Research Article

Assessment of Indigenous Chicken Production Characteristics Among Small-Scale Farmers in the Eastern Province of Zambia

Simushi Liswaniso[1]*, Kolawole Odubote[1] and Thobela Louis Tyasi[2]

[1]Department of Animal Science, School of Agricultural Sciences, University of Zambia, P.O. Box 32379, Lusaka, Zambia; [2]Department of Agricultural Economics and Animal Production, University of Limpopo, Private Bag X1106, Sovenga, Limpopo, South Africa.

Abstract | This study aimed to characterize Indigenous chicken production systems and management practices in the Eastern Province of Zambia to identify areas for intervention to enhance productivity. A structured questionnaire was administered to 450 small-scale farmers randomly selected from Nyimba, Katete, and Mambwe districts of eastern Zambia. The results revealed that all farmers reared their chickens extensively, with very little investment in their nutrition and health. A total of 82.35% of farmers provided their chickens with night shelter, and all flocks scavenged for their food, while only 46.41% of farmers supplied water. Most farmers (96.73%) sourced their breeding stock from within their communities, and 82.35% did not practice selection or breeding. Culling practices were common among farmers (79.74%), and 49.02% of culled chickens were consumed. With a clutch size of 12.42 eggs/hen/clutch and 2.98 clutches annually, the hatchability and mortality at 8 weeks were 83.68% and 32.30 %, respectively. All the farmers marketed their chickens as live birds, with 83.01% selling them directly at the farm gate. Diseases, predators, and theft were the most prominent challenges farmers faced. While 55.56% of farmers lacked access to veterinary services, 43.14% vaccinated their chickens. This study provides baseline evidence on production traits of Zambian Indigenous chickens in Eastern Province, enabling targeted breeding and management interventions. The findings can inform policy and extension support to improve smallholder farmers' performance and the sector's growth.

Received | February 13, 2026; **Accepted** | April 24, 2026; **Published** | June 19, 2026
***Correspondence** | Simushi Liswaniso, Department of Animal Science, School of Agricultural Sciences, University of Zambia, P.O. Box 32379, Lusaka, Zambia; **Email:** smliswaniso@gmail.com
Citation | Liswaniso, S., K. Odubote and T.L. Tyasi. 2026. Assessment of indigenous chicken production characteristics among small-scale farmers in the Eastern Province of Zambia. *Advances in Agriculture and Animal Sciences,* 42(1): 48-62.
DOI | https://dx.doi.org/10.17582/journal.aaas/2026/42.1.48.62
Keywords | Chicken marketing, Hatchability, Health practices, Mortality, Village chickens, Zambian chickens

Introduction

Indigenous chickens are a common enterprise among rural African communities, as they help rural households attain food and economic security (Dana *et al*., 2010; Muasya *et al*., 2022; Okeno *et al*., 2011). Their ability to withstand harsh conditions and diseases makes them popular among smallholder farmers (Dana *et al*., 2010; Muasya *et al*., 2022). These chickens are also preferred for other uses, such as income, offering a cheap protein source (Mapiye and Sibanda, 2005), and their unique taste (Manyelo

et al., 2020) makes these chickens a favorite among households. Indigenous chickens are also preferred for cultural and religious purposes, as a symbol of appreciation and welcome (Manyelo *et al.*, 2020; Muchadeyi *et al.*, 2004; Zaman *et al.*, 2004). Despite their low production costs, the market value can reach as much as USD 7.22 per chicken in Eastern Cape of South Africa (Gunya *et al.*, 2020) and over USD 9.00 (Kwacha equivalent) per live chicken in Zambia (Kanyama *et al.*, 2024). This underscores their significance for household economic stability.

According to the 2022 livestock and aquaculture survey, Zambia has over 21 million Indigenous chickens, with smallholder farmers accounting for 98% of this population (ZAMSTAT, 2023). Although these chickens are the most common enterprise in Zambia, they were reported to have low body weight and poor reproductive performance by Liswaniso *et al.* (2020). Small clutch sizes, small body weights, and late maturity have been reported to be typical of Indigenous chickens (Horst, 1991; Sebho, 2016). Egg production is a complex trait influenced by both genetic and non-genetic factors and is regulated through physiological pathways such as the hypothalamic-pituitary-gonadal (HPG) axis, which controls follicular development and laying performance (Qin *et al.*, 2020).

There have been attempts to increase the productivity of Indigenous chickens by crossing them with carefully selected exotic breeds, but these attempts were unsuccessful, as the resulting genotypes could not flourish in extensive production systems (Bett *et al.*, 2012; Magothe *et al.*, 2012; Natukunda *et al.*, 2011; Nigussie, 2011; Okeno *et al.*, 2012). This was due to the limited understanding of the production systems of these Indigenous chickens among small-scale farmers. The presumption was that all production systems were identical, with the same production goals and management strategies (Mahoro *et al.*, 2017; Okeno *et al.*, 2012), which may not be correct.

It was, therefore, suggested that to improve the productivity of Indigenous chickens, their production systems and characteristics should not be changed (Mahoro *et al.*, 2017). This, therefore, requires a clear understanding of the production systems in a specific area if any efforts to implement breeding programs aimed at enhancing the performance of these chickens are to succeed. Currently, limited information is available on the production characteristics and management practices of Zambian Indigenous chickens, particularly in the Eastern Province. This makes it difficult for policymakers and breeders to develop effective strategies to improve the performance of these chickens. A few studies have phenotypically characterized Zambian Indigenous chickens and their production system, but these have been in provinces far from the Eastern Province (Liswaniso *et al.*, 2020, 2023, 2024). But since breeding programs are tailored to specific production systems, these may not apply to the eastern province of Zambia as understanding the production characteristics of the target population is essential (Abebe *et al.*, 2020; Girma *et al.*, 2020; Maswana *et al.*, 2022). Therefore, this study aimed to describe the demographics of small-scale farmers engaged in indigenous chicken production, document the production characteristics of Zambian indigenous chickens in eastern Zambia, and identify the breeding and selection practices adopted by farmers. It also sought to detail the marketing practices, assess the health and biosecurity measures implemented, and identify the major constraints faced by these farmers. The findings of this study will provide a foundation for improving the selection and breeding of indigenous chickens to enhance their overall performance.

Materials and Methods

Study location

The study was conducted in the Eastern province of Zambia, which is predominantly agricultural, covering an area of approximately 51,476 $km^{2,}$ and home to an estimated 2.4 million residents (Nanyangwe and Tembo 2024). Figure 1 shows the sampling area, Eastern province and the sampled districts. For this study, three (3) districts (Nyimba, Katete, and Mambwe) were purposively sampled because they are the leading districts in Indigenous chicken populations in the Eastern province according to the latest livestock census figures.

The study districts differ in agro-ecological and market conditions that may influence indigenous chicken production. Katete is part of the Eastern Province plateau system and is characterized by relatively favorable rainfall and stronger road-market connectivity (Alvarez *et al.*, 2018). Nyimba spans both the drier Luangwa Valley and the wetter Eastern Plateau, resulting in marked within-district variation in altitude, rainfall, and production potential

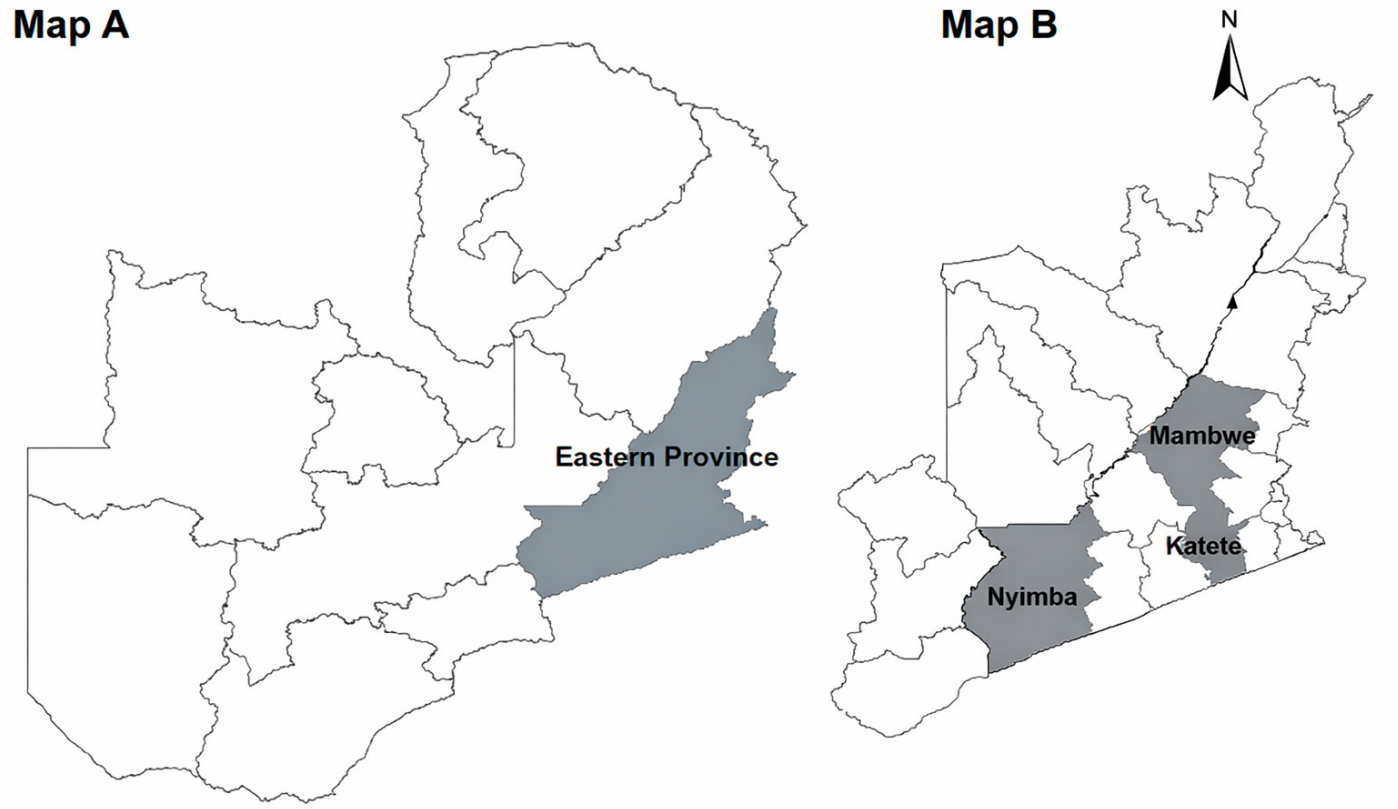

Figure 1: *Sample locations: Map A illustrates Zambia highlighting the Eastern Province, while Map B shows the locations of the three sampled districts within the Eastern Province of Zambia.*

(Gumbo *et al.*, 2016). Mambwe is generally described as lying within Agro-ecological Zone I and appears to have a distinct rural market-access context relative to more centrally connected districts (Mambwe District Council, 2019).

Sampling method and sampling size

The sample size was determined using the approach described by Thrusfield (2018), applying the formula:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where; n= sample size, Z= Z-score for the desired confidence level, P= anticipated prevalence, d= precision.

In each district, the required sample size was set at 81, based on an estimated 70% prevalence (indicating that about 70% of the population is involved in agriculture and related activities), with a 95% confidence interval and a 10% margin of error. However, this study sampled 150 farmers per district, resulting in a total of 450 households. This study employed a two-stage mixed sampling design. In the first stage, three districts (Nyimba, Katete, and Mambwe) were purposively selected because they have the largest Indigenous chicken populations in the province according to the latest livestock census figures. In the second stage, within each selected district, farmers were randomly selected from community farmer registers after filtering out those who did not keep chickens.

Data collection procedure

A structured questionnaire was used to collect data on the social demographics of small-scale Indigenous chicken producers, their chicken production systems, production performance, management practices, and the challenges they faced (Questionnaire attached as Supplementary File). Production performance was determined from farmers' recollections of their current or immediate past flock over a 12-month recall period. The questionnaire was pretested for appropriateness on 30 farmers and revised accordingly.

Data analysis

All qualitative data were analyzed and presented as frequencies of specific responses using the MINITAB V19 (Evans, 2009) statistical software for analysis. All qualitative (categorical) variables, including demographic characteristics (gender, age group, education, occupation, income, household

size), management practices (housing, bedding, supplementation, watering), breeding practices (source of stock, selection, culling), marketing practices, health management practices, and farmer-reported constraints, were summarized as frequencies and percentages. Differences in proportions across districts were evaluated using cross-tabulation and the chi-square (χ^2) test.

Variables with multiple responses, such as purpose of keeping chickens and types of livestock kept, were analyzed descriptively and presented as proportions without inferential statistical testing.

Quantitative variables, including age at first mating (cocks and hens), age at first egg, clutch size, clutch period, days per egg, number of clutches per year, hatchability, and mortality at 8 weeks, were analyzed using one-way analysis of variance (ANOVA) with district as the fixed effect. Where significant differences were detected ($p < 0.05$), Tukey's test was used for pairwise comparison of means. The following linear model was applied to all quantitative traits:

$$Y_{ij} = \mu + a_i + \varepsilon_{ij}$$

Where; where Y_{ij} is the observed value of a quantitative trait for farmer j in district i, μ is the overall mean, a_i is the fixed effect of district, and ε_{ij} is the random error term.

Results and Discussion

Farmer household and production characteristics

Demographics of respondents

Table 1 presents the socio-demographic characteristics of small-scale farmers involved in Indigenous chicken production in Zambia's Eastern Province. This study revealed diversity in the socioeconomic demographics of small-scale farmers of Indigenous chickens in the eastern province. This aligns with the findings of Ambrose-Oji (2009) who reported that small-scale farmers usually have different sociodemographic characteristics. This study found that more women owned these Indigenous chicken enterprises across all districts. The dominance of females in Indigenous chicken production established in this study is comparable to the earlier findings in other parts of Zambia (Liswaniso *et al.*, 2024). It is common for females to dominate backyard livestock ventures where the primary objective is food security, while men tend to dominate household ventures where higher income is expected (Banik and Barman, 2021). For instance, men dominate broiler production in Zambia, where income is the sole purpose (Liswaniso *et al.*, 2025). This is also strongly influenced by the traditions and cultures of rural people. However, the dominance of women in Indigenous chicken emphasizes the importance of this enterprise to household food and nutritional security.

Table 1: *Socioeconomic demographics of smallholder Indigenous chicken farmers in Eastern province of Zambia.*

Variable	Response	Katete (%) (n=150)	Mambwe (%) (n=150)	Nyimba (%) (n=150)	Overall (%) (n=450)	χ2	p value
Gender	Female	69.09	53.66	68.42	64.71	2.999	0.223
	Male	30.91	46.34	31.58	35.29		
Age	< 30 years	16.36	7.32	33.33	20.26	31.169	<0.001
	30-49 years	50.91	87.80	33.33	54.25		
	> 50 years	32.73	4.88	33.33	25.49		
Education	No formal education	18.18	75.61	8.77	30.07	64.590	<0.001
	Primary	52.73	24.39	77.19	54.25		
	Secondary	29.09	0.00	14.04	15.69		
Main occupation	Farming	100.00	97.56	92.98	96.73	4.482	0.106
	Other	0.00	2.44	7.02	3.27		
Income	Farming	100.00	100.00	92.98	97.39	6.918	0.031
	Others	0.00	0.00	7.02	2.61		
HH* size	< 5	20.00	34.15	47.37	33.99	16.685	0.002
	5-10	65.45	65.85	49.12	59.48		
	> 10	14.55	0.00	3.51	6.54		

*HH means Household size, * Multiple responses allowed; % = proportion of respondents selecting each option*

Table 2: *Farm characteristics among smallholder Indigenous chicken farmers in Eastern province of Zambia.*

Variable	Response	Katete (%) (n=150)	Mambwe (%) (n=150)	Nyimba (%) (n=150)	Overall (%) (n=450)
Type of Land ownership	Customary land	100.00	100.00	100.00	100.00
Purpose of keeping* chickens	Cash from the sales	98.18	97.56	100.00	98.69
	Cultural and ceremonial	7.27	0.00	26.32	12.42
	Egg consumption	16.36	9.76	66.67	33.33
	Manure	50.91	9.76	17.54	27.45
	Meat consumption	65.45	9.76	89.47	59.48
Other types of livestock*	Cattle	80.00	19.51	56.14	54.90
	Ducks	9.09	39.02	17.54	20.26
	Goat	45.45	73.17	43.86	52.29
	Pigs	10.91	56.10	29.82	30.07
	Sheep	0.00	9.76	5.26	4.58

* *Multiple responses allowed; % = proportion of respondents selecting each option.*

The current study found that most farmers were 50 years old or younger, with most falling between 30 and 50 years old. This indicates the potential for the enterprise's sustainability. Furthermore, the extant study found that most small-scale farmers in the Eastern Province involved in Indigenous chicken farming had at least completed primary school. In contrast, Biratu (2021) reported high literacy levels among Indigenous chicken farmers in Pawe district of Ethiopia. Education is vital in livestock production because it encourages the adoption of new technologies and best practices. The basic education level of most farmers in the current study suggests potential improvements in the Eastern province of Zambia for Indigenous chicken production. This is because they can easily understand and adopt new technologies that can enhance their production.

Farm characteristics

This study showed differences in farm characteristics among small-scale farms raising Indigenous chickens in Zambia's Eastern Province (Table 2). The reasons and motivations for keeping Indigenous chickens usually vary across communities, including cash from sales, household use, religious and cultural purposes, and breeding stock (Mahoro *et al.*, 2017). In the current study, the main reasons for rearing chickens were income generation across the districts. These reasons are comparable to those reported by other authors (Fitsum, 2017; Islam *et al.*, 2021). Chickens are an easy go-to source of protein, as they are often consumed in a single meal, require no intricate storage solutions, and have products that are exempt from cultural or religious prohibitions (Harrison *et al.*, 2024). Additionally, farmers can easily sell them to earn income within the community and meet other daily needs. It's for these reasons that Indigenous chicken production remains common among rural small-scale farmers.

This study found that smallholder farmers in the eastern part of Zambia often kept cattle, pigs, and goats alongside Indigenous chickens. This finding agrees with findings from East African countries of Rwanda and Ethiopia (Mahoro *et al.*, 2017; Melak *et al.*, 2021). Small-scale farmers usually keep a variety of livestock. This serves as a buffer against food insecurity. Most small-scale farmers engage in multiple enterprises, primarily to diversify their income and protein sources, thereby supporting their livelihoods. This means enhanced Indigenous chicken productivity through improved management, breeding, and nutrition reduces the risks for households.

Production system: Housing type, and nutrition of Indigenous chickens

Farmers employ various production systems when raising Indigenous chickens, which may be classified as intensive, semi-intensive, or extensive (Ngongolo and Chota, 2021). These classifications are mainly based on production objectives, prevailing husbandry practices, and the level of inputs and outputs (Ngongolo and Chota, 2021). The choice of exact methods depends on various factors, such as the level of investment and the scale of production. However, as established in this study (Table 3), the free-range production system remains the most common among

small-scale Indigenous chicken farmers, not only in this study but also elsewhere (Mahoro *et al.*, 2017). This is usually characterized by low investments in veterinary medicines, nutrition, and housing (Mukarumbwa *et al.*, 2021).

Housing and its accessories, including drinkers and feeders, have been identified as key assets in chicken production (Justus *et al.*, 2011). Farmers provide housing for chickens to protect them from adverse weather conditions, predators, diseases, and theft, as well as to facilitate easy feeding (Mujyambere *et al.*, 2022). Poultry housing conditions can influence immune function, which may in turn affect the response to vaccination and alter disease susceptibility (Hofmann *et al.*, 2020). In the current study, most farmers provided some form of shelter in designated poultry houses (Table 3), in agreement with the findings of Kenfo *et al.* (2023). Mahoro *et al.* (2017) reported that family houses and kitchen wastes were the most common housing for Indigenous chickens in Rwanda. Several factors influence the decision to choose a specific housing type. For instance, in Northern Zambia, in areas prone to theft, farmers housed their chickens in trees as a security measure (Liswaniso *et al.*, 2024). The farmers believed that housing chickens in an enclosure would make it easy for thieves to steal all the chickens at once, whereas when they were in trees, they would easily scamper for safety when danger was noticed.

Table 3: *Management practices of indigenous chickens among small scale farmers in Eastern province of Zambia.*

Variable	Response	Katete (%) N=150	Mambwe (%) N=150	Nyimba (%) N=150	Overall (%) N=450	χ2	P-value
Night shelter	Chicken house	63.64	85.37	98.25	82.35	25.55	0.000
	Family house	32.73	9.76	1.75	15.03		
	Trees	3.64	4.88	0.00	2.61		
Beddings	No beddings	72.73	97.56	56.14	73.20	38.35	0.000
	Chopped grass	27.27	0.00	17.54	16.34		
	Other[#]	0.00	2.44	26.32	10.46		
Main feed source	Scavenging	100.00	100.00	100.00	100.00		
Provide water	No	20.00	100.00	52.63	53.59	60.48	0.000
	Yes	80.00	0.00	47.37	46.41		
Production system	Free-range	100.00	100.00	100.00	100.00		

[#]*Others comprised of woven baskets, sand, empty grain bags, and plastics.*

Table 4: *Source of breed stock, mating system, and breeding system of indigenous chicken farmers in Eastern province of Zambia.*

Variable	Response	Katete (%) N=150	Mambwe (%) N=150	Nyimba (%) N=150	Overall (%) N=450	χ^2	P-value
Source of breed stock	Outside community	0.00	4.88	5.26	3.27	2.91	0.233
	Within community	100.00	95.12	94.74	96.73		
Practice selection and breeding	No	54.55	100.00	96.49	82.35	45.89	<0.001
	Yes	45.45	0.00	3.51	17.65		
Practice culling	No	0.00	2.44	52.63	20.26	59.00	<0.001
	Yes	100.00	97.56	47.37	79.74		
Reasons for culling	Low production	5.45	97.56	8.77	31.37	202.84	<0.001
	Old age	50.91	0.00	14.04	23.53		
	don't cull	0.00	2.44	52.63	20.26		
	Diseases	36.36	0.00	7.02	15.69		
	Financial Needs	0.00	0.00	17.54	6.54		
	Bad temperament	7.27	0.00	0.00	2.61		
Fate of the culls	Home consumption	85.45	12.20	40.35	49.02	129.12	<0.001
	Sale	14.55	85.37	7.02	30.72		
	Don't cull	0.00	2.44	52.63	20.26		

This study found that chickens in all sampled households in the eastern province of Zambia relied solely on scavenging as the primary source of nutrition (Table 3). This is characteristic of Indigenous chicken production in most areas. In Kenya, Anyona *et al.* (2023) reported that small-scale Indigenous chicken farmers rarely purchased feed. However, in contrast to the current study, some supplementation has been reported among small-scale farmers in Ethiopia (Gebremariam *et al.*, 2017). Islam *et al.* (2021) reported that small-scale farmers mostly supplement their chickens with kitchen refuse or grains. Dependence on kitchen refuse and processing by-products for human consumption suggests that these chickens may not receive their full nutritional requirements according to the NRC guidelines (NRC, 1994). It is therefore suggested that farmers improve the nutrition of these chickens by supplementing their diets with locally available feedstuffs.

Breeding management and selection practices

Source of breed stock and selection practices

Table 4 shows the sources of breed stock, selection and breeding practices, and culling methods among small-scale Indigenous chicken farmers. Due to limited sources of breed stock, nearly all respondents in this study reported purchasing both breed stock and replacement stock from fellow farmers within their local community. This finding aligns with those of Kassa *et al.* (2020) and Tadelle *et al.* (2003). The phenomenon persists due to a lack of properly organized breed-stock sources within rural communities. Introduction of easy sources of improved breeds will help reverse this situation.

The lack of selection and breeding, as well as controlled mating of Indigenous chickens reported in the current study (Table 4), is typical among small-scale farmers, as noted also in Uganda by Yussif *et al.* (2023). This study confirmed the lack of controlled mating or breeding among small-scale farmers of Indigenous chickens. This points to a potential for high inbreeding within the flocks. However, with targeted extension messages and avenues to source breed stock, this practice can be reversed.

Culling practices

This study showed that culling chickens was a common practice among small-scale farmers in the eastern province of Zambia (Table 4). Low production and old age were the main reasons for culling chickens. Regarding the fate of the culls, most culls were either used for home consumption (49.02%) or sold for cash (30.72%). The finding of this study on the high prevalence of culling practices is not unique to the current study location, as other researchers have also reported that culling is a common practice among small-scale farmers in Ethiopia and Uganda (Kassa *et al.*, 2020; Yussif *et al.*, 2023). In comparison to the findings of this study on the reasons for culling Indigenous chickens, several researchers also reported low hatchability, low production, illness, and old age as the main reasons for culling Indigenous chickens (Fitsum, 2017; Melese and Melkamu, 2014; Ngogo *et al.*, 2023). It was not surprising that the most common fate for the culls in the current study was home consumption, as one of the primary reasons for keeping these chickens in the study area was for home consumption. This finding is consistent with the findings reported by Melak *et al.* (2021) and Abera *et al.* (2014).

Production performance: Age at first mating, age at first egg, clutch size, and days/egg

Table 5 shows the reproductive performance of Indigenous chickens in Zambia's Eastern Province. The age at first mating for cockerels, considered the age of maturity, varied significantly ($p < 0.05$) across districts, with an average of 7.13 months across the province. The age at first mating for hens also showed significant differences ($p < 0.05$) between districts, with a provincial average of 6.85 months. The age at first mating reported in this study for cocks was higher than what we previously reported among Zambian Indigenous chickens in Muchinga, Northern, and Luapula provinces (Liswaniso *et al.*, 2024) but comparable to the age at maturity for Ethiopian male chickens (Mersha and Senbeta, 2020). The differences in age at maturity between the chickens in the Eastern Province of Zambia and those reported in other studies may be attributed to variations in genetic, environmental, and nutritional factors. Breed differences and management systems can affect chicken growth. Zambian Indigenous chicken performance varies with varying agroecological conditions, as recently reported by Nankonde *et al.* (2025).

Age at first egg (AFE) is a crucial trait in Indigenous chicken production, as it directly and substantially affects chicken population growth and egg production (Chomchuen *et al.*, 2022). Although the hens in the

current study reached sexual maturity at 6.85 months, they laid their first eggs at 8.29 months, and this also varied significantly ($p < 0.05$) across districts (Table 5). The age at first egg in the current study was higher than that of the chickens found in Northern Zambia (Liswaniso *et al.*, 2024) and those reported outside Zambia (Biratu, 2021; Shuma and Gurmessa, 2021). It is reported that the average AFE of Indigenous chickens under free range may vary from 6 to 8 months (Mwalusanya *et al.*, 2002). Genetics and nongenetic factors, such as nutrition and production systems, contribute to these discrepancies in age at first egg (Guni *et al.*, 2013). Zambian Indigenous chickens remain largely unimproved and of mixed genetics, as results their growth remains slow.

The clutch size of Indigenous chickens in the current study varied significantly ($p < 0.05$) across the surveyed districts (Table 5). On average, hens laid 12.42 eggs per clutch over a period of 14.90 days, resulting in an average rate of 1.22 days per egg (Table 5). This study further revealed that, on average, Indigenous chickens in the eastern province of Zambia lay fewer than three clutches per year (Table 5). The clutch size reported in this study (12.42 eggs/hen/clutch) is comparable to that in Western Ethiopia (12.30 eggs/hen/clutch) (Shuma and Gurmessa, 2021). However, higher clutch sizes have also been reported in Tanzanian Indigenous chickens (Ngogo *et al.*, 2023). The study revealed that it took 1.22 days to lay an egg, comparable to our earlier report (1.19 days) in another region of Zambia (Liswaniso *et al.*, 2024).

The number of clutches per year (2.98) reported in this study was slightly higher than the 2.80 reported by Wassie *et al.* (2021) in Ethiopia. Nevertheless, a higher number of clutches of 3.7 clutches per year in Ghanaian chickens and 3.3 clutches per year in Tanzanian chickens has been reported in a review by Sisay-Fikru and Senbeta (2020). Environmental and genetic variability, coupled with management practices, may account for differences in clutch numbers across these African countries.

Hatchability and mortality

Hatchability in the current study varied significantly ($p < 0.05$) among districts, with a mean of 83.68% (Table 5). This is in agreement with the findings of Assefa *et al.* (2015) in Ethiopian Indigenous chickens. Indigenous chickens have been reported to generally have higher hatchability rates of up to over 90% (Fathi *et al.*, 2022). Hatchability and survivability are crucial for increasing poultry populations (Ajayi and Agaviezor, 2016). They determine the productivity in a given period (Nwachukwu, 2014). However, several factors influence hatchability in chickens, including the age of the hen, seasonal variations, hygiene, nutrition, genetics, disease, egg quality, and incubation conditions (Kirunda *et al.*, 2010; Yemane *et al.*, 2014). Therefore, the differences in hatchability between the chickens in this study and those in other studies may be due to differences in management and genetic differences between the studied chickens. If management and breeding practices among farmers in the Eastern Province of Zambia are improved, hatchability would likely increase as well.

The first eight weeks after hatching are crucial in poultry production. As such, the chickens' survivability during this time is critical. This study revealed a mortality rate of 32.30% within the first 8 weeks (Table 5), resulting in a survival rate of 67.70% for

Table 5: *Reproductive performance of indigenous chicken farmers in Eastern province of Zambia.*

Variable	Katete	Mambwe	Nyimba	SEM	P-value	Overall
Cocks age at first mating (months)	6.27^{a}	7.66^{b}	7.58^{b}	0.14	<0.001	7.13
Hen age at first mating (months)	5.96^{a}	6.77^{b}	7.77^{c}	0.14	<0.001	6.85
AFE (months)	6.38^{a}	9.71^{b}	9.12^{b}	0.22	<0.001	8.29
Clutch size (eggs/hen)	13.85^{a}	12.05^{b}	11.30^{b}	0.21	<0.001	12.42
Period/clutch (days)	15.76^{a}	14.78^{ab}	14.16^{b}	0.27	0.035	14.90
Days/egg	1.15^{a}	1.24^{ab}	1.27^{b}	0.02	0.019	1.22
No. clutches/year	3.45^{a}	3.05^{b}	2.47^{c}	0.07	<0.001	2.98
Hatchability (%)	88.20^{a}	80.03^{b}	81.94^{b}	1.08	0.005	83.68
Mortality at week 8 (%)	29.53	36.58	31.88	1.32	0.110	32.30

AFE means age at first egg, SEM means standard error of the mean, numbers in the same row with different superscripts denote significant differences at p<0.05. Mortality was calculated as the percentage of chicks that died of the total hatched. The hatchability was taken as the percentage of number of eggs hatched of the number set.

Table 6: *Marketing practices and challenges faced by indigenous chicken farmers in Eastern province of Zambia.*

Variable	Response	Katete (%) (n=150)	Mambwe (%) (n=150)	Nyimba (%) (n=150)	Overall (%) (n=450)	χ^2	P-value
Marketing age	Less than 6 months	12.73	2.44	7.02	7.84	93.66	<0.001
	6-8 months	70.91	0	29.82	36.6		
	9-10 months	12.73	0	14.04	9.8		
	11-12 months	3.64	7.32	10.53	7.19		
	Over 1 year	0	90.24	38.6	38.56		
Marketing method	Farm gate sales	67.27	95.12	89.47	83.01	15.61	<0.001
	Supply local Market	32.73	4.88	10.53	16.99		
Product sold	Live chickens	100	100	100	100		
Challenges	Diseases	48.00	32.67	27.33	36.00	69.33	<0.001
	Predators	22.00	26.67	26.00	24.89		
	Theft	22.00	26.67	11.33	20.00		
	Feed scarcity	2.67	0.67	19.33	7.56		
	Other	5.33	13.33	16.00	11.56		

the chicks. Although some numerical variation was observed among districts, the differences were not statistically significant (p= 0.110; Table 5). Therefore, mortality at 8 weeks appeared to be relatively similar across districts in the study area. Despite the lack of significant district differences, the overall mortality level was still high and suggests persistent challenges in early chick management, including disease burden, predation, nutrition, and housing. These findings are in contrast to the 38.85% survival rate reported in Ethiopia (Matawork, 2018). Nonetheless, comparable mortality rates of 33.80% were also reported in Morocco (Boujenane, 2024). The differences in chicken mortality rates reported in the current study and those reported in the literature may be attributed to variations in housing, health management practices, breed or ecotype, seasonal changes, predator prevalence, chicken population density, and agroecological conditions (Sisay-Fikru and Senbeta, 2020). Therefore, enhancing health management practices, such as vaccinations and deworming, is essential to reduce mortality rates, as they are key indicators of poor welfare.

Marketing practices

Table 6 presents the marketing practices of Indigenous chickens among small-scale farmers. In all the districts studied, farmers sold their chickens as live animals without any form of value addition. This study revealed variation in the age at which Indigenous chickens were marketed across districts ($p < 0.05$). Most farmers sold their chickens at 6 months or older, with the majority (36.60%) selling their chickens between 6 and 8 months. Closer interrogation revealed that male chickens were sold earlier than the hens. This is because males generally grow faster and may not be needed in large numbers in the flock. As such, most farmers prioritized them for sale over the hens. Similarly, Indigenous chickens in other parts of Zambia were recently reported to mainly be marketed at 9.16 months (Liswaniso *et al.*, 2024). Nonetheless, Matawork (2018) noted that the age at marketing of Indigenous chickens is from 8 to 12 months. While age at marketing may depend on the chickens' environment and genetics, the production system and purpose of production may influence when the chickens are sold.

This study further revealed that all farmers sold their chickens live at the farm gate, with no value addition (Table 6). This may be because sales are inconsistent due to small flock sizes, and they only sell when there is a need for cash chickens. Zereu and Mesele (2016) reported comparable results in Ethiopia, indicating that most farmers sold their chickens live, with the majority selling them at the farm gate. This suggests that these farmers are less likely to make profits, as small flock sizes have been associated with little to no profit (Mbuza *et al.*, 2017). However, improving production may lead to higher profits through value addition, effective marketing, and economies of scale.

Constraints faced by farmers

Several challenges have been reported to affect Indigenous chicken production, including increased mortality and decreased productivity, theft, predators,

Table 7: *Health management practices among indigenous chicken farmers in Eastern province of Zambia.*

Variable	Response	Katete (%) (n=150)	Mambwe (%) (n=150)	Nyimba (%) (n=150)	Overall (%) (n=450)	χ^2	P-value
Access to veterinary services	No	58.18	17.07	80.70	55.56	39.340	<0.001
	Yes	41.82	82.93	19.30	44.44		
Chickens treated	No	23.64	24.39	82.46	45.75	49.320	<0.001
	Yes	76.36	75.61	17.54	54.25		
Vaccination	No	7.27	100.00	73.68	56.86	92.820	<0.001
	Yes	92.73	0.00	26.32	43.14		
Deworm	No	98.18	100.00	96.49	98.04	1.540	<0.001
	Yes	1.82	0.00	3.51	1.96		
Use of Ethnoveterinary	No	65.45	97.56	96.49	85.62	28.390	<0.001
	Yes	34.55	2.44	3.51	14.38		

and insufficient knowledge about poultry rearing (Moussa *et al*., 2019). The most common challenges farmers mentioned in this study were diseases, predators, theft, and feed scarcity. Other issues mentioned by fewer farmers included feed shortages, lack of capital, lack of better breeds, lack of information, inadequate housing, and price fluctuations (Table 6). This list of challenges faced by farmers is comparable to the one reported by Wambua *et al*. (2022) in Kenya. The low production performances discussed in the current study could be attributed to the challenges discussed above. Adequate extension strategies and messages targeted at both biosecurity and health care may lead to improved production.

Health and biosecurity practices

Table 7 shows the health practices of small-scale Indigenous chicken farmers. Effective health management practices are crucial for minimizing flock losses. This study showed that most farmers lacked access to veterinary services. Although many farmers in the current study treated their sick chickens, most did not vaccinate or deworm them. This may be because vaccines and dewormers might not be accessible to small-scale farmers, or when available, may be expensive. However, when disease outbreaks occurred, farmers in the current study were willing to pay to protect their flocks, as these outbreaks directly affected their profits. Biratu (2021) reported similar findings in their study.

Small-scale farmers employ various strategies to combat disease outbreaks, including the use of ethnoveterinary medicines. Such a type of medication was not common in the current study area. This may be because farmers in the extant study lacked knowledge of the various ethnoveterinary remedies. However, the use of ethnoveterinary methods to combat disease outbreaks is common in other countries, such as Uganda, where over 80% of farmers use ethnoveterinary concoctions to treat their chickens (Yussif *et al*., 2023). In Ghana, up to 36 plant species belonging to 25 different botanical families were identified as commonly used as ethnoveterinary remedies in Indigenous chickens. However, the use of ethnoveterinary remedies requires more education, as some may pose public health hazards and have antimicrobial properties that could lead to antimicrobial resistance in consumers.

Conclusions and Recommendations

This study revealed that the production characteristics of Zambian Indigenous chickens are largely traditional, and their performance is low. These findings can help breeders in implementing targeted interventions. This study's results demonstrate the potential of both the Zambian Indigenous chickens and the farmers to grow this sector. Additionally, these findings suggest that to develop indigenous chicken production in the eastern province of Zambia, the province's livestock development strategy should prioritize investment in village-based vaccination programs, accessible breeding stock, and nutrition education for smallholder indigenous chicken farmers.

The findings highlight several priority areas for intervention to improve productivity. First, strengthening health management practices, particularly vaccination and access to veterinary services, is critical to reducing mortality. Second, improving nutrition through strategic supplementation

using locally available feed resources would likely enhance growth and reproductive performance. Third, promoting basic breeding management practices, including controlled mating and access to improved or selected breeding stock, could help address low productivity and potential inbreeding.

However, the limitations of this study include the reliance on farmers' recollections for most of the data, which may be subject to recall bias. Additionally, the purposive selection of districts may limit the generalizability of the findings beyond the sampled areas. Furthermore, flock size data were not collected, which limits analysis of scale-related productivity and income effects. Another study, conducted on-farm and on-station, simulating small-scale farmer conditions, is recommended to validate the findings of the current study.

Acknowledgements

Gratitude to the extension officers in the sampled districts who helped with organising the sampled chickens

Novelty Statement

This is the first study that compares the production characteristics of Zambian chickens in the Eastern Province

Author's Contribution

SL: Conceptualization, data collection, Analysis, and visualization. IKO: Manuscript revision and data analysis. TLT: Conceptualization, revision and approval of manuscript, data visualization, and supervision.

Ethical approval

The study was approved by the institutional ethics review committee under approval number: SMHS-MU1-2024-49. Prior to data collection, informed consent was obtained from all participating farmers. The purpose of the study, the voluntary nature of participation, and the confidentiality of responses were explained to each participant in their local language where necessary. Verbal consent was documented by the enumerator, as some participants were unable to provide written consent. Participation was voluntary, and farmers could withdraw at any time without consequence.

Generative AI and AI-assisted technology statement

Grammarly was used as a writing assistant, mainly for grammar checks.

Supplementary material

There is supplementary material associated with this article. Access the material online at: https://dx.doi.org/10.17582/journal.aaas/2026/42.1.48.62

Conflict of interest

The authors have declared no conflict of interest.

References

Abebe, A.S., Alemayehu, K., Johansson, A.M. and Gizaw, S., 2020. Breeding practices and trait preferences of smallholder farmers for indigenous sheep in the northwest highlands of Ethiopia: Inputs to design a breeding program. PLoS One, 5(15): e0233040. https://doi.org/10.1371/journal.pone.0233040

Abera, B., Kebede, K. and Gizaw, S., 2014. Indigenous breeding practices and selection criteria of sheep breed in Selale area, Central Ethiopia. Int. J. Livest. Res., 7(4): 49-56. https://doi.org/10.5455/ijlr.20140423043726

Ajayi, F. and Agaviezor, B., 2016. Fertility and hatchability performance of pure and crossbred indigenous chicken strains in the high rainforest zone of Nigeria. Int. J. Livest. Prod., 7: 141-144.

Alvarez, S., Timler, C.J., Michalscheck, M., Paas, W. Descheemaeker, K. Tittonell, P. Andersson, J.A. and Groot, J.C.J. 2018. Capturing farm diversity with hypothesis-based typologies: An innovative methodological framework for farming system typology development. PLoS One, 5(13): e0194757. https://doi.org/10.1371/journal.pone.0194757

Ambrose-Oji, B., 2009. Urban food systems and African indigenous vegetables: Defining the spaces and places for African indigenous vegetables in urban and peri-urban agriculture. African Journal of Food, Agriculture, Nutrition and Development Cogent Economics & Finance African Indigenous Vegetables in Urban Agriculture, pp. 1-33. Earthscan.

Anyona, D.N., Musyoka, M.M., Ogolla, K.O., Chemuliti, J.K., Nyamongo, I.K. and Bukachi, S.A., 2023. Characterization of indigenous

chicken production and related constraints: Insights from smallholder households in rural Kenya. Sci. Afr., 20: e01717. https://doi.org/10.1016/j.sciaf.2023.e01717

Assefa, A., Yilma, T., Shibeshi, Z. and Workneh, T., 2015. Village Chicken production systems in selected areas of Benishangul-Gumuz, Western Ethiopia. Asian J. Poult. Sci., 9: 123-132. https://doi.org/10.3923/ajpsaj.2015.123.132

Banik, S. and Barman, K., 2021. Smallholder pig production system of Assam. Indian J. Anim. Sci., (90): 1441-1443. https://doi.org/10.56093/ijans.v90i10.111425

Bett, H., Bett, R., Peters, K. and Bokelmann, W., 2012. Linking utilisation and conservation of indigenous chicken genetic resources to value chains.

Biratu, D.T., 2021. Assessment of chicken production and productive performance in Pawe District, Beneshangul Gumuz Regional State, Ethiopia. Am. J. Manage. Sci. Eng., 1(6): 1-10. https://doi.org/10.11648/j.ajmse.20210601.11

Boujenane, I., 2024. Characterization of the phenotypic, morphometric and productivity traits of indigenous chickens in the Moroccan Region of Drâa-Tafilalet. 7. https://doi.org/10.24966/ARVS-3751/100058

Chomchuen, K., Tuntiyasawasdikul, V., Chankitisakul, V. and Boonkum, W., 2022. Genetic evaluation of body weights and egg production traits using a multi-trait animal model and selection index in Thai native synthetic chickens (Kaimook e-san2). Animals, 3(12): 335. https://doi.org/10.3390/ani12030335

Dana, N., van der Waaij, L.H., Dessie, T. and van Arendonk, J.A., 2010. Production objectives and trait preferences of village poultry producers of Ethiopia: Implications for designing breeding schemes utilizing indigenous chicken genetic resources. Trop. Anim. Health Prod., 7(42): 1519-1529. https://doi.org/10.1007/s11250-010-9602-6

Evans, M., 2009. Minitab manual. University of Toronto ISBN: 0-7167-2994-6 2009;

Fathi, M., Abou-Emera, O., Al-Homidan, I., Galal, A. and Rayan, G., 2022. Effect of genotype and egg weight on hatchability properties and embryonic mortality pattern of native chicken populations. Poult. Sci., 11(101): 102129. https://doi.org/10.1016/j.psj.2022.102129

Fitsum, M., 2017. Production objectives, breeding practices and selection criteria of indigenous chicken in central zone of Tigray, Northern Ethiopia. Acad. Res. J. Agric. Res., volume 7(5): 521-528.

Gebremariam, B., Mazengia, H. and Gebremariam, T., 2017. Indigenous chicken production system and breeding practice in southern Tigray, North Ethiopia. Poult. Fish. Wildl. Sci., 05. https://doi.org/10.4172/2375-446X.1000179

Girma, M., Banerjee, S. and Birhanu, T., 2020. Breeding practice and phenotypic characteristics of indigenous Woyito-Guji goat breeds reared in Nyangatom and Malle pastoral and agro-pastoral districts of SNNPR, Ethiopia. Int. J. Anim. Sci., 8(4).

Gumbo, D.J., Mumba, K.Y., Kaliwile, M.M., Moombe, K.B. and Mfuni, T.I., 2016. Agrarian changes in the Nyimba District of Zambia. In: Deakin, L., Kshatriya, M. and Sunderland, T., (Eds.) Agrarian Change in Tropical Landscapes, CIFOR, Bogor. pp. 242-251.

Guni, F.S., Katule, A.M. and A.M.P.A., 2013. Characterization of local chickens in selected districts of the Southern Highlands of Tanzania: II. Production and morphometric traits. Livest. Res. Rural Dev., 25.

Gunya, B., Muchenje, V., Gxasheka, M., Tyasi, T. and Masika, P., 2020. Management practices and contribution of village chickens to livelihoods of communal farmers: The case of centane and mount frere in Eastern Cape, South Africa. Biodiv. J. Biol. Div., 21: 1345-1351. https://doi.org/10.13057/biodiv/d210410

Harrison, S., Moono, M. and Odubote, K., 2024. Production systems and management practices of chicken populations in Zambia. Sustain. Agric. Res., 13: 61-61. https://doi.org/10.5539/sar.v13n1p61

Hofmann, T., Schmucker, S.S., Bessei, W., Grashorn, M. and Stefanski, V., 2020. Impact of housing environment on the immune system in chickens: A review. Animals, 7(10): 1138. https://doi.org/10.3390/ani10071138

Horst, P., 1991. Native fowl as a reservoir for genomes and major genes with direct and indirect effects on the adaptability and their potential for tropically oriented breeding plans. A review. Anim. Res. Dev., (33): 63-79.

Islam, R., Kalita, N., Sapcota, D., Sheikh, I.U., Mahanta, J.D. and Sarma, M., 2021.

Characterization of free-range indigenous chicken production system in north-east India (Assam). J. Anim. Res., 11: 59-70. https://doi.org/10.30954/2277-940X.01.2021.8

Justus, O., Owuor, G., Bebe, B. and Ochieng, D.O., 2011. Effect of management interventions on productive performance of indigenous chicken in Western Kenya. (23)

Kanyama, C., Ngosa, M., Sibanda, T., Moss, A. and Crowley, T., 2024. Rural poultry farming: Leveraging higher poultry input costs to grow Zambia's indigenous chicken sector. Poultry, 3: 383-398. https://doi.org/10.3390/poultry3040029

Kassa, B., Mengesha, Y., Woldegiorgiss, W. and Dessie, T., 2020. Village chicken breeding objectives and trait preferences of chicken producers' in western Amhara, Ethiopia. J. Biol. Agric. Healthc., 9(10).

Kenfo, H., Mustefa, A., Belayhun, T., Hailu, A. and Assefa, A., 2023. Production system of indigenous chickens in pastoral and agro-pastoral districts of south omo zone, south Ethiopia. 4: 54-73.

Kirunda, H., Muwereza, N., Kasaija, P., Kerfua, S. and Jumanyol, K., 2010. Infectious and non-infectious factors affecting hatchability in indigenous chickens in Eastern Uganda. Afr. J. Anim. Biomed. Sci., 5: 51-59.

Liswaniso, S., Mwambilwa, K., Odubote, K., Tyasi, T.L., Mweni, M., Sun, X., Xu, R. and Qin, N.. 2024. Zambian indigenous chicken genetic resources: Phenotypic characteristics and their production systems among small-scale farmers. Front. Vet. Sci., 11: 1-15. https://doi.org/10.3389/fvets.2024.1429869

Liswaniso, S., Ning, Q., Xueshan, S., Xue, S. and Rifu, X., 20233. Phenotypic characterization of indigenous free range chickens in Kalomo, Zambia. J. Anim. Plant Sci., 3(33). https://doi.org/10.36899/JAPS.2023.3.0658

Liswaniso, S., Odubote, K., Tyasi, T.L., Cao, S., Wang, S., Ou, Y., Zhang, D., Sun, X., Xu, R. and Qin, N. 2025. Assessment of backyard broiler production in Zambia: A potential for household food and economic security. Front. Sustain. Food Syst., (9). https://doi.org/10.3389/fsufs.2025.1446060

Liswaniso, S., Tyasi, T.L., Qin, N., Xue, S. and Xu, R., 2020. Assessment of the relationship between body weight and linear body measurement traits of Zambian indigenous free-range chickens using path analysis. Sylwan 11(164): 465-485.

Magothe, T., Okeno, T., Muhuyi, W. and Kahi, A., 2012. Indigenous chicken production in Kenya: I. Current status. World's Poult. Sci. J., 1(68): 119-132. https://doi.org/10.1017/S0043933912000128

Mahoro, J., Muasya, T.K., Mbuza, F., Habimana, R. and Kahi, A.K., 2017. Characterization of indigenous chicken production systems in Rwanda. Poult. Sci., 12(96): 4245-4252. https://doi.org/10.3382/ps/pex240

Manyelo, G., Selaledi, T., Hassan, Z. and Mabelebele, M., 2020. Local chicken breeds of africa: their description, uses and conservation methods. Animals, 12(10). https://doi.org/10.3390/ani10122257

Mapiye, C. and Sibanda, S., 2005. Constraints and opportunities of village chicken production systems in the smallholder sector of Rushinga district of Zimbabwe. Livest. Res. Rural Dev., 17.

Mambwe District Council, 2019. Mambwe District Investment Profile. Mambwe District Council, Mambwe, Zambia. Available at: https://www.mambwecouncil.gov.zm/wp-content/uploads/2023/12/DISTRICT-INVESTMENT-PROFILE.pdf [Accessed 5 February 2026].

Maswana, M., Mugwabana, T.J. and Tyasi, T.L., 2022. Evaluation of breeding practices and morphological characterization of donkeys in Blouberg local municipality, Limpopo province: Implication for the design of community-based breeding programme. PLoS One, 12(17): e0278400. https://doi.org/10.1371/journal.pone.0278400

Matawork, M., 2018. Productive and reproductive performance of indigenous chickens in Ethiopia. Int. J. Livest. Prod., 10(9): 253-259. https://doi.org/10.5897/IJLP2018.0451

Mbuza, F., Manishimwe, R., Mahoro, J., Thomas, S. and Nishimwe, K., 2017. Characterization of broiler poultry production system in Rwanda. Trop. Anim. Health Prod., (49). https://doi.org/10.1007/s11250-016-1160-0

Melak, A., Kenfo, H., Aseged, T. and Hailu, A., 2021. Production system and breeding practice of indigenous chickens in selected districts of Dawro zone and Konta special district, Southern Ethiopia. Asian J. Agric., 2(5). https://

doi.org/10.13057/asianjagric/g050204

Melese, G. and Melkamu, B., 2014. Assessment of chicken production under farmers management condition in east Gojam Zone, Amhara regional state, Ethiopia. Greener J. Anim. Breed. Genet., 1(1): 001-010. https://doi.org/10.15580/GJABG.2014.1.1213131029

Mersha, S.F. and Senbeta, E.K., 2020. Chicken reproductive performance in Ethiopia. Turk. J. Agric. Food Sci. Technol., 8(8): 1755-1762. https://doi.org/10.24925/turjaf.v8i8.1755-1762.3501

Moussa, H., Keambou, T., Hima, K., Issa, S., Motsa'a, S. and Bakasso, Y., 2019. Indigenous chicken production in Niger. Vet. Anim. Sci., 7: 100040. https://doi.org/10.1016/j.vas.2018.11.001

Muasya, T.K., Wol, B.D. and Kahi, A.K., 2022. Breeding practices and traits of economic importance for indigenous chicken in south Sudan. Trop. Anim. Health Prod., 3(24): 133-141. https://doi.org/10.20884/1.jap.2022.24.3.104

Muchadeyi, F., Sibanda, S., Kusina, N.T., Kusina, J. and Makuza, S., 2004. The village chicken production system in Rushinga District of Zimbabwe. Livest. Res. Rural Dev., 16.

Mujyambere, V., Adomako, K., Olympio, S.O., Ntawubizi, M., Nyinawamwiza, L., Mahoro, J., and Conroy, A. 2022. Local chickens in East African region: their production and potential. Poult. Sci., 1(101): 101547. https://doi.org/10.1016/j.psj.2021.101547

Mukarumbwa, P., Taruvinga, A. and Madikizela, A., 2021. An analysis of factors that determines the choice of indigenous chicken (IC) owned by rural households in Alice Communal Area, South Africa. J. Agribus. Rural Dev., 3. https://doi.org/10.17306/J.JARD.2021.01436

Mwalusanya, N., Katule, A., Mutayoba, S., Mtambo, M., Olsen, J. and Minga, U., 2002. Productivity of local chickens under village management conditions. Trop. Anim. Health Prod., 34: 405-416. https://doi.org/10.1023/A:1020048327158

Nankonde, L., chipolyonga, F., Manyanga, M., Mwila, P., Tyasi, T.L. and Liswaniso, S., 2025. Comparison of phenotypic characteristics of Zambian indigenous chickens across the three agroecological regions of Zambia. IX. Int. Congr. Domest. Anim. Breed. Genet. Husb., 121 pp., Szeged - HUNGARY 2025

Nanyangwe, V. and Tembo, R., 2024. Effects of climate-smart agriculture on smallholder farmers in the eastern province of Zambia. Int. J. Appl. Agric. Sci., 3(10). https://doi.org/10.11648/j.ijaas.20241003.12

Natukunda, K., Kugonza, D. and Kyarisiima, C., 2011. Indigenous chickens of the Kamuli Plains in Uganda: I. Production system and flock dynamics. Livest. Res. Rural Dev., 10(23): 1-13.

Ngogo, G.E., Guni, F.S. and Nguluma, A.S., 2023. Management systems and productivity of indigenous chickens in Busokelo district, Mbeya region, Tanzania. Eur. J. Agric. Food Sci., 1(5): 73-79. https://doi.org/10.24018/ejfood.2023.5.1.629

Ngongolo, K. and Chota, A., 2021. Chicken production, flock size, management systems, and challenges in the Dodoma region in Tanzania. Poult. Sci., 6(100): 101136. https://doi.org/10.1016/j.psj.2021.101136

Nigussie, D., 2011. Breeding programs for indigenous chicken in Ethiopia: Analysis of diversity in production systems and chicken populations. Wageningen University and Research.

NRC, 1994. Nutrient requirements of poultry: National Academies Press.

Nwachukwu, E., 2014. Effect of strain and associations of some fertility and hatchability traits of indigenous guinea fowls raised in the rain-forest zone of South-East Nigeria. Effect of strain and associations of some fertility and hatchability traits of indigenous guinea fowls raised in the rain-forest zone of South-East Nigeria 2: 098-102.

Okeno, T.O., Kahi, A. and Peters, K., 2011. Breed selection practices and traits of economic importance for indigenous chicken in Kenya. Growth, 3(2): 1-44. https://doi.org/10.1007/s11250-011-9942-x

Okeno, T.O., Kahi, A.K. and Peters, K., 2012. Characterization of indigenous chicken production systems in Kenya. Trop. Anim. Health Prod., 44: 601-608. https://doi.org/10.1007/s11250-011-9942-x

Qin, N., Shan, X., Sun, X., Liswaniso, S., Chimbaka, I. and Xu, R., 2020. Evaluation and validation of the six housekeeping genes for normalizing mRNA expression in the ovarian follicles and several tissues in chicken. Rev. Brasil. Ciência Avícola, 22. https://doi.org/10.1590/1806-

9061-2019-1256

Sebho, H.K., 2016. Exotic chicken status, production performance and constraints in Ethiopia: A review. Asian J. Poult. Sci., 1(10): 30-39. https://doi.org/10.3923/ajpsaj.2016.30.39

Shuma, S. and Gurmessa, K., 2021. A study on management systems and performances of local chicken kept under smallholder farmers: The case of Jimmahorro district of Kelem Wollega Zone Western Oromia. Int. J. Agric. Sci. Food Technol., 7: 92-98.

Sisay Fikru and Senbeta, E.K., 2020. Chicken reproductive performances in Ethiopia. Turk. J. Agric. Food Sci. Technol., 8: 755-1762. https://doi.org/10.24925/turjaf.v8i8.1755-1762.3501

Tadelle, D., Million, T., Alemu, Y. and Peters, K., 2003. Village chicken production systems in Ethiopia: Flock characteristics and performance. Livest. Res. Rural Dev., 1(15): 1-9.

Thrusfield, M.R.C., Helen, B., Peter, J., Diggle, N.F., Keith, H., Louise, K., Annette, O., Jan Sargeant, H.W., 2018. Veterinary epidemiology. John Wiley & Sons. https://doi.org/10.1002/9781118280249

Wambua, S., Macharia, I. and Mwenjeri, G., 2022. Challenges and opportunities in improved indigenous chicken production in Kenya. East Afr. Agric. For. J., 3 & 4(86): 10-10.

Wassie, A., Kenfo, H., Aseged, T. and Hailu, A., 2021. Production system and breeding practice of indigenous chickens in selected districts of Dawro zone and Konta special district, Southern Ethiopia. Asian J. Agric., (5). https://doi.org/10.13057/asianjagric/g050204

Yemane, N., Tamir, B. and Belihu, K., 2014. Characterization of village chicken production performance under scavenging system in Halaba district of southern Ethiopia. Ethiop. Vet. J., 17: 68. https://doi.org/10.4314/evj.v17i1.6

Yussif, I., Kugonza, D., Amuge, P., Costa, R. and Anjos, F., 2023. Uganda chicken genetic resources: I. phenotypic and production characteristics. Front. Genet., 13: 1033031. https://doi.org/10.3389/fgene.2022.1033031

Zaman, M.P.S. and Mar, H., 2004. Egg production performances of a breed and three crossbreeds under semi-scavenging system of management. Livest. Res. Rural Dev., 16(16).

ZAMSTATS, (2023). 2023 Livestock Survey Report. Republic of Zambia.

Zereu, G. and Mesele, T., 2016. Production and reproduction performance of local chicken breeds and their marketing practices in Wolaita Zone, Southern Ethiopia. Afr. J. Agric. Res., 11: 1531-1537. https://doi.org/10.5897/AJAR2015.10728