

Indigenous Chicken Production Practices; Adoption Rates, Market Participation, and Determinants of Adoption Score Among Smallholder Farmers in Chikankata District, Zambia

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Abstract

Indigenous chickens (ICs) play an important role in the livelihoods of smallholder farmers in Zambia. However, there is limited empirical information on the adoption of, market participation, and their influencing factors among these farmers in Chikankata District. This study evaluated the adoption of IC production practices, compared the adoption status between market participants and non-participants, and determined the factors influencing adoption score among 202 IC farmers. Data were collected from 202 smallholder farmers selected using a multistage sampling technique. Descriptive statistics, an independent samples t-test, chi-square test, and Poisson regression analysis with robust standard errors were used in the analysis. The study revealed that clean water availability was almost universal (97%), while improved breed adoption was very low (0.5%). In addition, market participants recorded a significantly higher adoption score ($M = 4.99$, $SD = 2.49$) than the non-participants ($M = 3.60$, $SD = 1.63$; $t = 4.745$, $p < 0.001$). Poisson regression analysis indicated that access to extension services ($IRR = 1.474$, $p < 0.001$) and credit ($IRR = 1.449$, $p < 0.001$) were the most influential factors associated with adoption score positively. Similarly, flock size ($IRR = 1.006$, $p < 0.001$) and income from poultry sales ($IRR = 1.0001$, $p < 0.001$) were positively associated with adoption score. However, experience with improved chickens ($IRR = 0.987$, $SD = 2.490$) and training frequency ($IRR = 0.885$, $SD = 2.491$) were negatively related to adoption score. It was concluded that increasing adoption score of IC production practices by smallholder farmers in Zambia requires promoting access to financial services and extension services.

Keywords: Indigenous Chicken, Production Practices, Adoption, Market Participation, Zambia.

1. INTRODUCTION

Indigenous chicken (IC) production plays a critical role in smallholder farming systems in sub-Saharan Africa contributing to food security, income and socio-cultural practices (Liswaniso et al., 2024). In Zambia, ICs represent the most produced livestock species as each household of the 1.6 million farmers houses an average of 21 million chickens (Liswaniso et al., 2024). However, the productivity of indigenous chickens in smallholder farming is constrained by slow growth rates, low egg production and high chick

mortality (Kanyama et al., 2024). The production practices used by smallholder farmers are important in managing these factors to promote production (Liswaniso et al., 2024).

Indigenous chicken production in Zambia is mostly based on free-range and semi-intensive systems where most farmers allow their chickens to scavenge (Liswaniso et al., 2024). Liswaniso et al. (2024) report that all the farmers interviewed in their study allowed their chickens to scavenge while only 45.58% of them supplemented their diets with feed. The average flock size was 12.5 chickens per household while 42.03% of the farmers interviewed housed their chickens inside their family dwellings exposing them to unfavourable weather conditions and predators (Liswaniso et al., 2024). As a result, there is a high rate of chick mortality with farmers reporting 67.57% mortality rate in their flocks at eight weeks (Liswaniso et al., 2024).

Newcastle disease (ND) is the most devastating constraint to IC production in Zambia. Musako and Abolnik (2012) report that 73.9% of the birds sampled in five provinces of Zambia tested positive to ND virus antibodies with the seroprevalence being 91.3% in Monze district of the Southern Province. Mebelo et al. (2026) demonstrate that virulent Newcastle disease virus (NDV) strains continue to circulate in Zambian poultry flocks with genotype VII.2 detected among both vaccinated and unvaccinated flocks. These results indicate inadequate vaccination coverage which puts individual flocks at risk of ND outbreaks (Mebelo et al., 2026).

Limited availability of veterinary services, high vaccine cost and insufficient government funds for vaccination programmes contribute towards the low adoption of IC production practices (Kanyama et al., 2024). Smallholder farmers face several challenges in adopting improved IC production practices due to inadequate extension services and limited access to credit to finance inputs (Kanyama et al., 2024). As a result, low adoption of improved IC production practices has been reported to have a negative effect on productivity and commercialization (Kamau et al., 2024). The low level of adoption of improved IC production practices has an adverse economic impact to smallholder farmers. Kanyama et al. (2024) report that smallholder farmers can generate higher income from indigenous chickens compared to commercial broilers under the family poultry system.

The relationship between market participation and adoption of improved IC production technologies in smallholder farming systems in Zambia has not been documented. There is limited information on the influence of market participation on the adoption of improved IC production technologies as demonstrated in Kenya (Mwololo et al., 2020). Mwololo et al. (2020) show that there is a positive correlation between market participation and adoption of improved IC technologies. Mwololo et al. (2020) report that market pullers were more likely to adopt improved IC technologies compared to non-market pullers. Kamau et al. (2024) demonstrate that in Machakos County, the adoption of improved IC technologies was influenced by the level of experience, credit access and extension services. In addition, Kamau et al. (2024) report that education level, group membership and distance to training points influenced the impact of improved IC breeds on smallholder farmers. Chawala et al. (2022) examine the influence of gender on the commercialization intentions of ICs in selected districts in Zambia. Their study reveals that gender influences commercialization intentions of ICs through attitudes, subjective norms and perceived behavioral control.

The review of literature demonstrates that there is a need to address the knowledge gap regarding the influence of socio-economic and institutional factors on adoption score of IC production practices by farmers. Chawala et al. (2022) report that IC production is common in Chikankata District which is one of the districts where the current study will be conducted. Very few studies have been conducted on IC

production in Zambia with most of them focusing on characterization of genetic resources (Liswaniso et al., 2024) and prevalence of diseases (Mebelo et al., 2026; Musako & Abolnik, 2012) among ICs instead of addressing the factors influencing adoption of production practices (Kanyama et al., 2024). This study sought to address the knowledge gap by examining the adoption of IC production practices, comparing the adoption between market participants and non-market participants and determining the factors influencing adoption score of IC production practices.

The specific objectives of the study were: (i) to identify the indigenous chicken production practices adopted by smallholder farmers in Chikankata District; (ii) to determine the differences in adoption of indigenous chicken production practices between market participants and non-market participants; and (iii) to examine the socio-economic, institutional and market participation factors influencing the extent of adoption of indigenous chicken production practices.

2. MATERIALS AND METHODS

2.1 Study Area, Design and Sampling Technique

The study was conducted in Chikankata District of Southern Province of Zambia. It is located 130 km south of Lusaka along the Lusaka - Livingstone road. The district is located in Agro -ecological region IIa characterized by average altitude (m) of 400 m to 1470 m above sea level. It has a population of 98,671 people (Zambia Statistics Agency, 2022). The District is divided into 2 major farming blocks being Mapangazya and Nansenga block. The blocks are subdivided into a total of 17 agricultural camps with 10 camps in Mapangazya block and 7 camps in Nansenga Block.

A Multi-stage (purposive and random) sampling method was used at three levels in selecting the individual farming households. The first stage involved purposively selecting Nasenga and Mapangazya farming blocks, second stage involved purposive selection of four agricultural camps; Nadzwe and Upper Kaleya camp in Mapangazya block, and Nansenga and Siamatuli camp in Nansenga Block. These four camps were purposively selected due to their active involvement in livestock production in particular indigenous chickens and a final stage random sample of 202 indigenous chicken farmers (Nadzwe (52), Upper Kaleya (75), Nansenga (41), and Siamatuli (34)) camps. Secondary and primary data were collected and utilized for this study. Primary data were obtained from respondents through an administered questionnaire that sought information on socio-economic and institutional factors affecting adoption score of production practices.

2.2 Data Analysis

Descriptive statistics in terms of mean, frequency, and percentages, an independent samples t-test, chi-square test were used to describe the characteristics of sample variables. Econometric analysis was conducted using Poisson regression model with robust (Huber-White) standard errors to identify socio-economic, and institutional factors affecting indigenous chicken farmer's adoption of production practices.

2.3 Analytical Framework (Poisson Regression Model –Standard Robust Errors)

Three count-data regression models were estimated to determine determinants of the adoption score. The dependent variable, Adoption Score, is a count of the number of production practices that have been adopted by each farmer. Since the dependent variable is a count, then a Poisson regression model is an appropriate one (Cameron & Trivedi, 2013; Wooldridge, 2010). The Breusch-Pagan test detected significant heteroscedasticity ($\chi^2 = 19.09$, $p < 0.001$), rejecting the standard Poisson model's assumption of homoscedasticity. The negative binomial model did not provide a better fit than the Poisson, as the dispersion parameter α was effectively zero ($3.40e-08$) and the likelihood ratio test of $\alpha = 0$ was not

significant ($p = 0.499$). The Poisson model, when estimated with robust standard errors, provided consistent coefficient estimates with heteroscedasticity-consistent standard errors, z-scores, p-values, and confidence intervals (Huber, 1967; White, 1980). On this basis, the Poisson model with robust standard errors was then selected as the best specification since it produced identical incidence rate ratios as the standard Poisson but with heteroscedasticity-consistent standard errors, z-statistics, p-values, and confidence intervals.

General Poisson Model Equation

Let Y_i represent the number of production practices that were adopted by farmer i , with i taking values 1, 2, ..., 202. According to the Poisson regression model, Y_i is assumed to follow a Poisson distribution with mean μ_i .

$$\Pr(Y_i = y_i | X_i) = \frac{e^{-\mu_i} \mu_i^{y_i}}{y_i!}, y_i = 0, 1, 2, \dots \quad (1)$$

Where the conditional mean is specified as an exponential function of the explanatory variables:

$$E(Y_i | X_i) = \mu_i = \exp(X_i' \beta) \quad (2)$$

The implicit model of the regression was specified as follows:

$$Y_i = f(X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{12} + X_{13})$$

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + e_i \quad (3)$$

Where: Y_i is the dependent variable and X_i ($i=1$ to 13) are independent socio-economic and institutional variables, β_0, β_1 to β_{13} are the parameters to be estimated, and e_i is the error term.

Where

Y_i = Adoption score (0-21)

X_1 = Age of respondent

X_2 = Gender (1=male; 0=female),

X_3 = Education years

X_4 = Household size

X_5 = Flock size (quantity)

X_6 = Experience in indigenous chicken rearing (years),

X_7 = Market participation (dummy)

X_8 = Income from indigenous chicken (kwacha)

X_9 = Distance to the market (kilometers)

X_{10} = Cooperative membership (dummy)

X_{11} = Access to extensions services (dummy)

X_{12} = Number of times trained

X_{13} = Access to credit service (dummy)

e_i = error term (assumed to be independent and normally distributed with mean zero and constant variance).

Variable Definitions

Table 1 below presents the operationalization of study variables

Table 1: Variable Definitions

Symbol	Variable	Measurement	Expected Sign
Y_i	Adoption Score	Count of production practices adopted (0–21)	—
X_1	Age	Years	$\pm$
X_2	Gender	1 = Male; 0 = Female	$\pm$
X_3	Education Years	Years of formal schooling	+
X_4	Household Size	Number of household members	$\pm$
X_5	Flock Size	Number of birds owned	+
X_6	Experience in IC Rearing	Years	$\pm$
X_7	Market Participation	1 = Participant; 0 = Non-participant	+
X_8	Income from IC	Zambian Kwacha (ZMW)	+
X_9	Distance to Market	Kilometers	—
X_{10}	Cooperative Membership	1 = Member; 0 = Non-member	+
X_{11}	Access to Extension Services	1 = Access; 0 = No access	+
X_{12}	Times Trained	Number of training sessions attended	+
X_{13}	Access to Credit	1 = Access; 0 = No access	+
β_0	Intercept	—	—
$\beta_1, \dots, \beta_{13}$	Parameters	—	—
ϵ_i	Error Term	Assumed independent, mean zero, constant variance	—

Incidence Rate Ratio (IRR) Interpretation

The estimated coefficients are interpreted using incidence rate ratios:

$$IRR_j = e^{\hat{\beta}_j} \quad (4)$$

For a one-unit increase in X_j , holding all other variables constant, the expected adoption score changes by a factor of IRR_j . Equivalently, the percentage change is:

$$\% \Delta \text{Adoption Score} = (IRR_j - 1) \times 100\% \quad (5)$$

$$\widehat{\text{Var}}_{\text{robust}} \hat{\beta} = (X' \widehat{W} X)^{-1} \left(\sum_{i=1}^N \widehat{u}_i^2 \mathbf{x}_i \mathbf{x}_i' \right) (X' \widehat{W} X)^{-1} \quad (6)$$

Where:

- $\widehat{W} = \text{diag}(\widehat{\mu}_i) = \text{diag}(\exp(X_i' \hat{\beta}))$
- $\widehat{\mu}_i = y_i - \mu$ is the residual for farmer i
- $\mathbf{x}_i$ is the vector of covariates for farmer i

2.4 Model Diagnostics

Multicollinearity was not an issue with a mean variance inflation factor (VIF) of 1.45. The model was highly significant (Wald $\chi^2 = 230.03$, $p < 0.001$; Pseudo $R^2 = 0.1170$), and the goodness-of-fit test revealed no evidence of lack of fit ($\chi^2 = 119.29$, $p = 1.000$).

3. RESULTS AND DISCUSSION

3.1 Socio-economic, and Institutional Characteristics of Respondents by Market participation.

The analysis involved the comparison of socio-economic characteristics between respondents classified in the market participants category ($n = 135$) and those that were not ($n = 67$) using independent sample t-test and chi-square test. The difference in the adoption scores of the two groups was also statistically significant at (Mean (M) = 4.99, Standard deviation (SD) = 2.49) and ($M = 3.60$, $SD = 1.63$; $t = 4.745$, $p < 0.001$). This result demonstrated that members of the former group had adopted more improved indigenous chicken rearing technologies than the latter. Consistent with the current finding, Ayieko et al., (2015) report that in Kenya, indigenous chicken farmers that participated in agricultural markets were more likely to adopt new technologies as a way of maximizing profit than those that did not take part in any market activities.

Flock size was a significant differentiator, with participants owning larger flocks ($M = 22.59$ birds) than non-participants ($M = 14.88$ birds; $t = 3.717$, $p < 0.001$). This corroborates results in Makueni County, Kenya, where flock size had a positive and significant effect on the decision to participate in the indigenous chicken markets (Ayieko et al., 2015). Larger flocks allow farmers to generate marketable surpluses whilst retaining sufficient numbers for household consumption and reproduction. Similarly, household size was significantly larger for participants ($M = 6.78$) than non-participants ($M = 5.61$; $t = 2.884$, $p = 0.004$). Larger households could provide the labour needed for intensified poultry management and evidence from South Africa indicates that household size significantly influences commercialization levels of indigenous poultry production (Seti, 2026).

The experience in rearing indigenous chicken was higher among the market participants ($M = 19.44$ years) compared to the non-participants ($M = 14.19$ years; $t = 2.472$, $p = 0.015$). This observation aligns with the findings of Machakos County, Kenya, where the relationship between experience and the intensity of

improved indigenous chicken technology adoption was evident (Kamau et al., 2024). More experienced farmers had greater knowledge of flock management, disease control and market trends, which enabled them to produce more efficiently and participate in market exchange activities. The exposure to training sessions also varied significantly where market participants attended more training sessions in the past year ($M = 0.53$) compared to non-participants ($M = 0.22$; $t = 2.791$, $p = 0.006$). This supports the findings that training and extension contact significantly influence the decision of market participation among smallholder poultry farmers (Seti, 2026).

Income from poultry sales was significantly higher among market participants ($M = \text{ZMW } 1,004.87$) than non-participants ($M = \text{ZMW } 0.00$; $t = 11.429$, $p < 0.001$), which is expected by definition. However, this demonstrates the income-generating power of market-oriented indigenous chicken production. Evidence from Zambia suggests that while chicken market participation had small and insignificant income effects as compared to goats and cattle, reinforcing extension services aiming to improve livestock productivity and husbandry remains critical in enhancing market gains (Lubungu, 2011).

Access to extension services was significantly associated with market participation ($\chi^2 = 10.793$, $p = 0.001$). More specifically, 82.8% of market participants had access to extension services while only 17.2% of non-participants had access to similar services, a finding which is consistent with the assertion that access to extension services significantly influences commercialization levels of indigenous poultry production (Seti, 2026). The former facilitates farmers' knowledge of improved management practices, disease control as well as market opportunities thus promoting transition from subsistence to market production. Lubungu (2011) reports similar sentiments for the need for improved extension services in the livestock sub-sector in Zambia.

Table 2: Socio-economic, and Institutional Characteristics of Indigenous Chicken Farmers

Variable	Market Participation		Test Statistic	p-value
	(Yes) =135	(No) =67		
Age (years)	48.04 (14.56)	45.12 (16.06)	$t = 1.299$	0.195
Gender			$\chi^2 = 0.028$	0.868
Male	83 (66.4%)	42 (33.6%)		
Female	52 (67.5%)	25 (32.5%)		
Education (years)	8.24 (3.44)	7.94 (2.97)	$t = 0.603$	0.547
Household size	6.78 (2.81)	5.61 (2.48)	$t = 2.884$	0.004**
Flock size	22.59 (15.50)	14.88 (12.99)	$t = 3.717$	0.000***
Experience in IC rearing (years)	19.44 (12.91)	14.19 (14.79)	$t = 2.472$	0.015*

Variable	Market Participation (Yes) =135 (No) =67		Test Statistic	p-value
Income from poultry sales (ZMW)	1,004.87 (1,021.53)	0.00 (0.00)	t = 11.429	0.000***
Distance to market (km)	12.76 (12.94)	11.82 (11.75)	t = 0.519	0.605
Times trained in past year	0.53 (0.97)	0.22 (0.60)	t = 2.791	0.006**
Adoption score	4.99 (2.49)	3.60 (1.63)	t = 4.745	0.000***
Cooperative membership			$\chi^2 = 2.376$	0.123
Yes	118 (87.4%)	53 (79.1%)		
No	17 (12.6%)	14 (20.9%)		
Access to extension service			$\chi^2 = 10.793$	0.001***
Yes	53 (82.8%)	11 (17.2%)		
No	82 (59.4%)	56 (40.6%)		
Access to credit			$\chi^2 = 4.068$	0.044*
Yes	12 (92.3%)	1 (7.7%)		
No	123 (65.1%)	66 (34.9%)		

Source: Field Survey (2023)

***, **, * imply significant 1%, 5% and 10% level of significance.

3.2 Adoption of Production Practices among Indigenous Chicken Farmers

The analysis of production practices adopted in (figure 1) revealed significant variation in the adoption rate of the different practices amongst the 202 sampled Indigenous Chicken Farmers. There was a significantly high level (97%) of adoption of clean water provision to the flock, highlighting the common recognition of water provision to the flock as integral to poultry production. This observation is aligned with the recommendation of the Food and Agriculture Organization (2004) that clean water provision is essential for family poultry production and management of flock health. Local flocks were kept exclusively by 85% of the farmers, highlighting the dominance of indigenous breeds in the production of local chickens due to their hardiness and disease resistance (Liswaniso et al., 2024).

Laying nets provision (45%), permanent clean house (33%) and vaccination against Newcastle disease and fowlpox (38% and 38% respectively) were adopted by a significant minority of farmers. The relatively low rate of vaccination against Newcastle Disease (38%) is surprising given the prevalence of this disease that has been reported as the most devastating impediment to indigenous chicken production in Zambia (Kanyama et al., 2024). Almost 92% of farmers reported the presence of clinical symptoms of Newcastle Disease amongst their flocks (Kanyama et al., 2024). The low rate of vaccination adoption is an indicator of the challenges of vaccine availability and veterinary care in rural Zambian communities (Kanyama et al., 2024). Control of ectoparasites (33%) and deworming (18%) were adopted less frequently, an indication of the inadequate emphasis on external and internal flock parasite and pest control.

Feed-related practices were least adopted with feeders provided (17%), ready-made feed (14%) and minerals/vitamins supplementation (11%). This observation is an indicator of the extensive nature of indigenous chicken production in scavenging systems where birds are allowed to scavenge freely, reducing the need for supplementary feeding (Sonaiya & Swan, 2004). Food and Agriculture Organization (2004) highlights that the genetic potential for growth of unselected indigenous birds is too low for the investment in commercial feeds in extensive production systems and that the ability to scavenge may be lost with the ad libitum feeding of commercial feeds.

In relation to housing and management practices, provision of chick shed (11%) and cool-dry egg storage (8%) were adopted by a minority of farmers while dusting broody hens (4%) and frequent egg collection (2%) were rarely adopted. The low rate of adoption of chick shed provision is an issue of concern given the high rate of chick mortality that is a major impediment to indigenous chicken production (Mubanga et al., 2020). It has been reported that chick brooding technologies and shelter provision are critical interventions to reduce chick mortality through the provision of regulated heat (Food and Agriculture Organization, 2015).

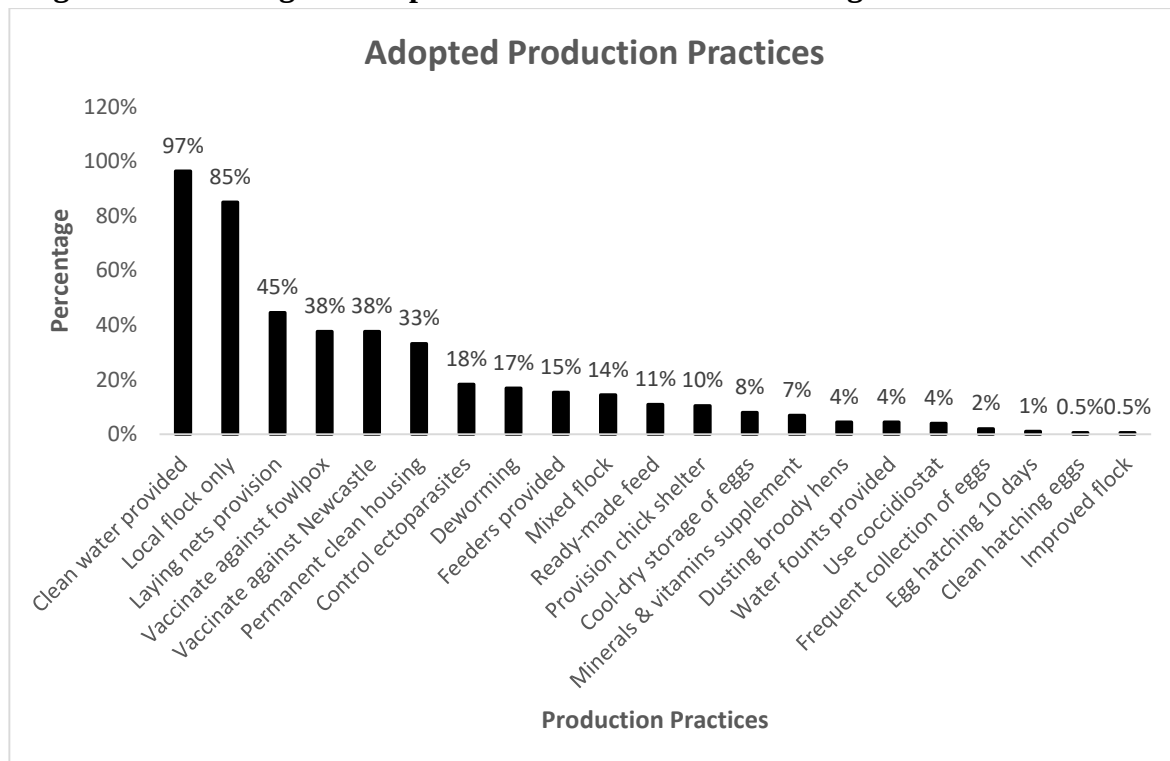
The very low adoption of dusting broody hens (4%) and egg hatching at 10 days (1%) indicates the extent to which farmers practice natural brooding. Natural brooding is self-sustaining and does not require the farmer to provide any additional resources but it is associated with the limitation of low numbers of clutches per year and exposure of eggs and chicks to predators and the adverse effects of interspecific feeding (Mubanga et al., 2020). Clean hatching eggs (0.5%) and improved flock (0.5%) were the least adopted practices, an indication of the lack of interest in improvements in flock genetics.

An analysis of the adoption pattern of the different production practices revealed that the majority of farmers adopt those practices that require minimal inputs and align with the traditional extensive scavenging system of production (clean water provision, local flock keeping) while those with high requirements for external inputs (vaccination, commercial feeds, improved breeds and housing) are poorly adopted. This observation is aligned with the findings of the study of improved poultry technology adoption in Machakos County, Kenya that revealed the low rate of adoption of improved technologies in spite of the promotion of these technologies by various stakeholders (Kamau et al., 2024).

The low rate of adoption of improved breeds (0.5%) and mixed flock (14%) is an indication of the low level of awareness by farmers of the performance of exotic breeds and the benefits of crossbreeding in improving productivity. The use of high-producing breeds like Sasso and Black Australorp chickens in tropical environments has been highlighted by Liswaniso et al. (2024) as a means of achieving faster maturity rate (at 20 weeks) and increased egg productivity (150-240 eggs per year) compared with indigenous chickens. However, the use of exotic breeds is associated with the requirement for supplementary feeding and the need to implement disease prevention measures (Kanyama et al., 2024).

Thus, the low rate of adoption of improved breeds is an indication of the low level of interest in the use of these birds for production in rural Zambian communities. Indigenous chickens have been reported to have higher farm income potential than commercial broiler production in small-scale chicken production in Zambia (Kanyama et al., 2024). This implies the rationality of the decision of farmers to keep local flocks.

Figure 1: Percentage of Adopted Production Practices among Smallholder Farmers



3.3 Association between Production Practices and Market Participation (N = 202)

Table 3 presents the results of a cross-sectional survey among 202 indigenous chicken rearing households examining the association between production practices and market participation. The Pearson Chi-square with Fisher's exact test was used to identify associations. Disease prevention and housing infrastructure practices showed the strongest and most significant associations with market participation.

The most significant link found in this study was between vaccination of Newcastle disease and fowlpox and participation in the market ($\chi^2 = 11.954$, $p = 0.001$). Farmers who vaccinated against Newcastle and fowlpox disease had a market participation rate of 81.6%, compared with 18.4% of those without. Farm households who vaccinated their flocks were significantly more likely to sell poultry or eggs. A randomized controlled trial of 537 households was conducted over 18 months by Otiang et al. (2021). Ectoparasite control was also significantly associated with market participation ($\chi^2 = 5.872$, $p = 0.015$). Farmers who controlled ectoparasites had a market participation rate of 83.8%, compared with 16.2% of those without. This finding is consistent with work by Dione et al (2026), which found that management practices related to animal health, including deworming and disease prevention, were among the most distinguishing factors between flock management clusters in Burkina Faso. The main point of this study was that animal health management practices were much better differentiators between management types than market practices, suggesting that flock health management is more important to flock market participation than marketing practices are.

Permanent clean housing was significantly associated with market participation ($\chi^2 = 5.256$, $p = 0.022$). Farmers who had permanent housing had a market participation rate of 77.6% compared with 22.4% of those without. This finding is consistent with the systematic review by Conan et al. (2012) which identified good flock management and housing as among the most basic forms of biosecurity for backyard poultry in developing countries. The review concluded that improved housing reduced mortality and disease transmission thus increasing the number of birds available for sale. However, evidence from a cluster-randomized trial in Cambodia, found that basic biosecurity interventions including housing improvements did not reduce poultry mortality rates in backyard flocks (Conan et al., 2013), suggesting that housing alone may be insufficient without complementary management practices. Recent evidence from Zambia indicates that only 37.5% of indigenous chicken farmers provide dedicated chicken housing with many birds housed in family dwellings or left to roost in trees (Liswaniso et al., 2024). Proper housing protects birds from predators, adverse weather and disease and is essential for raising chickens to marketable age (Liswaniso et al., 2024). The association observed in this study is likely due to the fact that farmers who invest in permanent housing are those with greater resource endowments and stronger commercial orientation.

Water fount provision was marginally associated with market participation ($\chi^2 = 4.675$, $p = 0.031$), but this finding must be interpreted with caution, given the very small number of households providing water founts ($n = 9$). Water provision to chickens is nearly universal in smallholder systems throughout sub-Saharan Africa (Hailemichael & Gebremedhin, 2020), and there is a wide range of watering containers with no obvious link to commercialization outcomes. Thus, the marginal association observed here probably reflects differences in unobserved characteristics between the households who invested in dedicated water founts—perhaps those having greater resources or better extension contact—rather than a causal effect of water fount provision on market participation.

The usage of ready-made feed was found to have a significant positive association with market participation ($\chi^2 = 6.457$, $p = 0.011$). Out of the 22-household commercial feed users, 90.9% were market participants. This observation is consistent with the findings of Zeberga (2010) who reported that feed supplementation had a highly significant influence on farmers' decision to supply chickens and eggs for market purpose. Similarly, a more recent study in Uganda also reports supplemental feeding as a significant determinant of indigenous chicken commercialization (Olor, 2025). In terms of the current study, one can argue that feed supplementation is indeed an indicator of commercial orientation since it implies that farmers are supplying more than subsistence amounts of their produce to the market.

Dusting Broody Hens was strongly associated with market participation ($\chi^2 = 4.675$, $p = 0.031$). All nine (100%) farmers who practiced dusting of broody hens were market participants. This is because controlling ectoparasites is an important component of improved poultry management that reduces deaths and improves flock productivity, facilitating production for the market (Teklewold et al., 2006). Ectoparasites infestation in chickens cause weight loss and low productivity due to the bird's blood being siphoned off and discomfort that leads to poor feeding and brooding behaviour (Enaro, 2021). This means that farmers who invest in managing broody hens have more chicks that hatch and survive to be sold for profit instead of being used to feed the family.

Chick Shelter provision was associated with market participation at the 10% level ($\chi^2 = 3.770$, $p = 0.052$). Of the 21 farmers who provided shelter for their chicks, 18 (85.7%) participated in the market while 3 (14.3%) did not. This finding is consistent with the evidence that providing shelter is critical to biosecurity and productivity that enables farmers to produce more and participate in the market (FAO, 2025). The

Food and Agriculture Organization (FAO) (2025) agrees that providing appropriate housing for poultry meets their physiological needs and keeps them free from pathogens and stress, promoting productivity and commercialization.

The practice of storing eggs in a cool-dry place had a marginal association with participating in the market ($\chi^2 = 3.349$, $p = 0.067$). A total of 14 out of 16 farmers who stored eggs in a cool-dry place participated in the market (87.5%). This is in line with the evidence that appropriate post-harvest handling of eggs improves their quality and reduces losses which will promote marketability leading to more farmers selling their produce in either formal or informal markets (Yang et al., 2025). Storing eggs at low temperatures is critical to preserving the internal egg quality since temperature affects the rate of deterioration, as well as the physical properties of the albumen and yolk (Gogo et al., 2021; Obianwuna et al., 2022). Thus, the association between cool-dry egg storage and market participation was marginal as only a few farmers practiced it.

Table 3: Association between Adopted Production Practices and Indigenous Chicken Market Participation

Production Practice	Market Participation		Total	χ^2	P
	No n (%)	Yes n (%)			
Flock Composition					
Local flock only	61 (35.5)	111 (64.5)	172	2.756	0.097*
Mixed flock only	6 (20.7)	23 (79.3)	29	2.379	0.123
Improved flock only	0 (0.0)	1 (100.0)	1	0.499	1.000 ^a
Total	67 (33.2)	135 (66.8)	202 (100)		
Housing and Water					
Permanent clean housing	15 (22.4)	52 (77.6)	67	5.256	0.022**
Water founts provided	0 (0.0)	9 (100.0)	9	4.675	0.031**
Clean water provided	65 (33.3)	130 (66.7)	195	0.069	0.793 ^a
Feeding					
Feeders provided	10 (32.3)	21(67.7)	31	0.014	0.907
Ready-made feed	2 (9.1)	20(90.9)	22	6.457	0.011**

Production Practice	Market Participation		Total	χ^2	P
	No n (%)	Yes n (%)			
Minerals and vitamins supplement	2 (14.3)	12(85.7)	14	2.420	0.120
Disease and Parasite Control					
Vaccinate against Newcastle	14 (18.4)	62(81.6)	76	11.954	0.001***
Vaccinate against fowlpox	14 (18.4)	62(81.6)	76	11.954	0.001***
Use coccidiostat	2 (25.0)	6 (75.0)	8	0.251	0.617
Deworming	9 (26.5)	25 (73.5)	34	0.827	0.363
Control ectoparasites	6 (16.2)	31 (83.8)	37	5.872	0.015**
Egg Handling and Hatching					
Laying nets provision	29 (32.2)	61 (67.8)	90	0.066	0.798
Frequent collection of eggs	1 (25.0)	3 (75.0)	4	0.123	1.000 ^a
Cool-dry storage of eggs	2 (12.5)	14 (87.5)	16	3.349	0.067*
Clean hatching eggs	0 (0.0)	1 (100.0)	1	0.499	1.000 ^a
Dusting broody hens	0 (0.0)	9 (100.0)	9	4.675	0.031*** ^a
Egg hatching 10 days	0 (0.0)	2 (100.0)	2	1.003	1.000 ^a
Provision chick shelter	3 (14.3)	18 (85.7)	21	3.770	0.052*

Source: Field Survey (2023)

***, **, * imply significant 1%, 5% and 10% level of significance. Superscript ^a Fisher's Exact Test p-value was used when the expected number of counts was less than five (better than Pearson χ^2).

3.4 Poisson Regression with (Robust Standard Error's) Estimates of Socio-Economic, and Institutional Determinants of Indigenous Chicken Production Practices Adoption Score

Table 4: Socio-Economic, and Institutional Determinants of Indigenous Chicken Production Practices Adoption Score.

Variable	IRR	Robust SE	Z	p-value
Age	1.0008	0.0025	0.33	0.744
Gender	1.0148	0.0558	0.27	0.789
Education (years)	1.0128	0.0078	1.66	0.097*
Household size	1.0137	0.0111	1.24	0.215
Flock size	1.0060	0.0017	3.53	0.000***
Experience IC (years)	0.9869	0.0025	-5.21	0.000***
Market Participation	1.1085	0.0738	1.55	0.122
Income IC (sales)	1.0001	0.00003	3.49	0.000***
Distance to market	0.9986	0.0015	-0.87	0.382
Cooperative Membership	1.1747	0.1012	1.87	0.062*
Access to extension services	1.4740	0.1089	5.25	0.000***
Times trained in (1year)	0.8852	0.0358	-3.01	0.003***
Access to credit	1.4487	0.1264	4.25	0.000***

Source: Field Survey (2023)

IRR = Incidence Rate Ratio. ***, **, * imply significant 1%, 5% and 10% level of significance.

The Poisson regression with robust standard errors showed that access to extension services is the most influential factor positively associated with adoption score. Farmers with access to extension services reported 47.4% higher adoption score than those without access (IRR = 1.474, $p < 0.001$). Extension services improve farmers' knowledge, skill, and capacity to implement new technologies, particularly for intensive technologies that require experiential learning and continuous decision-making (Birhanu et al., 2024).

Access to credit was also positively and significantly associated with adoption score. Farmers with credit access scored 44.9% higher on adoption than those without credit access (IRR = 1.449, $p < 0.001$). Access to credit facilitates the adoption of input-intensive and capital-intensive technologies by enabling farmers to finance the additional costs of adoption (Oyetunde-Usman, 2022). Credit facilitates the purchase of complementary agricultural inputs such as feed, vaccines, and housing required by improved chicken production systems (Liswaniso et al., 2025).

Total flock size was positively and significantly associated with adoption score. For every additional bird, the farmers' adoption score increased by 0.6% on average (IRR = 1.006, $p < 0.001$). The effect of flock size on adoption is consistent with the evidence that extensive livestock farming positively influences the adoption of improved technologies because large-scale farmers can bear the risks and fixed costs of technology adoption (Teklewold et al., 2006).

Income from poultry sales was also positively associated with adoption score. The higher the income, the higher the adoption score; for every additional unit of income, the adoption score increased by 0.01% (IRR = 1.0001, $p < 0.001$). The effect of income on adoption score is consistent with the evidence that income influences the extent of technology adoption because farmers with higher income have greater capacity to invest in technologies that increase productive efficiency (Birhanu et al., 2024).

Education years was significantly associated with adoption score at the 10% level. Every additional year of formal education increased the likelihood of higher adoption score by 1.3% (IRR = 1.0128, $p = 0.097$). Education improves farmers' capacity to access and utilize technical information to adopt improved technologies (Oyetunde-Usman, 2022; Teklewold et al., 2006). The marginal effect of education on adoption score suggests that the impact of education on adoption in this study may be marginal.

Cooperative membership was significantly associated with adoption score at the 10% level. The adoption score of cooperative members was 17.5% higher than that of non-members (IRR = 1.175, $p = 0.062$). Cooperative membership facilitates the adoption of improved technologies because cooperatives provide farmers with access to information, inputs, and markets (Choruma et al., 2024).

The number of years of improved chicken experience was significantly and negatively associated with adoption score. For every additional year of improved chicken experience, the adoption score reduced by 1.3% (IRR = 0.987, $p < 0.001$). Improved chicken experience has a negative effect on adoption score, which is counterintuitive. The negative coefficient of the number of years of improved chicken experience suggests that more experienced farmers report lower adoption score. A likely explanation is that more experienced farmers have adopted most of the recommended technologies and therefore have lower adoption scores. Alternatively, more experienced farmers only adopt technologies that they perceive to be profitable (Birhanu et al., 2024).

The number of training sessions attended in the past year was significantly and negatively associated with adoption score. Each training session reduced the adoption score by 11.5% (IRR = 0.885, $p = 0.003$). The negative association between the number of training sessions attended and the adoption score is counterintuitive to the extensive body of evidence on the positive impact of Farmer Field Schools on technology adoption, especially for technologies that require experimental learning and critical thinking (Palis, 2006; FAO, 2025). The negative impact of training on the adoption score could be because the adoption score in this study is based on the set of recommended practices that farmers are encouraged to apply. It is possible that training is provided to less experienced farmers, and for them, training has a negative impact on the adoption score. In other words, training is negatively related to adoption score

because it is provided to the category of farmers whose adoption score is low. This would explain why higher training attendance reduces the adoption score.

4. CONCLUSION

The study examined the adoption of practices for indigenous chicken farming among 202 small-scale farmers in the district of Chikankata, Zambia. A clear hierarchy of adoption was found whereby practices that involve little dependence on external inputs and are suitable for extensive scavenging systems such as provision of clean water were widely adopted (97%), while practices involving a lot of inputs and intensive management such as vaccination (38%), commercial feeds (14%) and improved breeds (0.5%) were less adopted (Food and Agriculture Organization, 2004). This is consistent with the theory of rational resource allocation under conditions of resource scarcity. Market participants had significantly higher adoption rates ($M = 4.99$ Vs 3.60 , $p < 0.001$), larger flock sizes, more experience and better access to extension services (82.8% Vs 17.2%, $p = 0.001$) and credit facilities (92.3 Vs 7.7%, $p = 0.044$). Poisson regression identified access to extension services ($IRR=1.474$, $p < 0.001$), and credit facilities ($IRR=1.449$, $p < 0.001$) as the positive determinants while training frequency ($IRR=0.885$, $p = 0.003$) and experience with improved chicken production ($IRR=0.987$, $p < 0.001$) were negative factors. The Ministry of Fisheries and Livestock should beef up extension services, create more credit facilities, rethink the targeting of training schemes, facilitate improved vaccine delivery through private-public partnerships, promote formation of producer organizations, and encourage sequential intensification of production. There is a need for further studies on training and gender implications in commercialization of indigenous chicken (Chawala et al., 2022).

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