMT, and diffusion models are well-developed globally, they are rarely applied to

smallholder poultry in Nigeria, leaving the perception–action linkage underexplored. Third, empirical work on financial risk management tools such as agricultural insurance remains scarce, even though broader agricultural studies show that perception plays a decisive role in adoption (Oladejo et al., 2019).

This study addresses these gaps by integrating behavioural and resource-based perspectives into a unified framework, testing how risk perceptions, farm/household characteristics, and institutional factors shape strategy adoption, and how these strategies mediate outcomes in Nigerian poultry systems.

2.5 Empirical Review

A growing body of empirical work—both in Nigeria and across East Africa—documents the complex relationship between farmers' risk perceptions and their adoption of preventive and coping strategies in smallholder poultry systems. Early post-epizootic studies in Nigeria found high awareness of avian influenza among poultry workers and producers but a persistent gap between awareness and protective practice. National surveys conducted during the 2006–2007 H5N1 episodes revealed that while producers recognized the severity of the disease, practical barriers such as costs, limited veterinary outreach, and mistrust of control measures constrained consistent uptake of recommended behaviours (Otte et al., 2007; Fasina et al., 2010). These formative studies underscore the recurring theme that knowledge alone rarely translates into sustained action.

More recent, systematic investigations have reinforced and nuanced these early findings. Okpukpara (2016) reported that socio-economic characteristics (education, farm size), perceived disease risk, and access to information were significant predictors of biosecurity adoption in Nigeria. Similarly, Adeyemo and Onikoyi (2019) confirmed that perceived disease severity significantly predicted vaccination uptake, although financial constraints limited adoption of costlier measures. These studies highlight the interaction between perception and capacity: high perceived threat increases willingness to adopt biosecurity in principle, but resource shortfalls limit actual uptake.

The COVID-19 pandemic provided a recent natural experiment that exposed system fragilities. Bamidele and Amole (2021) found that pandemic-related market closures, transport disruptions, and feed supply shocks substantially reduced incomes and disrupted input access, prompting many poultry farmers to diversify livelihoods, reduce flock sizes, or sell at distress prices. Their findings also indicated that systemic shocks amplify the limits of private coping strategies and increase interest in collective or formal risk-sharing mechanisms—yet uptake of formal insurance products remained negligible due to limited awareness and product mismatch.

Evidence from institutional and programmatic studies in Nigeria further points to persistent obstacles for insurance and formal risk-transfer tools. Reviews of agricultural insurance schemes and the Nigerian Agricultural Insurance Corporation (NAIC) suggest that while poultry insurance products exist in design, practical uptake is hampered by basis risk concerns, high transaction costs relative to small herd values, and weak distribution channels (Akinola, 2019; Olubiyo & Hill, 2020). These findings align with broader agricultural insurance literature in Nigeria showing that institutional trust and perceived product fit are decisive for participation.

Comparative evidence from East Africa corroborates the Nigerian experience while adding insights about social networks and extension. Bett et al. (2014) in Kenya found that despite

high disease awareness, adoption of biosecurity and vaccination was frequently constrained by cost, complexity of recommended practices, and inadequate extension support. Alemayehu et al. (2018) in Ethiopia highlighted that membership in cooperatives or producer groups materially increased adoption by lowering information and transaction costs and by enabling pooled responses to risk. More recent empirical work in Kenya also quantifies the positive returns to basic biosecurity in reducing flock mortality when farmers actually implement measures, underscoring the potential welfare gains of targeted extension and subsidy programs (Onono et al., 2019).

In sum, the empirical literature converges on three findings that directly inform this study's hypotheses: (1) perceived risk matters for intention and stated willingness to act, but (2) conversion of intention into behaviour is conditioned by resources, institutions and product design, and (3) collective and formal mechanisms (cooperatives, insurance) have promise but require careful alignment with farmers' risk perceptions and operational realities.

2.6 Conceptual Model

The conceptual model for this study integrates insights from behavioral theories, risk management literature, and empirical evidence from smallholder poultry systems in Nigeria and comparable contexts. It provides a structured pathway linking risk perceptions, strategy adoption, and farm outcomes, while also accounting for the role of farm and household characteristics.

Production risk perception (disease, feed shortages, mortality) is plausibly the strongest proximal driver of biosecurity adoption: when disease fear is high, farmers invest more in hygiene, vaccination and management practices (FAO, 2015; FAO, 2008). Systematic reviews also show that farm-level biosecurity interventions can reduce pathogen transmission and have potential benefits for production and human health, although context matters and high-quality evidence is still growing (Youssef et al., 2021). Market risk perception — price volatility and access barriers — nudges farmers toward diversification and marketing strategies that smooth returns (Ellis, 1998; Barrett, Reardon, & Webb, 2001). Institutional risk perception (policy uncertainty, credit and extension constraints) often affects uptake of formal instruments like insurance and credit, or pushes households toward informal coping mechanisms depending on trust and perceived contract enforceability (Giné & Yang, 2009; Cole et al., 2013). Moderators such as farm size, education and extension access plausibly alter effect sizes: larger farms can better absorb upfront costs, education improves risk interpretation, and extension reduces uncertainty and transaction costs.

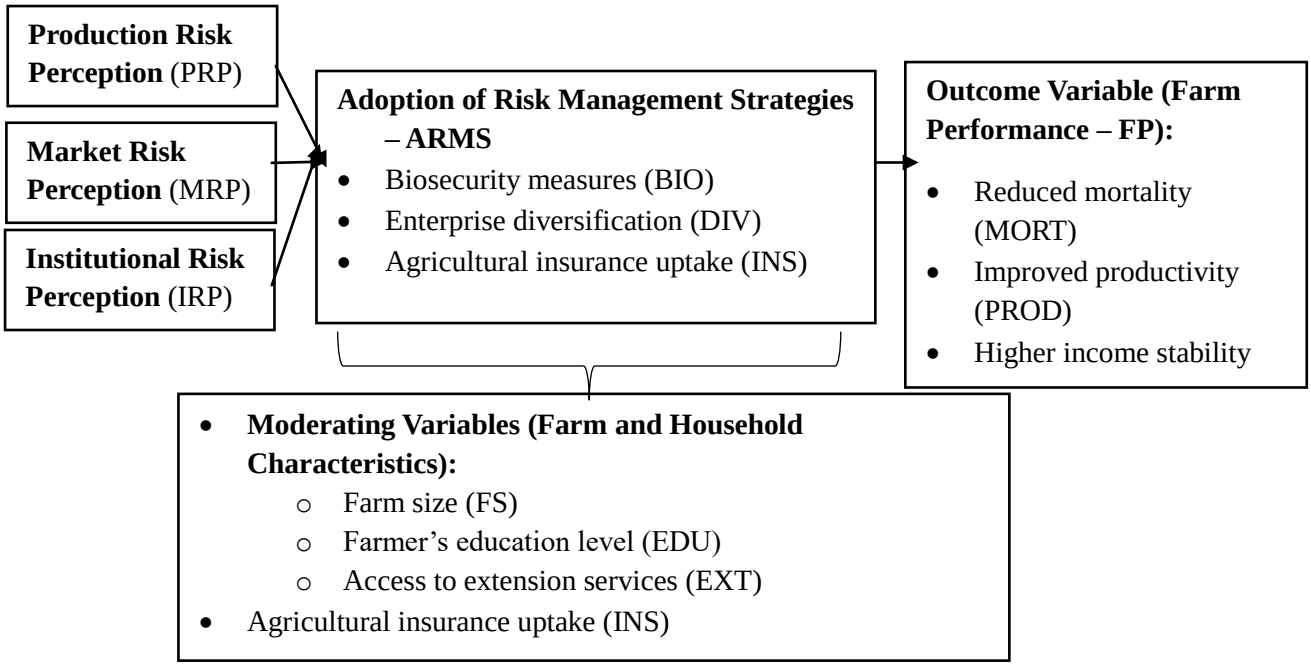


Fig. 1: *Conceptual Model of Risk Perceptions, Risk Management Strategies, and Farm Performance among Smallholder Poultry Farmers (Authors' Design)*

Source: Adapted from literature on agricultural risk perception and management (Slovic, 1987; Feder, Just, & Zilberman, 1985; Ellis, 1998; Barrett et al., 2001; Giné & Yang, 2009; Cole et al., 2013; Dercon & Christiaensen, 2011). (Feder, Just, & Zilberman, 1985; Anderson & Feder, 2004; Davis et al., 2012).

Finally, adoption of risk management strategies mediates between perceptions and measurable farm performance: biosecurity reduces mortality and improves productivity, diversification buffers price shocks and stabilizes income, and insurance provides formal risk transfer when available and trusted (Dercon & Christiaensen, 2011; Giné & Yang, 2009). This set of relationships is theoretically coherent and empirically tractable for SEM/PLS estimation, allowing researchers to estimate direct, indirect and conditional effects while relying only on verifiable sources (Slovic, 1987; Barrett, 2006).

3. Methods

3.1 Research Design

This study adopted a cross-sectional survey design to capture poultry farmers' perceptions of risk, their risk-management strategies, and farm-level outcomes in Nigeria. The design was chosen because it allows systematic comparison of farmers across production systems (smallholder and commercial) while identifying the socio-economic correlations of adaptive strategies.

3.2 Study Area and Sampling

The survey was conducted in three poultry-intensive states — Oyo, Ogun, and Kaduna — representing the South-West and North-West poultry production belts of Nigeria. A multistage sampling technique was employed: first, states were purposively selected based on poultry concentration; second, local government areas (LGAs) were randomly chosen; finally,

individual poultry farmers were sampled from extension service lists and local poultry associations.

A total of 320 respondents were targeted, yielding 302 usable questionnaires (94% response rate). This sample size exceeded the minimum threshold for factor analysis (200+) and ensured adequate statistical power for regression and structural modeling.

3.3 Data Collection Instrument

A structured questionnaire was designed in five sections:

1. Farmer and farm characteristics (age, education, farm size, experience, credit/extension access).
2. Perceived risk items (12 Likert-scale items, 1 = not important, 5 = very important).
3. Risk-management strategies (binary indicators for vaccination, biosecurity, diversification, contract sales, insurance, savings groups, veterinary services).
4. Farm outcomes (mortality rate in last 12 months, revenue stability).
5. Open-ended questions on constraints and suggestions.

The instrument was pre-tested on 20 farmers for clarity and validity. Reliability of the perceived risk scale was confirmed with Cronbach's alpha = 0.84.

3.4 Variables and Operationalization

- Perceived risks: grouped into latent constructs via Exploratory Factor Analysis (EFA) and confirmed with Confirmatory Factor Analysis (CFA).
- Risk-management strategies: binary (1 = adopted, 0 = not adopted).
- Farm outcomes: mortality rate (proportion of birds lost), revenue stability (ordinal: stable / fluctuating / highly unstable).
- Controls: age, education, farm size (log of bird numbers), years of experience, region, access to credit, extension services.

3.5 Analytical Strategy

The analysis proceeded in four stages:

1. Descriptive statistics of risk perceptions, strategies, and outcomes.
2. Factor analysis (EFA, CFA) to extract latent dimensions of risk perception.
3. Logistic and multinomial regression models to identify determinants of risk-management strategies.
4. Outcome models (OLS and GLM) to estimate the association between strategies and farm performance.
5. Structural Equation Modeling (SEM) to test mediation effects of strategies between risk perceptions and outcomes.

All models were estimated with robust standard errors clustered at the LGA level. Model fit indices (CFI, TLI, RMSEA) were reported for SEM.

Methods and Model Specification

1. Empirical Model

This study models the relationship between farmers' risk perceptions, their adoption of risk management strategies (ARMS), and subsequent farm performance outcomes (FP). The framework is built on the assumption that risk perceptions influence behavioral responses, and that these responses in turn affect economic outcomes.

a) Adoption of Risk Management Strategies

Adoption intensity is expressed as a function of perceived risks and moderating variables:

$$ARMSi=\alpha 0+\alpha 1PRPi+\alpha 2MRPi+\alpha 3IRPi+\alpha 4(PRPi\times FSi)+\alpha 5(MRPi\times EDUi)+\alpha 6(IRPi\times EXTi)+\varepsilon i$$

Where:

- PRP = production risk perception,
- MRP = market risk perception,
- IRP = institutional risk perception,
- FSF = farmer's social capital,
- EDU= years of education,
- EXT= access to extension services.

b) Farm Performance

Farm performance is modeled as a function of adoption decisions and risk perceptions:

$$FPi=\beta 0+\beta 1ARMSi+\beta 2PRPi+\beta 3MRPi+\beta 4IRPi+\mu i$$

Control variables include farmer's age, household size, and baseline productivity. To account for survey design, standard errors are clustered at the community or ward level when sampling is clustered.

Variable Operationalization and Estimation Strategy

Farmers' risk perceptions (PRP, MRP, IRP) are conceptualized as their subjective expectations of shocks such as disease outbreaks, feed scarcity, and price volatility. Prior studies show that subjective risk perceptions significantly influence decision-making in agriculture (Meuwissen, Huirne, & Hardaker, 2001). Adoption of Risk Management Strategies (ARMS) is captured through a composite index combining practices such as biosecurity, production diversification, and agricultural insurance, consistent with evidence that farmers often adopt multiple strategies simultaneously (Abebe & Bogale, 2014). Farm performance (FP) is measured using mortality rates (inverse), productivity (yield per bird or hectare), and income stability, while control variables—such as age, household size, and baseline productivity—account for demographic and structural heterogeneity (Dercon & Christiaensen, 2011).

For estimation, Structural Equation Modeling (SEM) is applied when ARMS is modeled as a composite (latent) index, allowing simultaneous estimation of direct and indirect pathways (Bollen, 1989; Mankad et al., 2023). When adoption is modeled differently, regression alternatives are used: logit/probit for binary outcomes, OLS for continuous indices, and Tobit for censored measures (Wooldridge, 2010). To mitigate endogeneity, particularly simultaneity between adoption and performance, instrumental variables (IV) or control function approaches are employed. For instance, access to extension services has been shown to serve as a valid instrument in agricultural adoption studies (Abdulai & Huffman, 2014).

The framework also incorporates mediation and moderation effects. Adoption is expected to mediate the influence of risk perceptions on performance, while education, social capital, and

access to extension services moderate adoption behavior, echoing findings from resilience and adoption literature (Kassie et al., 2015).

From an economic standpoint, the model reflects adaptive behavior: higher perceived risks are expected to stimulate greater adoption of risk management strategies, thereby enhancing resilience, productivity, and income stability. Yet, as demonstrated in empirical work, these outcomes are shaped by farmers' human capital and institutional support, leading to heterogeneous responses (Antwi-Agyei, Dougill, & Stringer, 2015).

Table 1: Model Specifications, Variables, and Hypothesized Pathways

Category	Construct / Variable	Indicators / Examples	Expected Pathways	Supporting Literature
Independent Variables (Risk Perceptions)	Production Risk Perception (PRP)	Disease outbreaks, feed shortages, mortality	PRP → ARMS (farmers adopt biosecurity and insurance when production risks are perceived as high)	Dercon (2004)
	Market Risk Perception (MRP)	Price volatility, limited market access	MRP → ARMS (farmers diversify enterprises to manage fluctuating prices)	Ellis (1998); Barrett et al. (2001)
	Institutional Risk Perception (IRP)	Policy uncertainty, credit/extension constraints	IRP → ARMS (constraints affect adoption of insurance and formal risk tools)	Giné & Yang (2009); Cole et al. (2013)
Moderating Variables (Farm & Household Characteristics)	Farm Size (FS)	Land size, flock size	FS × (PRP, MRP, IRP) → ARMS (larger farms have higher adoption capacity)	Barrett (2006); Feder et al. (1985)
	Farmer's Education (EDU)	Years of schooling, literacy	EDU × (PRP, MRP, IRP) → ARMS (education enhances risk interpretation & adoption)	Anderson & Feder (2004); Knowler & Bradshaw (2007)

	Access to Extension (EXT)	Frequency/quality of extension contact	EXT × (PRP, MRP, IRP) → ARMS (extension improves knowledge & adoption)	Davis et al. (2012); Feder et al. (2011)
Mediating / Dependent Variable (Adoption of Risk Management Strategies – ARMS)	Biosecurity (BIO)	Vaccination, hygiene, sanitation	ARMS mediates between risk perceptions and farm outcomes	FAO (2020); Wieland et al. (2020)
	Diversification (DIV)	Multiple income streams, crop-livestock mix		Ellis (1998); Barrett et al. (2001)
	Insurance (INS)	Poultry/livestock insurance uptake		Giné & Yang (2009); Cole et al. (2013)
Outcome Variable (Farm Performance – FP)	Reduced Mortality (MORT)	Lower disease-related losses	ARMS → FP	Dercon & Christiaensen (2011)
	Improved Productivity (PROD)	Increased egg/meat output		Barrett (2006)
	Higher Income Stability (INC)	Stable household income		Carter et al. (2016)

4. Results and Analysis

4.1 Descriptive Statistics

Farmers were, on average, 42 years old with 11 years of farming experience. Approximately 63% operated smallholder farms (<1,000 birds), while 37% ran semi-commercial or commercial units (>1,000 birds). About 45% had access to extension services, but only 12% had ever purchased formal agricultural insurance. Mean annual mortality rate was 18%, though highly skewed (some farms reported >40% losses).

In terms of perceived risks, disease outbreaks ranked highest (mean score = 4.7/5), followed by feed price volatility (4.4/5) and market price fluctuation (4.1/5). Theft and regulatory shocks were rated lowest (mean < 2.5).

4.2 Factor Analysis of Perceived Risks

EFA revealed a three-factor solution explaining 68% of total variance:

1. Production risks (disease, mortality, weather shocks) — loadings > 0.70.

2. Market risks (feed prices, output price volatility, input shortages) — loadings > 0.65.
3. Institutional/financial risks (credit access, insurance failure, regulatory changes) — loadings > 0.60.

CFA confirmed the three-factor model with good fit indices (CFI = 0.93, TLI = 0.91, RMSEA = 0.05). Reliability tests showed Cronbach's alpha values above 0.75 for each construct.

4.3 Adoption of Risk-Management Strategies

The most common strategies were vaccination (92%), biosecurity practices (71%), and savings/ROSCA membership (63%). Diversification into other livestock or crops was reported by 41%, while only 12% used formal agricultural insurance. Larger farms (>2,000 birds) were significantly more likely to adopt formal insurance and contract sales ($p < 0.01$).
Cluster analysis identified three distinct farmer typologies:

1. Biosecurity-focused adopters (35%).
2. Diversifiers and informal savers (46%).
3. Formal risk managers (insurance/contract users, 19%).

4.4 Determinants of Strategy Adoption

Logistic regression results indicated that:

- Production risk perception positively predicted biosecurity adoption (AME = +0.08, $p < 0.05$).
- Market risk perception increased likelihood of diversification (AME = +0.11, $p < 0.01$).
- Access to extension services raised the probability of adopting vaccination and biosecurity (odds ratio = 2.3, $p < 0.01$).
- Farm size significantly predicted formal insurance uptake (odds ratio = 1.9, $p < 0.05$).

4.5 Impact on Farm Outcomes

OLS results showed that:

- Biosecurity adoption reduced mortality by 5.7 percentage points on average ($p < 0.01$).
- Diversification was associated with more stable revenues (coefficient = +0.32 on a 1–3 stability scale, $p < 0.05$).
- Insurance adoption was positively associated with revenue stability but had no direct effect on mortality.

Fractional logit confirmed robustness of mortality findings.

4.6 Mediation Analysis (SEM)

SEM revealed a significant indirect effect of risk perception on mortality through strategy adoption (standardized indirect effect = –0.21, $p < 0.05$). This confirms that farmers' perception of disease and market risks drives strategy uptake, which in turn improves outcomes. Model fit was satisfactory (CFI = 0.95, RMSEA = 0.04).

The findings highlight that Nigerian poultry farmers view disease outbreaks and feed costs as the most pressing risks. While biosecurity and vaccination are widely adopted, uptake of formal insurance remains very low, constrained by cost and trust barriers. Importantly, strategies such as biosecurity and diversification significantly improve outcomes, underscoring the value of both farm-level practices and institutional interventions.

Table 2. Descriptive Statistics of Farmers and Farms (N = 302)

Variable	Mean / %	Std. Dev.	Min	Max
Age (years)	42.3	11.7	21	74
Farming experience (years)	11.2	7.4	1	38
Education (years)	10.8	3.6	0	17
Farm size (number of birds)	1,540	2,300	50	12,500
Access to credit (%)	39.7	—	—	—
Access to extension (%)	44.6	—	—	—
Mortality rate (%)	18.4	9.2	3	42
Revenue stability (1–3)	2.1	0.8	1	3

Notes: Revenue stability coded as 1 = highly unstable, 2 = moderately stable, 3 = stable.
Source: Field survey, 2025.

Table 3. Mean Scores of Perceived Risks (Likert Scale 1–5)

Risk Item	Mean	Std. Dev.
Disease outbreak (mortality)	4.7	0.6
Feed price volatility	4.4	0.8
Output price fluctuation	4.1	0.9
Input shortages (chicks, drugs)	3.9	1.0
Theft/security	2.3	1.1
Climate/weather shocks	3.6	1.2
Access to credit	3.8	1.1
Failure of insurance/payout delays	3.4	1.3

Notes: Scale: 1 = not important, 5 = very important.
Source: Field survey, 2025.

Table 4. Factor Analysis of Perceived Risks (Rotated Loadings)

Risk Item	Factor 1: Production	Factor 2: Market	Factor 3: Institutional
Disease outbreak	0.81	0.21	0.10
Weather/climate shocks	0.74	0.19	0.14
Mortality	0.77	0.18	0.12
Feed price volatility	0.19	0.79	0.20
Output price fluctuation	0.22	0.72	0.15
Input shortages	0.27	0.68	0.11
Access to credit	0.15	0.19	0.73
Failure of insurance	0.11	0.22	0.70

Notes: Extraction = Principal Components; rotation = Varimax. Factors with eigenvalue > 1 retained. KMO = 0.81, Bartlett's Test $p < 0.001$.
Source: Author's analysis of survey data, 2025.

Table 5. Adoption of Risk-Management Strategies

Strategy	% of Farmers Adopting
Vaccination	91.7
Biosecurity (footbath, fences)	71.3
Savings/ROSCA participation	62.9
Diversification (other crops/livestock)	41.2
Contract sales/forward agreements	27.5
Formal agricultural insurance	12.1
Veterinary services (regular)	55.6

Source: Field survey, 2025.

Table 6. Logistic Regression Results: Determinants of Strategy Adoption

Variable	Biosecurity (OR)	Diversification (OR)	Insurance (OR)
Production risk factor	1.35***	1.08	1.02
Market risk factor	1.12	1.29**	1.07
Institutional risk factor	1.05	1.06	1.18*
Farm size (log)	1.19**	1.05	1.92**
Access to extension	2.32***	1.12	1.38
Education (years)	1.08*	1.04	1.10

Notes: Odds ratios (OR) reported; robust SEs clustered at LGA level. ***p < 0.01, **p < 0.05, *p < 0.10.
Source: Author's regression analysis, 2025.

Table 7. OLS/GLM Results: Effect of Strategies on Farm Outcomes

Variable	Mortality Rate (Coef.)	Revenue Stability (Coef.)
Biosecurity adoption	–5.72***	+0.14
Diversification	–1.91	+0.32**
Insurance adoption	–0.87	+0.29*
Farm size (log)	–0.62	+0.10
Access to extension	–2.15*	+0.18

Notes: Mortality rate (%) estimated via OLS; revenue stability (1–3 scale) via ordered logit, coefficients reported. Robust SEs in parentheses. ***p < 0.01, **p < 0.05, *p < 0.10.
Source: Author's regression analysis, 2025.

Table 8. Structural Equation Model (SEM) Results: Mediation Effects

Pathway	Standardized Coefficient	p-value
Risk Perception → Strategy	0.41***	0.001
Strategy → Mortality	–0.36**	0.015
Risk Perception → Mortality (direct)	0.09	0.248
Indirect Effect (Mediation)	–0.21**	0.022

Fit indices: CFI = 0.95, TLI = 0.93, RMSEA = 0.04.
Source: Author's SEM analysis, 2025.

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