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Predation dynamics: hunting tactics, impact, and control strategies of indian house crows on local chicken in Dodoma district, Tanzania

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Abstract

Predation is one of the major challenges threatening chicken farmers, hindering the livelihood potentials in the poultry sector. We employed a cross-sectional design to assess the economic burden and strategies for overcoming predation by Indian House Crows (IHC) among farmers of indigenous chickens in Dodoma City, Tanzania. Data were collected through semi-structured interviews, focus group discussions, and key informant interviews. Quantitative data were analyzed using International Business Machines Statistical Package for the Social Sciences (IBM SPSS) version 26, while qualitative data were analyzed through content analysis. The mean flock size was 24±5 chickens, kept mainly under a free-range system. Depredation of chickens by IHC was high (210 chickens, 35.8%) during the dry season, with chicks being largely affected (461 individuals, 78.7%) compared to other age groups. Factors influencing depredation included the free-range system, young age of chickens, diseases, the dry season, and large flock sizes. Farmers perceived chicken depredation by IHC as a burden that impoverished their livelihood efforts. The main prevention measures against IHC predation were locking chickens up and chasing and shouting at crows. This study recommends further research on effective mechanisms to control IHC in the district and other areas with high crow populations to ensure the sustainability of chicken production and the poultry sector at large.

Keywords: *Chicken management systems; Local chicken breeds; Scavenging; White meat*

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Introduction

The increased consumption of meat has given white meat an advantageous position over red and processed meats (Zeraatkar*et al.*, 2019). This trend has led to a high market demand for poultry meat, particularly from indigenous chickens, surpassing the current production rate (Alabbodyand Lafta, 2022). Consequently, farmers are motivated to raise indigenous breeds due to their highly nutritious eggs and meat, which are beneficial for human consumption (Pius *et al.*, 2021), as well as their superior adaptability to tropical climates and disease resistance (Manyelo*et al.*, 2020). These breeds also have the ability to lay optimally sized eggs (Idowu *et al.*, 2021) and grow to an optimum body weight (Kpomasse*et al.*, 2023). Additionally, indigenous chickens can forage for their own food in free-grazing environments, which reduces the financial burden of feed costs for farmers compared to other chicken breeds (Abioja and Abiona, 2021).

Tanzania is home to over 38.2 million indigenous chickens (Ngogo*et al.,* 2023). However, the growing demand for indigenous chicken meat exceeds the current production rate in the country (Pius *et al.,* 2021). Dodoma district, the capital city of Tanzania, is experiencing rapid population growth (Gayo, 2023). This has led to a high demand for chicken products, providing a better market opportunity for urban and peri-urban farmers in the district (Ngongolo and Chota, 2022; Mramba, 2023). Various studies in the district and elsewhere have examined several aspects of chicken production, including the lack of adequate chicken farming knowledge, which hampers household economic growth (Idowu *et al.,* 2021; Ngongolo*et al.,* 2021), the negative impact of flock size and poor management systems on chicken production (Kpomasse*et al.,* 2023), the effects of sex, age, diseases, and control interventions on chicken mortality (Ngongolo and Chota, 2022), and the contribution of feeds to the spread of chicken pathogens (Mramba, 2023). Other investigations have looked into the lack of knowledge on diseases, practices, and the threats of drug residues in chicken food chains (Chota *et al.,* 2021). However, information on the depredation rate of indigenous chickens is scarce.

The Indian House Crow (*Corvus splendens*) is widely recognized as an invasive species with a remarkable ability to adapt to various environments and an aggressive disposition that often leads to conflicts with native wildlife and human activities (Kaur and Khera, 2020; Anjum*et al.,* 2021). Originating from the Indian subcontinent, these crows have successfully established populations in many parts of the world, including the Middle East (Buniyaadi*et al.,* 2020), East Africa (Ndimuligo*et al.,* 2022), and Southeast Asia (Iqbal *et al.,* 2022), largely due to human activities such as trade and travel (Fraser *et al.,* 2015). The adaptability of the Indian House Crow is attributed to its opportunistic feeding habits, intelligence, and social structure (Iqbal *et al.,* 2022). These crows are omnivorous, consuming a wide range of food items including fruits, insects, small animals, and human refuse (Johan *et al.,* 2022; Kumar and Ojha, 2023). Their social behavior, characterized by strong cooperative tendencies and complex communication, enhances their ability to exploit new environments and resources effectively (Buniyaadi*et al.,* 2020; Mahesh and Suseela, 2021). In Dodoma District, Tanzania, the presence of Indian House Crows has raised significant ecological and socio-economic concerns. The local communities, particularly those engaged in poultry farming, have reported increasing incidents of crow predation on local chickens (Shimba and Jonah, 2017). Poultry farming is a vital economic activity in Dodoma, providing income, food security, and employment for many households (Ngongolo and Chota, 2022). Indigenous chickens are often raised in free-range systems, making them vulnerable to predation by the highly adaptable and aggressive crows (Kimario *et al.,* 2020).

Empirical evidence on incidences of Indian house crows spreading diseases to other fauna exist (Johan *et al.,* 2022; Verma, 2022). Global trend and general impacts of house crows are reported (Shivambu *et al.,* 2020). Factors influencing the distribution of the invasive house crow are also explored (Wilson *et al.,* 2015; Ndimuligo*et al.,* 2022; Jaipal and Singh, 2023). Extensive research is also done on ecology of Indian house crow focusing on its foraging (Kumar and Ojha, 2023), nesting (Shimba and Jonah, 2017), roosting (Saiyad *et al.,* 2017; Mahesh and Suseela, 2021), invasive potential (Kaur and Khera, 2020), breeding Season (Kimario *et al.,* 2020), population estimation and distribution (Radadia, 2013; Kaur and Khera, 2020), and evolutionary history (Sunnucks and Pavlova, 2017). However, inadequate information on the economic impact of crows through depredation of domestic fowl is less reported. The loss of chickens to crow predation translates to financial losses for farmers, threatening their livelihoods and food security. The socio-economic implications extend beyond immediate financial losses. The psychological stress and frustration experienced by farmers due to repeated predation events can lead to decreased productivity and a decline in the overall well-being of the affected communities.

Moreover, current data on the status of indigenous chicken keeping in the district is limited. Thus, investigating the economic burden and strategies for overcoming IHC predation is crucial for promoting indigenous chicken keeping in the district. The present study aims to address this research gap by answering the following research questions: (i) What is the status of indigenous chicken keeping in the study area? (ii) What is the extent of indigenous chicken predation by IHC, and what are the techniques of predation? (iii) What factors influence the predation of indigenous chickens by IHC? (iv)What is the economic loss incurred by chicken farmers due to IHC predation? (v) What strategies are used by chicken farmers against IHC predation in the study area? The findings of this study are expected to inform policy and various practitioners to improve chicken production among farmers, despite the growing population of IHC and other similar natural predators in the district and elsewhere in the world.

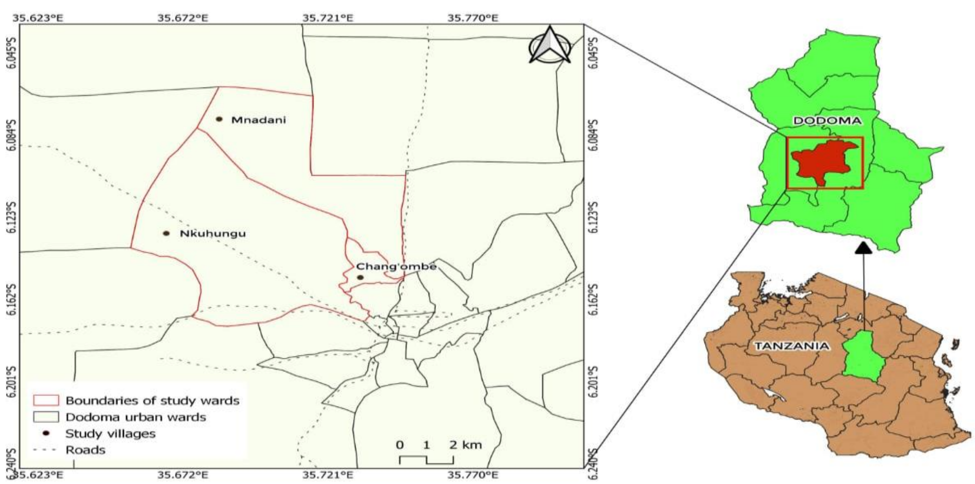
Materials and Methods

Study area description

Dodoma district is a semi-arid region located at 6°11′29′′S; 35°82′80′′E (Figure 1).

Figure 1

Map showing the study area



It receives annual rainfall of 550–600 mm between December and April (Gayo, 2021). The annual mean temperature is about $29^{o}C$, fluctuating from $13^{o}C$ in July to $30.6^{o}C$ in November (Ngongolo and Chota, 2022). The district has low vegetation cover, dominated by shrubs and thickets of Adansonia digitata and Acacia spp (Gayo, 2022). The Dodoma district, covering 2,576 km^2, is inhabited by 765,179 people (URT, 2022). The main socio-economic activities include crop production, mixed farming, urban tourism, formal employment, and businesses. The major staple and food crops grown in Dodoma include maize, millet, groundnuts, cassava, and bambara nuts, while grapes and sunflowers are cash crops (Gayo, 2023). Cattle, sheep, and goats are common livestock kept by agropastoralists (Mramba, 2023).

Materials and Methods

A cross-sectional study design was used to assess the economic burden of the Indian House Crow and the strategies local people employ to overcome this issue among those keeping local chickens in the district. Primary data were collected from the Nkuhungu, Chang'ombe, and Mnadani wards, as these areas have a large number of chickens (Ngongolo*et al.,* 2021).

Naing*et al.* (2006) formula was used to determine the sample size as n= $[NZ^2P(1-P)]/[d^2(N-1)+Z^2P(1-P)]$ such that; n = sample size, N = estimated population size (2400 households in three study wards), Z = 1.96 as Z score value for a level of confidence, P = 0.5 as a proportion of the total surveyed population for the maximum sample size with normal distribution, d = 0.08 as precision at 92% level of confidence. Following a reconnaissance survey, the obtained sample size (n = 145) was divided among study wards based on their household populations keeping indigenous chickens. Specifically, 55, 50, and 40 household respondents were engaged in the household questionnaire survey (HQS) from Nkuhungu, Chang'ombe, and Mnadani, respectively. Households for the questionnaire survey were sampled using the snowball technique because the study aimed to engage only respondents who keep local chickens, making it a suitable purposive sampling method (Naderifar*et al.*, 2017). A questionnaire with closed and open-ended questions was administered to selected respondents in their households.

Focus group discussions (FGDs), key informant interviews (KIIs), and participant observation was used to supplement the data collected by HQS for triangulation purposes, thereby increasing the reliability of the results (Lauri, 2011). At least two FGDs per study ward, each consisting of 12 chicken farmers, were conducted (Masadeh, 2012). Regarding KIIs, a total of four informants were consulted for in-depth interviews, including one district livestock officer and three ward executive officers.

The ethics committee of the University of Dodoma granted ethical approval for this study, with reference number MA.84/281/09. To ensure that all methods were performed in accordance with relevant guidelines and regulations, informed consent was obtained from all participants. They were guaranteed the privacy and confidentiality of their information. Agreed respondents were then asked to fill out an informed consent form.

Theoretical framework

We applied Optimal Foraging Theory (OFT) as a model that helps to predict how Indian House Crow behaves when searching for food particularly chickens. According to Krebs (1977),the theory suggests that crows make foraging decisions that provide the most benefit (in terms of energy gained) while minimizing the costs (in terms of energy expended, time, and risk of predation). In the aspect of hunting tactics, The *C. splendens* is an opportunistic feeder with a highly adaptable foraging strategy. The application of OFT to their predation on local chicken involves understanding how these crows balance the costs and benefits of targeting chickens as prey (Shochat*et al.*, 2004). Crows are likely to target chickens because they provide a high net energy gain. This involves considering the energy content of the chickens, the effort needed to capture and handle the chickens, and the risk of injury or retaliation from protective hens or humans. In OFT model, crows would also assess the risk of predation or human interference (Green, 2006). They may develop specific tactics to reduce these risks, such as targeting unattended chicks or exploiting times and places where human presence is minimal.

Regarding the predation impact of Indian House Crows on local chicken populations we also applied OFT to predict how changes in the environment (such as increased human activity or availability of alternative food sources) might influence crow predation behavior (Shochat*et al.*, 2004). For example, if crows find chickens to be a consistently profitable resource, their foraging efficiency increases, potentially leading to more frequent and concentrated attacks on chicken populations. Moreover, high predation pressure can reduce chicken populations, especially if crows preferentially target vulnerable chicks or eggs. This can lead to reduced reproductive success and long-term population declines in local chickens.

In the context of control strategies to be employed by farmers of lock chickens, principles of OFT can inform effective control strategies including resource management such that altering the availability of food resources; it might be possible to make chickens less attractive targets. For example, ensuring that chickens are well-guarded or that alternative, high-energy food sources are available could shift crow predation pressure. Also, environmental modificationinvolving changes to the environment to make it less favorable for crows, such as reducing nesting sites or increasing human presence, can decrease the likelihood of crows targeting chickens. Moreover, behavioral interventions involved employing deterrents that increase the perceived risk or effort of predation (e.g., scare tactics, protective enclosures) can make chickens a less optimal choice for foraging crows.

Data analysis

Descriptive statistics on demographic factors of respondents, the proportion of farmers keeping chickens, the estimated number of indigenous chickens kept, chickens predated by IHC, economic losses of chicken farmers due to IHC, and the strategies used to prevent predation were summarized and analyzed using Microsoft Excel. The variation among respondents' responses to different variables was determined using either the Mann-Whitney statistical test (U) or the Kruskal-Wallis statistical test (H), as the data were non-parametric. Variations were considered significant at $p < 0.05$ (Mann and Whitney, 1947; Kruskal and Wallis, 1952). Factors influencing the predation rate were analyzed using a generalized linear mixed model in IBM SPSS version 26 software, where wards were considered random variables, and management system, diseases, age of chickens, and flock size were fixed variables. Qualitative data were analyzed through content analysis by following the steps of decontextualization, recontextualization, categorization, and compilation, as recommended by Bengtsson (2016).

Results

Status of indigenous chickens keeping among respondents

Table 1 indicates a total of 2,454 indigenous chickens kept by farmers in the study area. These chickens fall into four ecotypes: Kuchi, Horasi, Naked Neck, and Frizzled. Indigenous chickens were kept mainly for food, income, manure, and offerings to God. Similar results were obtained during a focus group discussion in the Chang'ombe ward, as one of the discussants stated, "Chickens are kept primarily for meat, eggs, revenue and sacrifices to God"

Table 1

Status of indigenous chickens keeping among respondents in the study wards

Variable	Responses in study wards			Total	p-value
	Nkuhungu	Chang'ombe	Mnadani		
Number of IC kept	805	1120	532	2454	< 0.003
Households keep IC under free range	35 (64%)	40 (80%)	28 (70%)	103 (71%)	0.139
Households keep IC under semi-intensive	13(24%)	6 (12%)	9 (23%)	28 (19%)	0.068
Households keep IC under intensive	7(12%)	4(8%)	3(7%)	14 (10%)	0.204
Average (IC/household)	23±4	28±6	19±3	24±5	0.058
Maximum number of IC/households	38	47	31	47	0.391
Minimum number of	5	10	11	5	0.257

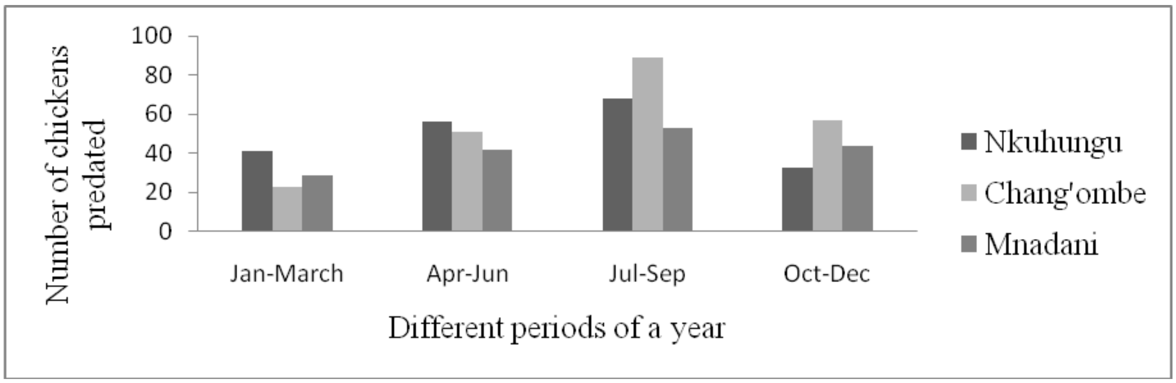
IC/households

Where IC=Indigenous chickens

The higher predation (210, 35.8%) of indigenous chickens by IHC occurs between July and September across all study wards (Figure 2).

Figure 2

Extent of chicken predation by IHC in different period of 2022 year



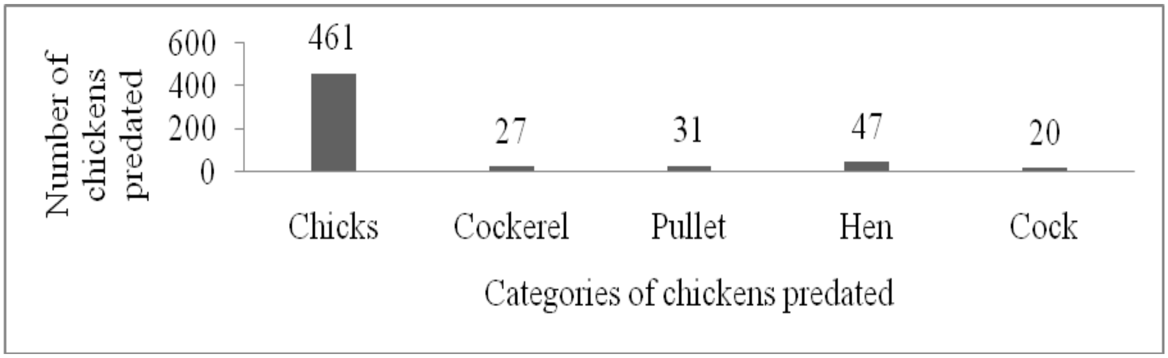
Approximately 198, 220, and 168 chickens were predated in the Nkuhungu, Chang'ombe, and Mnadani wards, respectively. However, the predation rate was not significantly different among the study wards (U = 18.00, P = 0.157) (Figure 2). The annual average number of chickens predated per household in the study area is 9 ± 2 chickens, while the maximum and minimum numbers of chickens predated per household were 23 and 5, respectively, between 2021 and 2022. Cases of chicken predation were also confirmed through in-depth interviews, as one key informant from Nkuhungu stated,

"We have experienced population growth of the invasive bird C. splendens in our district, resulting in an increase in poultry depredation"

We also assessed the extent of depredation across five different age/sex categories of chickens and found significant variation among the groups (KWS 311.121, p=0.0016). Predation was notably higher in chicks compared to other categories (see Figure 3). Additionally, we defined 'Cockerel' as a young male chicken and 'Pullet' as a young female chicken under the age of 1 year.

Figure 3

Number of indiginous chickens predated between 2021 and 2022 in the study wards



Respondents perceived four major hunting techniques used by IHC in preying on indigenous chickens (refer to Table 2). The variation was statistically significant (KWS 41.332, p=0.0053), with the majority of respondents reporting a higher frequency of destructive noise-making and capture compared to the other techniques. Predation rates were influenced by various factors, as indicated in Table 3.

Table 2

Perceived hunting techniques of IHC by responedents

Hunting technique	Nkuhungu	Mnadani	Chang'ombe	Test statistic	p-value
Making destructive noise and capture	22	19	21	41.332	0.0053
Hunting in team	15	12	15		
Chasing the chicken and capture	5	4	6		
Camoflaging by plying with chicks and capture	8	7	9		

Table 3

Factors influencing indigenous chickens' depredation by IHC

Level of measurement	Variables	EC	SE	Z variable	p-value
	Intercept	5.74	0.43	16.27	<2e-9
Management system	Intensive	0.38	0.09	5.22	0.2833

	Semi-intensive	0.63	0.05	13.26	**<33e-12**
Disease	No	0.26	0.13	2.32	0.0204
Age of chicken	Juvenile (<1 year)	0.31	0.19	3.28	**6.01e-7**
	Adult (> year)	0.33	0.01	1.06	0.13
Flock size	10-20 chickens	0.36	0.42	9.25	0.0701
	20 > chickens	1.22	0.25	5.13	**3.09e-6**
Season of a year	Wet season	-1.34	2.68	4.17	0.0633
Housing quality	Poor	0.53	0.11	3.06	0.112

Where; EC=coefficient estimate, SE= Standard error

Economic loss of chicken farmers through Indian house crows in the study area

The economic loss incurred by farmers due to depredation by IHC among local chicken populations was estimated, as indicated in Table 4.

Strategies employed by chicken farmers to prevent predation

Figure 4 illustrates the strategies employed by farmers to safeguard their chickens against predation. The diversity among responses demonstrated statistical significance (KWS 31.271, p=0.0001).

Table 4

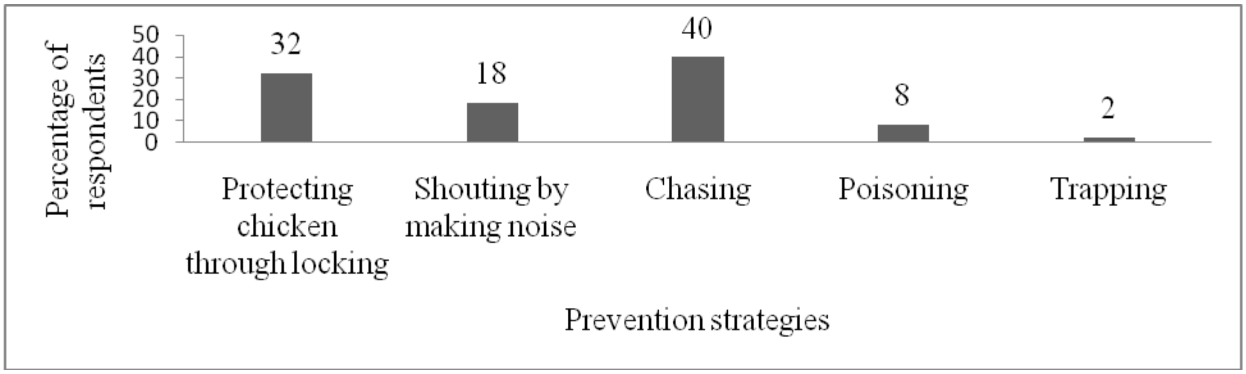
Estimated revenue lost from chickens depredated by IHC between 2021 and 2022

Chicken category	Unit price in TSh (USD)	Estimated revenue lost in TSh (USD)
Chicks	2000 (0.84)	922000 (387.24)
Cockerel	6000 (2.51)	162000 (67.77)
Pullet	6000 (2.51)	186000 (77.81)
Hen	12000 (5.01)	564000 (235.47)
Cock	18000 (7.52)	360000 (150.4)
Total		2194000 (916.08)

Where; conversion rate was 1USD=2395Tsh as per 20th June, 2023

Figure 4

Strategies employed by farmers to prevent chicken depredation by IHC



Discussion

Keeping chickens, particularly indigenous breeds, is practiced in both rural and urban areas mainly for food and income generation. We observed a similar scenario in Dodoma district, where local communities in the study wards were keeping indigenous chickens for protein, manure, income, and offering to God (Ngongolo and Chota, 2022). These results are consistent with those of Sule *et al.*, (2019) who found that meat, eggs, and income are the major motives for keeping chickens in Nigeria. The majority of respondents kept indigenous chickens under a free-range system, likely due to inadequate capital to provide the chicken feeds required for semi-intensive and intensive management systems. Similar results were reported in Kamuli Town Council and Namasagali sub-county of eastern Uganda, where 92% of farmers practiced free-range or scavenging as the dominant production system with seasonal/conditional feed supplementation (Yussif*et al.*, 2023). Additionally, Melak *et al.*, (2021) reported that 306 (100%) farmers were raising indigenous chickens in the North Wollo zone, the eastern part of the Amhara regional state of Ethiopia, through free-range scavenging with seasonal supplementation.

Contrary to our results, other comparable studies reported intensive and semi-intensive management systems as the major chicken management systems in Dodoma region, possibly because they included exotic breeds (Ngongolo and Chota, 2022; Mramba, 2023). The preferred management system in the study wards could be advantageous, as indigenous chickens are able to find their own feeds in household backyards, thereby reducing the feed burden on farmers (Kpomasse*et al.,* 2023). Additionally, managing chickens under a free-range system has less effect on disease transmission compared to other management systems (Mramba, 2023).

A high number of chickens were recorded in Chang'ombe ward, while the least were in Mnadani ward; however, this difference could have occurred by chance, as many farmers of indigenous chickens were sampled from Chang'ombe. We recorded a smaller average flock size compared to that reported by other similar studies conducted in Dodoma district (Ngongolo and Chota, 2022; Mramba, 2023). Such a discrepancy perhaps occurred because the present study focused on indigenous chickens, while the other studies assessed all chicken breeds, including layers and broilers, kept in large numbers under intensive management systems. Exotic breeds are preferred for commercial purposes, as they can generate high profits in a short time compared to indigenous chickens. The majority of the surveyed farmers were constrained by limited capital, which is the basic resource for large-scale chicken farming (Wilson *et al.,* 2022).

Indigenous chickens are preferred by farmers due to their lower capital requirement for feeding compared to other breeds. However, they are prone to predation, mostly due to their free-range system for searching for food (Manyelo*et al.,* 2020). The observed high rate of predation on indigenous chickens by IHC between July and September across all study wards is possibly due to the dry season, during which vegetation cover is low, exposing chickens to predation by IHC. Dodoma, a semi-arid land experiencing prolonged drought with less vegetation cover (Gayo, 2021; Gayo, 2022), reduces cover for poultry against aerial predators. A similar finding was reported by Mujyambere*et al.,* (2022) who found that farmers experience high predation of indigenous chickens during the dry season in Kamuli district, eastern Uganda. Contrary to our findings, Chikumba and Chimonyo (2021) in Msinga, South Africa, found a higher chick survival rate in sparsely vegetated areas than in densely vegetated spaces. The probable reason could be the increased presence of terrestrial predators in densely vegetated areas compared to less vegetated ones.

Furthermore, Conroy *et al.,* (2005) reported increased chicken depredation by house crows during the dry season in Daipur and Trichy Districts in rural India, associating it with the lack of vegetation cover. In the wet season, mammals depredated more chickens than birds of prey did, possibly due to the cover provided by vegetation.

A high number of indigenous chickens were predated in Chang'ombe ward compared to the rest, possibly because the ward has the greatest number of chickens. Predation rates were not the same across all age/sex categories of chickens; rather, chicks were highly predated compared to others. High predation of chicks was also reported in previous studies, including Conroy *et al.,* (2005) in Daipur and Trichy Districts in rural India, Okitoi*et al.,* (2006) in western Kenya, Badubi*et al.,* (2006) in Botswana, and Matawork (2018) in Ethiopia. The probable reason could be the ease with which chicks can be captured by IHC compared to larger chickens, which are more able to escape. Although the free-range system is cost-effective in poultry production, it possibly exposes chickens to predators more than other management systems (Ndlovu *et al.,* 2021; Desta and Wakeyo, 2023). Chickens threatened by diseases may perhaps be more easily captured by predators than those in good health (Simbizi*et al.,* 2021). The large flock size probably attracts predators in the study area more than a small flock size. Similar findings were reported by Badubi*et al.,* (2006) in Botswana, Matawork(2018) in Ethiopia, and Ngongolo and Chota (2022) in selected districts of the Dodoma region.

Farmers of chickens suffer economic loss from various factors, including diseases in terms of treatment, feed supplements, and poultry death (Sambo *et al.,* 2015; Simbizi*et al.,* 2021). However, our study found depredation to be another significant threat to the production efforts of many chicken growers in the selected wards of Dodoma district. The higher loss of financial resources through IHC depredation was in terms of chicks, probably because the survival of juveniles to the recruitment stage is a vital determinant of chicken population growth and sustainable development of the poultry sector (Chikumba and Chimonyo, 2021). Economic loss was also perceived by chicken farmers to be relatively higher in hen depredation, possibly because some hens were captured while defending their chicks against predators. Through the free-range management system, poultry parenthood is critical in determining the survivability and recruitment of chicks to adulthood (Manyelo*et al.,* 2020; Chikumba and Chimonyo, 2021; Kpomasse*et al.,* 2023). Depredation of hens could automatically expose chicks to more risks of depredation (Pius *et al.,* 2021).

The economic loss suffered by chicken farmers due to IHC depredation in the study area could have numerous indirect economic implications. The increased depredation of chickens poses a threat to the livelihood security of households by compromising food availability and hindering farmers' ability to engage in financial transactions (Matawork, 2018). The majority of local poultry growers in developing countries belong to resource-poor communities, disadvantaged and marginalized groups, who primarily rear poultry for various socioeconomic purposes such as meeting nutritional requirements, generating income, and creating employment opportunities (Kpomasse*et al.,* 2023). Consequently, the depredation of chickens by IHCs could contribute to the impoverishment of many households and undermine their efforts towards socioeconomic development.

The productivity and reproductive potential of indigenous chickens are contingent upon their survival rate (Idowu *et al.,* 2021). Efforts to reduce chicken mortality rates play a fundamental role, among other factors, in supporting the poultry sector. Despite the implementation of strong initiatives to combat diseases and feed shortages, as well as the provision of training and extension services, along with increased accessibility to marketing systems (Ngongolo and Chota, 2022; Mramba, 2023), farmers in the study area grapple with IHC predation due to weak strategies, such as locking up chickens, chasing, and shouting at crows, likely because they are not lethal. Other strategies, such as poisoning and trapping the predators, are less practiced, perhaps due to their non-selective nature, which could harm unintended organisms, including poultry. These findings may warrant governmental intervention to safeguard farmers' efforts to realize the full potential of poultry production against IHC predation. Overwhelming socioeconomic impacts of house crows are also reported by local people in Saudi Arabia (Alshamlih*et al.,* 2022), in Daipur and Trichy Districts in rural India (Conroy *et al.,* 2005), who seek governmental support to eradicate the species. Singapore successfully eradicated house crows through culling and nest destruction due to their ecological and socioeconomic impacts (Tan *et al.,* 2022). The abundance of crows is higher in urban areas than rural landscapes, particularly in business and residential areas with a higher availability of rubbish, mostly food scraps (Yong*et al.,* 2024). Thus, it could be imperative to integrate effective cleanliness measures with other applied house crow management strategies to control the overpopulation of the species and mitigate its socio-ecological impacts.

Conclusion

Indigenous chickens are a vital resource for poor households, providing both food security and a source of income. These chickens are typically raised in small flocks under free-range systems, which are accessible and low-cost, making them a practical choice for many rural families. Their contribution to household nutrition is substantial, as they supply eggs and meat, and their sale offers a much-needed source of cash. In many communities, poultry farming is one of the few livelihood options available, particularly for women and marginalized groups. However, the free-range nature of these systems exposes the chickens to various predators, with indigenous house crows (IHC) being a significant threat. This predation not only reduces flock sizes but also diminishes the potential income from chicken sales and weakens food security by limiting the availability of eggs and meat. The constant losses caused by IHC and other predators present a major challenge for farmers, particularly those already struggling with poverty. These challenges hinder the ability of small-scale poultry farmers to improve their economic well-being and escape the cycle of poverty. Consequently, addressing this issue is crucial for ensuring the long-term sustainability and success of indigenous poultry farming systems.

Recommendation

The study recommends increased intervention from government and non-governmental organizations to control IHC populations in affected areas. Governments could also introduce policies that incentivize the protection of poultry from predators, while NGOs can offer technical and financial support to farmers. Public awareness campaigns should be launched to educate communities on most effective methods for controlling IHC populations without harming other species or disrupting local ecosystems. Non-lethal conflict management strategies should be implemented to balance the needs of farmers with biodiversity conservation. Empowering farmers to transition from free-range to more intensive farming systems can enhance poultry production while minimizing predation risks.

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