Journal of Animal Science and Veterinary Medicine
Volume 11(3), pages 154-162, June 2026
Article Number: 1C2D603F1
ISSN: 2536-7099
https://doi.org/10.31248/JASVM2026.643
https://integrityresjournals.org/journal/JASVM

Full Length Research

Prevalence and risk factors of ectoparasites in local chickens in Uganda

Ronald Fashaho, Sylvia Angubua Baluka*, William Microsse Kabasa, Joyna Ofungi and Ann Nanteza

College of Veterinary Medicine, Animal Resources & Biosecurity, Makerere University, Kampala, Uganda.

*Corresponding author. Email: sylvia.baluka@mak.ac.ug/sbaluka3@gmail.com; Tel: +256775043052; ORCID: 1000-0003-3926-5332

Received Date: 25 February 2026 | Accepted Date: 25 March 2026 | Published Date: 30 June 2026

ABSTRACT: The research sought to evaluate the prevalence and risk factors linked to flea and lice infestations in indigenous chickens in the Mityana district of Uganda, where ectoparasites continue to pose a major limitation to rural poultry productivity. Cross-sectional research was carried out between May and July 2024 with 284 local chickens. A multi-phase random sampling strategy was utilised in two parishes (Kireku and Nakaseeta) within the Busimbi division. Information regarding management practices, age, and gender was gathered through organised forms, followed by physical assessments and lab identification using stereomicroscopy. Statistical analysis, utilising univariate chi-square tests and multivariate binary logistic regression, was conducted with IBM SPSS Statistics to determine significant predictors of infestation. The total prevalence of ectoparasite infestation was 81%, with lice (68.3%) being notably more common than fleas (27.5%). The majority of infested chickens (82%) had only single infestations. Multivariate analysis indicated that age and management system were significant predictors; adult chickens had a 591.8 times higher likelihood of having lice compared to chicks (OR = 591.8; $p<0.001$), while those in semi-intensive systems were 39.6 times more likely to carry lice than free-range birds (OR = 39.6; $p=0.016$). The management system was the only element that notably affected flea infestation ($p<0.001$), as semi-intensive systems exhibited a 100% prevalence rate. The significant ectoparasite load, especially lice in adult birds and fleas in enclosed environments, highlights the necessity for enhanced poultry hygiene and management practices. We suggest establishing age-specific housing, focused farmer education on environmental health, and the regular, strategic application of suitable insecticides to improve local poultry well-being, household livelihoods and rural economies.

Keywords: Chicken, ectoparasites, fleas, infestation, lice, local, prevalence.

Abbreviations: C.I., Confidence Interval; **OR,** Odds Ratio; **UBOS,** Uganda Bureau of Statistics; **PPE,** Personal Protective Equipment.

INTRODUCTION

In Africa, about 80% of the poultry population is reared under traditional, smallholder systems (Belihu *et al*. 2009). In Uganda (UBOS, 2017), the poultry population is estimated at 57.7 million chickens, of which 87.7% are indigenous breeds kept mainly under free-range systems. Poultry contributes about 4.3% of Uganda's agricultural revenue and plays a vital role in household nutrition, income generation, and food security (UBOS, 2017). Local chickens are particularly valued for their adaptability, low input requirements, and socio-cultural importance among rural communities (Tainika and Duman, 2019). Despite their importance, the productivity of local chickens remains low due to multiple constraints, including infectious diseases and parasitic infestations. Among these, ectoparasites such as fleas and lice are a major challenge, although often overlooked (Kebede *et al*., 2017; Mata *et al*., 2018). In tropical regions, warm and humid conditions favour ectoparasite development, while poor housing and hygiene practices exacerbate infestation rates. The productivity of indigenous poultry is severely hampered by ectoparasite infestations, resulting in stunted growth and substantial economic losses (Rezaei *et al*., 2016; Onyekachi, 2021). Although the poultry sector is a vital pillar of rural livelihoods, its potential remains constrained by high parasite burdens (UBOS, 2017). Heavy infestations may even result in mortality, particularly among chicks. Moreover, some species act as mechanical or biological vectors of zoonotic pathogens (such as tularemia and bartonellosis), hence posing potential public health risks. The significant impact of these parasites on smallholder poultry systems has been documented across various regions, with studies in Nigeria (Biu *et al*., 2007; Sadiq *et al*., 2003; Zaria *et al*., 1996) and Ethiopia (Alemu *et al*., 2015; Tamiru *et al*., 2014) highlighting their role as major production bottlenecks. General control guidelines emphasise that effective management is the first line of defence (Williams, 2010; Permin and Hansen, 1998).

Even with these implications, the prevalence and risk factors of poultry ectoparasites remain under-researched in Uganda. Most previous parasitological studies focused on endoparasites such as helminths, like Haemonchus, and viral diseases, such as Newcastle disease (Byaruhanga *et al*., 2017). Current knowledge on poultry ectoparasites is essential for guiding effective management, control strategies and policies. The study investigated the prevalence of fleas and lice infestations and their associated risk factors in local chickens in Busimbi division, Mityana district, Uganda. These findings provide baseline information for designing targeted ectoparasite control strategies aimed at improving local poultry health, productivity, and farmer livelihoods.

MATERIALS AND METHODS

Study area

The study was conducted in Busimbi division, Mityana Municipality, Mityana district, in Central Uganda (approximately 77 km west of Kampala, the capital city of Uganda; coordinates ~ 0° 24’N, 32° 32’E). Two parishes within Busimbi Division (Kireku and Nakaseeta) were purposively selected because they have the highest numbers of local chickens in Mityana district (UBOS, 2017), as shown in Figure 1. Mityana district was selected because indigenous poultry farming is an important livelihood activity in the area more so for women smallholder farmers (Matovu, 2021) and due to its high human population and demand for animal proteins, close proximity to Kampala, the capital city, thus it serves as a food basket for the high city population. Hence the need to control ectoparasites so as to improve the productivity of local chicken and food security for the fast-growing urban population.

Study design and period

A cross-sectional study was conducted from May 1st to July 30th, 2024, supported by laboratory analysis to determine the prevalence of fleas and lice infestations in local chickens and the associated risk factors.

Sample size determination

The necessary sample size was calculated using the formula for estimating a single proportion in a large population, as explained by Thrusfield (1995). With an anticipated prevalence of 50% and a precision level of 5%, a total of 384 chickens were sampled throughout the study region: at 95% level of confidence and 75% expected ectoparasites prevalence (Odenu *et al*., 2016) and 0.05% desired absolute precision.

$$n = [Z^2 * P(1-P)] / d^2$$

Where Z = 1.96 (95% confidence), expected prevalence P = 0.75 (Odenu *et al*., 2016), and absolute precision d = 0.05, giving a target sample size N = 288 chickens.

Due to opting out by some selected households, a total of 284 chickens were examined and included in the study, giving a non-response rate of 1.4%, which was considered insignificant and did not affect the study outcomes.

Study population and eligibility

The study primarily focused on indigenous (local) chicken ecotypes, which are the dominant birds in rural Mityana. These included common local phenotypes such as the Normal feathered, Naked Neck, and Frizzled chickens. Unlike commercial Broilers (Cobb 500) or Layers (ISA Brown), typically managed under intensive biosecurity, these indigenous birds are reared under free-range scavenging systems, which increases their environmental exposure to diverse parasite populations

For purposes of this study, the free range system was where the chickens were housed only at night and let out in the morning up to sunset. Under the semi-intensive system, the chickens were housed at night and provided with feed in the housing, which was fenced off, and during the day, they could be let out to feed outside the housing within the fence. Whereas the chickens under the intensive system were housed and fed in the house throughout. Chickens that were clinically ill with conditions unrelated to ectoparasites or that could not be safely handled were excluded.

Sampling procedure

The first author and two research assistants sanitised their

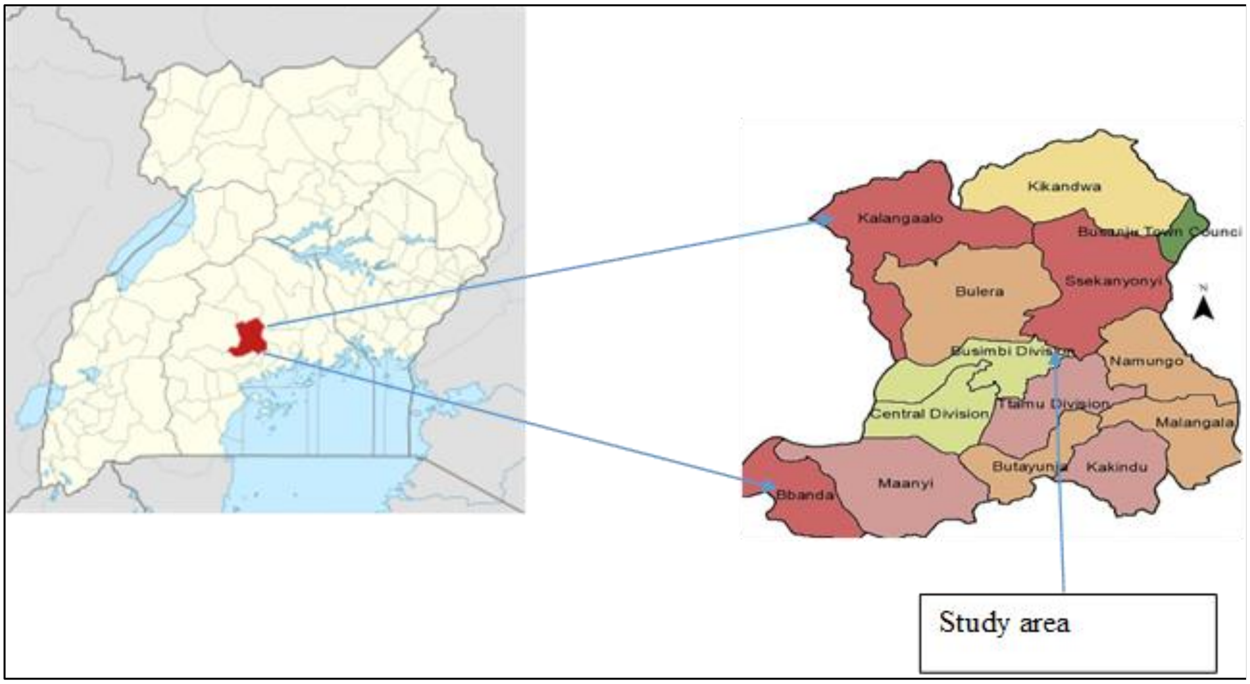

Figure 1. Map of Uganda showing the study area (Map sourced from the Uganda Bureau of Statistics (UBOS): https://ubos.maps.arcgis.com/home/

hands, put on personal protective equipment (PPE), which included overalls and gum boots, and disinfected upon arrival on each farm before examining the chicken. A random sampling method with multiple stages was utilised. Initially, two parishes (Kireku and Nakaseeta) were intentionally chosen. Among these, six villages were selected at random. In the end, households were chosen from a total of 1,230, and 25% of the birds from each household were sampled to guarantee a representative distribution. A farmer's consent was obtained before sampling. Only 4 households (about 1.4%) of the households originally selected declined to participate and were not replaced since they accounted for a small percentage that could not affect the study outcomes significantly.

Data and specimen collection

For each examined bird, the sex and estimated age category (chick < 2 months, grower 2-8 months, adult > 8 months) and the production management system were recorded or captured using a structured data sheet. Age classification was based on physical criteria such as crown size, spur length, and xiphoid cartilage flexibility (Magwisha *et al*., 2002, Maina 2005).

Each bird was physically examined for ectoparasites by parting the feathers and inspecting the skin and feather bases following a systematic protocol (Kebede *et al*., 2017). Birds were restrained manually by an assistant during examination. Immediately after collection, the ectoparasite specimens from each bird were placed in 70% ethanol in labelled vials having a unique ID matching the bird and household. The specimens were then placed in a cool box and transported within 6 hours after collection to the parasitology laboratory at the College of Veterinary Medicine, Animal Resources and Biosecurity, for further processing.

Parasite processing and identification in the parasitology laboratory

Specimens were cleared in lactophenol and examined under a stereomicroscope. Identification to taxon (lice and fleas) was carried out under x100 magnification using standard morphological keys adopted from (Mathison and Pritt, 2014; Modrý *et al*., 2017). Records included presence/absence of fleas or lice alone or both, and the dominant ectoparasite per chicken.

Data analysis

Data were entered into Microsoft Excel and exported to SPSS for statistical analysis. Descriptive statistics, including frequencies and percentages, were used to determine the overall prevalence of lice and fleas. To identify risk factors, a Chi-square test (X^2) was first used to

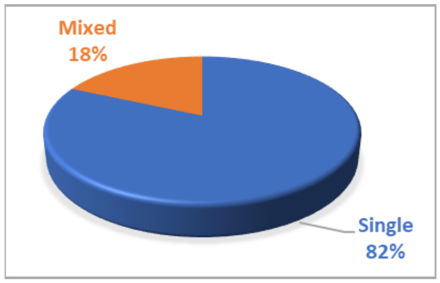

Figure 2. Fleas and lice infestation in the local chickens studied.

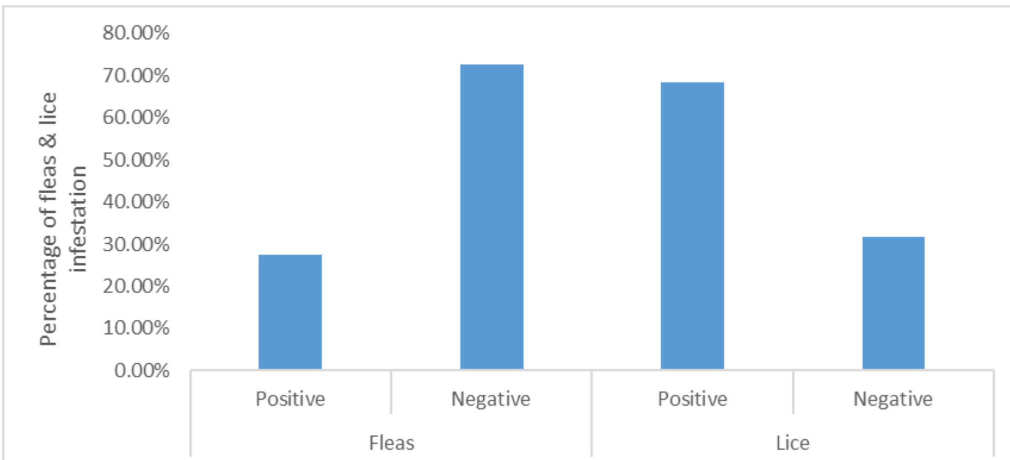

Figure 3. Comparative prevalence of fleas and lice among local chickens examined.

assess associations between parasite infestation and categorical variables (age, sex, and management system). Variables with a *p*-value were then included in a multivariable logistic regression model to calculate Adjusted Odds Ratios (aOR) with 95% Confidence Intervals (CI). Statistical significance was set at p<0.05.

RESULTS

Overall prevalence

A total of 284 local chickens were examined, of which 230 (81%; 95% CI: 95% CI: 1.34–13.45) were infested with either fleas or lice. Most infested chickens (82%) had single infestations, while 18% had dual infestations (Figure 2).

Lice infestation of the local chicken studied (68.3%) was significantly higher (*p = 0.001*) than the number of local chickens infested with fleas (27.5%), as shown in Figure 3.

Prevalence of fleas and associated risk factors

In the univariate analysis, the prevalence of fleas varied significantly across management systems (p < 0.001), but age (p = 0.193) and sex (p = 0.068) did not influence significantly (Table 1). Fleas were most prevalent in chickens reared under semi-intensive (100%) and intensive (56.3%) systems, compared to free-range (22.3%).

In the multivariate logistic regression model (Hosmer–Lemeshow = 0.613), management system remained a significant predictor of flea infestation (Table 2). Chickens reared under intensive and semi-intensive systems were 3.9 and 6.2 × 10^{12} times more likely to harbour fleas compared to those under free-range systems. Although female chickens were slightly less likely to have fleas (OR = 0.528, p = 0.05), age was not a significant factor (p>0.2).

Prevalence of lice and associated risk factors

The overall prevalence of lice was 68.3%, and infestation varied significantly by age (p<0.001) and management system (p = 0.001), as shown in Table 3. Adults recorded the highest prevalence (94.4%), followed by growers (72.4%), while chicks showed the lowest prevalence

Table 1. Risk factors associated with flea prevalence in local chickens (univariate analysis)

Variable	Category	N	n (positive)	% Positive	*P*-value
Sex	Female	221	55	24.9	0.068
	Male	63	23	36.5	
Age	Adults	180	43	23.9	0.193
	Grower	29	9	31.0	
	Chicks	75	26	34.7	
Management system	Free range	256	57	22.3	< 0.001
	Intensive	16	9	56.3	
	Semi-intensive	12	12	100	

N= Number of samples, n= positive samples.

Table 2. Multivariate analysis of risk factors influencing flea prevalence in local chickens

Variable	Category	*P*-value	OR	95% C.I. for OR	
				Lower	Upper
Sex	Female	0.05	0.528	0.279	1.000
	Male (ref)	-	1	-	-
Age	Adult	0.230	0.673	0.352	1.285
	Grower	0.710	0.818	0.281	2.376
	Chick (ref)	-	1	-	-
Management System	Intensive	0.013	3.916	1.334	11.495
	Semi-intensive	0.998	6.2 E 12	0.000	-
	Free range (ref)	-	1	-	-

OR = Odds Ratios, C.I. = Confidence Intervals.

Table 3. Risk factors influencing prevalence of lice in local chicken.

Variable	Category	Number	n (positive)	% Positive	*P*-value
Sex	Female	221	154	69.7	0.351
	Male	63	40	63.5	
Age	Adult	180	170	94.4	
	Grower	29	21	72.4	< 0.001
	Chick	75	3	4.0	
Management system	Free range	256	178	69.5	
	Intensive	16	5	31.3	0.001
	Semi-intensive	12	11	91.7	

(4.0%). Among management systems, lice infestation was highest in semi-intensive (91.7%), moderate in free-range (69.5%), and lowest in intensive systems (31.3%). The multivariate logistic regression model (Hosmer–Lemeshow = 0.876) confirmed that both age and management system were significant predictors of lice prevalence (Figure 4). Age was a statistically significant risk factor for lice infestation (p<0.001). Adult chickens exhibited the highest prevalence (94.4%), with an adjusted odd ratio (aOR) of 591.84 compared to chicks, suggesting a cumulative exposure risk over time, while growers were 82.1 times more likely (OR = 82.1). Chickens under semi-

Table 4. Multivariate analysis of risk factors influencing lice prevalence in local chickens

Variable	Category	*P*-value	OR	95% C.I. OR	
				Lower	Upper
Age	Adult	< 0.001	591.839	122.411	2861.459
	Grower	< 0.001	82.063	15.368	438.204
	Chick (ref)	-	1	-	-
Management System	Intensive	0.993	0.988	0.063	15.401
	Semi-intensive	0.016	39.581	2.006	781.131
	Free range (ref)	-	1	-	-

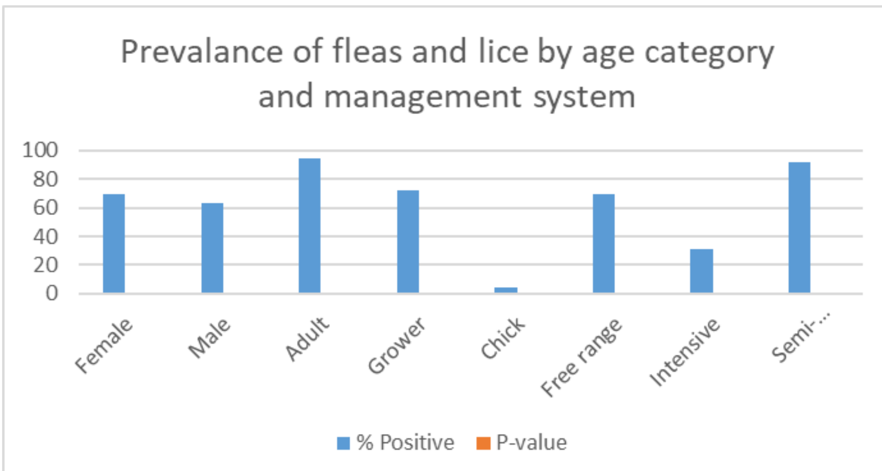

Figure 4. Distribution of flea and lice prevalence by management system and age category.

intensive systems were 39.6 times more likely to harbour lice compared to those under free-range management.

Summary of key patterns

Collectively, the findings reveal that ectoparasite infestation is highly prevalent among local chickens in Busimbi Division, Mityana District. Lice were the most prevalent ectoparasites, particularly among adult birds and those kept under semi-intensive management systems. Flea infestations, while on the overall were less common, were strongly influenced by production systems, with semi-intensive and intensive systems presenting markedly higher odds of infestation than free-range systems.

DISCUSSION

The overall prevalence of ectoparasite infestation in local chickens in this study (81%) was high, indicating widespread exposure in the study areas, particularly under semi-intensive systems. This finding aligns closely with reports from Tanzania (84%) (Swai *et al*. 2010), Ethiopia, 83.9% (Mulugeta *et al*., 2013), 68.6% (Alemu *et al*., 2015; Tamiru *et al*., 2014), Kenya 95.8% (Sabuni *et al*. 2010; Sabuni *et al.,* 2023), Iran 52.8% (Mirzaei *et al*. 2016) though somewhat lower than rates exceeding 90% reported in Bangladesh and Nigeria (Shanta *et al*., 2006; Bala *et al*., 2011, Odenu *et al*. 2016, Sadiq *et al*., 2003). Variation likely reflects differences in climate, sampling season, housing hygiene, and ectoparasite control practices (Mungube *et al*., 2008; Mekuria and Gezahegn, 2010).

The significant occurrence of ectoparasites noted in this study (94.4%) could also be affected by seasonal variations in Mityana District. In tropical regions such as Uganda, the rainy season usually increases humidity, which is recognised to speed up the life cycle of lice and mites. In contrast, the dry season can result in heightened dust and gathering of birds, which aids the horizontal spread of fleas such as *Echidnophaga gallinacea*. Although the data reflects a particular snapshot, the possibility of seasonal fluctuations in parasite load as observed in comparable agro-ecological regions by Permin *et al*. (2002) indicates that control measures should be carefully scheduled to occur before peak transmission times.

Lice were the predominant ectoparasites (68.3%) compared to fleas (27.5%), which is comparable to an earlier study in Nigeria, which estimated the lice and mite infestation prevalence at 88% and 7.2%, respectively. This pattern agrees with Refisa *et al* (2025) in Ethiopia, where lice (69%) were also more prevalent than fleas (33%), but contrasts with findings from Kenya (Maina, 2005; Mungube *et al*., 2008), where fleas were dominant. Lice are permanent parasites adapted to the host's plumage microclimate, whereas fleas spend part of their lifecycle in the environment; thus, their prevalence is more sensitive to litter management and humidity (Magwisha *et al*. 2002). The relatively lower flea prevalence in this study may reflect less favourable environmental conditions for flea larval development or more frequent litter disturbance in some systems. Moreover, the biological traits of these parasites, outlined in the MSD Veterinary Manual (Amy, 2022) clarify why lice are constant inhabitants of the host's feathers, unlike the temporary presence of fleas.

Adult chickens showed a significantly higher prevalence of lice (94.4%) than growers (72.4%) or chicks (4.0%), consistent with Belihu *et al*. (2009). Adults provide a larger feather surface area and more stable body heat for lice reproduction. The low infestation in chicks may also reflect the protective brooding behaviour of hens, which limits exposure to contaminated environments. In contrast, flea prevalence decreased with age, but the differences were not statistically significant, suggesting that all age groups are equally exposed to environmental flea reservoirs.

Although lice prevalence was slightly higher in females (69.7%) than in males (63.5%), the difference was not statistically significant. Previous studies show inconsistent sex patterns, with some reporting higher prevalence in males (Belihu *et al*., 2010; Mungube *et al*., 2008) and others in females (Bala *et al*., 2011). These inconsistencies likely stem from behavioural rather than physiological factors, as both sexes receive similar management and share habitats.

The management system strongly influenced lice and/or prevalence. Lice infestation was highest in semi-intensive (91.7%) and free-range (69.5%) systems, and lowest in intensive systems (31.3%). Flea infestation followed a similar trend, with the semi-intensive system recording the highest prevalence (100%). These findings emphasise the role of housing hygiene, litter accumulation, and restricted dust-bathing opportunities. Semi-intensive systems often combine limited confinement with suboptimal sanitation, creating ideal conditions for both lice transmission and flea larval development (Murillo, 2022). In contrast, intensive systems benefit from routine cleaning and biosecurity measures that limit flea and/or lice survival.

Overall, these results corroborate previous East African findings showing high ectoparasite burdens in backyard poultry (Mungube *et al*., 2008; Mekuria and Gezahegn, 2010; Kebede *et al*., 2017). The present findings provide the first structured data on poultry ectoparasitism in central Uganda, contributing to the regional epidemiological map.

Given the high prevalence and mixed infestation patterns, farmer education on hygiene, environmental sanitation, and the use of safe insecticidal dusts is essential. Dust-bathing areas and dry litter should be promoted to disrupt parasite life cycles. Fleas, in particular, are of zoonotic concern as vectors of *Bartonella henselae* and *Rickettsia felis* (Bitam *et al*., 2010), underscoring the need for awareness among farmers and handlers. Limitations of this study include its cross-sectional nature, restriction to a single season, and lack of species-level identification of parasites. Although this study recognises key groups of parasites, morphological identification was restricted to the genus. Subsequent research employing molecular methods or comprehensive morphological keys would bolster these results by verifying the distinct species diversity found in Central Uganda.

While this study provides a critical baseline for Mityana District, further research is required to inform national poultry policy. It is proposed that future studies expand this scope by incorporating stratified random sampling to capture the environmental and regional variability across Uganda's diverse agro-ecological zones. Additionally, research should move beyond ectoparasites to consider concurrent constraints such as endoparasite burdens and viral challenges (like Newcastle Disease). To ensure sustainable impact, future interventions should be integrated with local agricultural extension services, fostering better data access and increasing the direct involvement of poultry farmers in community-based parasite control programs.

COMPETING INTERESTS

The authors have no competing interests.

REFERENCES

Alemu, N., Muktar, Y., Kassaye, D., & Hiko, A. (2015). Prevalence of lice and fleas in backyard chickens of Bishoftu Town, Ethiopia. *American-Eurasian Journal of Agricultural and Environmental Sciences*, *15*(11), 2136-2142.

Amy, C. M. (2022) Lice of Poultry - Poultry - MSD Veterinary Manual. Merck & Co., Inc., Rahway, NJ, USA. Retrieved from https://www.msdvetmanual.com/poultry/ectoparasites/lice-of-poultry.

Bala, A. Y., Anka, S. A., Waziri, A., & Shehu, H. (2011). Preliminary survey of ectoparasites infesting chickens (Gallus domesticus) in four areas of Sokoto Metropolis. *Nigerian Journal of Basic and Applied Sciences*, *19*(2), 173-180.

Belihu, K., Mamo, A., Lobago, F., & Ayana, D. (2009). Prevalence of ectoparasites in backyard local chickens in three agroecologic zones of East Shoa, Ethiopia. *Revue de Médecine Vétérinaire*, *160*(11), 537-541.

Bitam, I., Dittmar, K., Parola, P., Whiting, M. F., & Raoult, D. (2010). Fleas and flea-borne diseases. *International journal of infectious diseases*, *14*(8), e667-e676.

Biu, A. A., Agbede, R. I., & Peace, P. (2007). Studies on ectoparasites of poultry in Maiduguri, Nigeria. *Nigerian Journal of Parasitology*, *28*(2), 69-72.

Byaruhanga, J., Tayebwa, D. S., Eneku, W., Afayoa, M., Mutebi, F., Ndyanabo, S., Kakooza, S., Okwee-Acai, J., Tweyongyere, R., Wampande, E. M., & Vudriko, P. (2017). Retrospective study on cattle and poultry diseases in Uganda. *International Journal of Veterinary Science and Medicine*, *5*(2), 168-174.

Kebede, A., Abebe, B., & Zewdie, T. (2017). Study on prevalence of ectoparasites of poultry in and around Jimma town. *European Journal of Biological Sciences*, *9*(1), 18-26.

Magwisha, H. B., Kassuku, A. A., Kyvsgaard, N. C., & Permin, A. (2002). A comparison of the prevalence and burdens of helminth infections in growers and adult free-range chickens. *Tropical Animal Health and Production*, *34*(3), 205-214.

Maina, A. N. (2005). Prevalence, intensity and lesions associated with gastro-intestinal parasites of indigenous chickens in Kenya. MSc Thesis, University of Nairobi.

Mata, W., Galgalo, W., & Jilo, K. (2018). Prevalence of the major ectoparasites of poultry in extensive and intensive farms in Jimma, Southwestern Ethiopia. *Journal of Parasitology and Vector Biology*, *10*(7), 87-96.

Mathison, B. A., & Pritt, B. S. (2014). Laboratory identification of arthropod ectoparasites. *Clinical Microbiology Reviews*, *27*(1), 48-67.

Matovu, B. (2021). Women participation in income generating activities for socioeconomic development: A case study of Mityana Municipality, Uganda. *International Journal of Innovative Research and Advanced Studies*, *8*(2), 19-27.

Mekuria, S., & Gezahegn, E. (2010). Prevalence of External parasite of poultry in intensive and backyard chicken farm at Wolayta Soddo town, Southern Ethiopia. *Veterinary World*, *3*(12), 533-538 .

Mirzaei, M., Ghashghaei, O., & Yakhchali, M. (2016). Prevalence of ectoparasites of indigenous chickens from Dalahu region, Kermanshah province, Iran. *Türkiye Parazitolojii Dergisi*, *40*(1), 13-16.

Modrý, D., Hofmannová, L., Mihalca, A. D., Juránková, J., Neumayerová, H., & D'Amico, G. (2017). Field and Laboratory diagnostics of parasitic diseases of domestic animals: from sampling to diagnosis. *Department of Pathology and Parasitology, University of Veterinary and Pharmaceutical Sciences Brno, Czech Republic*. Pp.20-27.

Mulugeta, A., Chanie, M., & Bogale, B. (2013). Major constraints of village poultry production in Demba Gofa District of Southern Region, Ethiopia. *British Journal of Poultry Sciences*, *2*(1), 01-06.

Mungube, E. O., Bauni, S. M., Tenhagen, B. A., Wamae, L. W., Nzioka, S. M., Muhammed, L., & Nginyi, J. M. (2008). Prevalence of parasites of the local scavenging chickens in a selected semi-arid zone of Eastern Kenya. *Tropical Animal Health and Production*, *40*(2), 101-109.

Murillo, A. C (2022) Fleas of Poultry - Poultry - MSD Veterinary Manual. Retrieved from https://www.msdvetmanual.com/poultry/ectoparasites/fleas-of-poultry

Odenu, R. A., Mohammed, B. R., Simon, M. K., & Agbede, R. I. S. (2016). Ecto-parasites of Domestic Chickens (*Gallus gallus domesticus*) in Gwagwalada Area Council, Abuja, Nigeria-West Africa. *Alexandria Journal of Veterinary Sciences*, *51*(1), 140-146.

Onyekachi, O. (2021). Prevalence of ectoparasites infestation of chicken in three poultry farms in Awka. *Asian Basic and Applied Research Journal*, *3*(1), 41-53.

Permin, A., & Hansen, J. W. (1998). *Epidemiology, diagnosis and control of poultry parasites.* Food and Agriculture Organization of the United Nations, Rome. Italy. Pp. 1-157.

Permin, A., Esmann, J. B., Hoj, C. H., Hove, T., & Mukaratirwa, S. (2002). Ecto-, endo-and haemoparasites in free-range chickens in the Goromonzi District in Zimbabwe. *Preventive Veterinary Medicine*, *54*(3), 213-224.

Refisa, N., Firouzivand, Y., Chanie, M., Garedaghi, Y., & Rebuma, T. (2025). Prevalence of ectoparasites on poultry managed under backyard system in and around Ambo town, central Ethiopia. *International Journal of Medical Parasitology and Epidemiology Sciences*, *6*(2), 46-52.

Rezaei, F., Hashemnia, M., Chalechale, A., Seidi, S., & Gholizadeh, M. (2016). Prevalence of ectoparasites in free-range backyard chickens, domestic pigeons (Columba livia domestica) and turkeys of Kermanshah province, west of Iran. *Journal of Parasitic Diseases*, *40*(2), 448-453.

Sabuni, Z. A., Mbuthia, P. G., Maingi, N., Nyaga, P. N., Njagi, L. W., Bebora, L. C., & Michieka, J. N. (2011). Prevalence of haemoparasites infection in indigenous chicken in Eastern Province of Kenya. *Livestock Research for Rural Development, 23*(11).

Sabuni, Z. A., Mbuthia, P. G., Maingi, N., Nyaga, P. N., Njagi, L. W., Bebora, L. C., & Michieka, J. N. (2010). Prevalence of ectoparasites infestation in indigenous free-ranging village chickens in different agro-ecological zones in Kenya. *Livestock Research for Rural Development*, *22*(11). Retreived from https://www.lrrd.cipav.org.co/lrrd22/11/sabu22212.htm.

Sadiq, N. A., Adejinmi, J. O., Adedokun, O. A., Fashanu, S. O., & Alimi, A. A. (2003). Ectoparasites and haemoparasites of indigenous chicken (gallus domesticus) in Ibadan and environs. *Tropical Veterinarian, 21*(4), 187-191.

Shanta, I. S., Begum, N., Anisuzzaman, A., Bari, A. S. M., & Karim, M. J. (2006). Prevalence and clinico-pathological effects of ectoparasites in backyard poultry. *Bangladesh Journal of Veterinary Medicine*, *4*(1), 19-26.

Swai, E. S., Kessy, M., Sanka, P., Bwanga, S., & Kaaya, J. E. (2010). A survey on Ectoparasites and haemoparasites of free-range indigenous chickens of Northern Tanzania. *Livestock Research for Rural Development*, *22*(9). Retrieved from https://www.lrrd.cipav.org.co/lrrd22/9/swai22158.htm.

Tainika, B., Şekeroğlu, A., Duman, M., & Şentürk, E. (2019). Poultry production in Uganda: Challenges and opportunities. In *International Congress of the Turkish Journal of Agriculture-Food Science and Technology (International Congress of TURJAF) at Antalya, Turkey*.

Tamiru, F., Dagmawit, A., Askale, G., Solomon, S., Morka, D., & Waktole, T. (2014). Prevalence of ectoparasite infestation in chicken in and around Ambo Town, Ethiopia. *J Vet Sci Technol*, *5*(189), 10-4172.

Thrusfield, M. (1995). *Veterinary epidemiology*. 2nd Edition. Oxford: Blackwell Science Ltd.

UBOS (2017). The State of Uganda Population Report 2017.

Kampala: Uganda Bureau of Statistics.
Williams, R. E. (2010). *Control of poultry pests. Publ. No*. E-3-W. Purdue Cooperative Extension Service. Purdue University.
Zaria, L. T., Sinha, P. K., Natiti, L. S., & Nawathe, D. R. (1996). Incidence of ectoparasites of domestic fowl in an arid. *Nigerian Journal of Animal Production*, *23*(1), 91-93.