RESEARCH



Newcastle disease awareness and vaccination practices among indigenous chicken farmers in the Biharamulo district of Tanzania

Rosemary Peter Mramba^{1*}, Pensia Elias Mapunda¹ and Agnes Carol Kisanga¹

Abstract

Background Indigenous chicken production is a significant economic activity in rural sub-Saharan Africa. These chickens are naturally resilient to unfavourable environmental conditions such as poor-quality feed and infections, making them ideal for village conditions. However, Newcastle disease is a major challenge to village chicken production. Since the chickens are kept in a free-range system, they are more likely to catch the disease from the environment and spread it throughout the whole village. Vaccination is one of the main strategies for controlling Newcastle disease. However, various socio-economic and local environmental issues impede vaccination efforts. The study examined the awareness of and vaccination of indigenous chickens against Newcastle disease in rural areas of the Biharamulo district in northern Tanzania. It sought to understand the extent of knowledge among farmers about the disease, the availability of vaccines, and the factors influencing vaccination uptake. Data collection methods included household interviews, focus group talks, and key informant interviews.

Results The findings reveal both challenges and opportunities for improving Newcastle disease control and promoting sustainable poultry farming in the region. While most farmers reported being aware of Newcastle disease, many did not vaccinate their chickens. Those who vaccinated their chickens did so irregularly or used herbal medicines as vaccines. Various socio-demographic aspects, including the age and education level of the chicken owner, awareness of the disease, production experience, and previous experience with Newcastle disease outbreaks, determined the probability of vaccination. The farmers identified limited information about Newcastle disease vaccination as a major constraint on vaccinating their flocks.

Conclusion The study underscores the need for targeted interventions to improve Newcastle disease control among indigenous chicken farmers in rural areas of Biharamulo district. Addressing these challenges requires strengthening farmer education, expanding access to vaccines, and enhancing extension services. Promoting community-based vaccination programs and awareness campaigns can help bridge these gaps, contributing to sustainable poultry farming and improved livelihoods in the region.

Keywords Awareness, Newcastle disease, Vaccination, & village chicken

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Introduction

Chicken production have an important contribution to poverty alleviation and nutritional improvement among village communities in sub-Saharan Africa [1–3]. These village communities keep indigenous breeds of chickens

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As with other developing nations, the indigenous chickens play a significant role in Tanzania's poultry industry [13–15]. Out of the country's current chicken population of approximately 87 million, around 71 million are indigenous breeds [16]. Small-scale farmers in rural areas rear approximately 90% of these indigenous chickens [9, 17]. Like in many other developing nations, these chickens are typically raised under an extensive scavenging system, often without supplementary feeding [7, 18]. The demand for chicken products in Tanzania remains high, surpassing local supply, primarily due to the low productivity of indigenous breeds [5, 17, 18]. High disease prevalence poses a significant challenge to indigenous chicken farming [19]. The free-range system exposes chickens to various pathogens and parasites in their environment [3, 20, 21]. Additionally, other factors such as poor nutrition, adverse weather, and environmental stressors can compromise the health of free-range chickens, making them more susceptible to diseases [22-24]. Consequently, regular monitoring, vaccination, and treatment are essential to prevent infestations and mitigate their adverse effects on bird health and productivity.

Newcastle disease is among the most economically important chicken diseases in Tanzania, capable of causing up to 100% mortality in unvaccinated flocks [25–27]. Newcastle is a viral disease that has no cure, but its occurrence can be avoided through the vaccination of chickens [28]. Village chickens, wild and other domestic birds, the physical environment, and live bird markets are often involved in the movement of the virus [26, 29–31]. Although Newcastle disease can affect commercial chicken production, farmers are more aware of the disease and hence vaccinate their chickens regularly [32, 33]. In contrast, the production systems used to raise village chickens and the socio-economic status of the owners make Newcastle disease control in the village very complex [27, 34]. Vaccination is generally considered a cost-effective intervention against Newcastle disease [35–37]. However, there are various obstacles encountered in the efforts to promote vaccination [38, 39]. These include farmers' lack of awareness about the disease and vaccines, limited availability of agricultural extension services, vaccine unavailability, and the high costs associated with vaccination [5, 38, 40]. Additionally, many rural areas lack reliable electricity and refrigeration facilities, leading to challenges in preserving vaccines during storage and transportation [41].

In order to advocate for vaccination within rural communities, it's essential to understand the fundamental factors and specific limitations, which can then inform broader and more comprehensive interventions. This study aimed to assess the level of awareness and vaccination practices regarding Newcastle disease among indigenous chicken keepers in the Biharamulo district of the Kagera region of Tanzania. The study determined factors related to Newcastle disease vaccination, obstacles that impede vaccination, and mitigation strategies, as reported by farmers.

Materials and methods

Study area

Biharamulo district is one of eight districts in the Kagera region. It is a predominantly rural area located in the northwestern part of Tanzania [42]. According to the 2022 population census, the population of Biharamulo district is 457,114 [43]. Much of the landscape of Biharamulo District consists of undulating hills covered in dense tropical vegetation, including forests and expansive grassy plains [44]. The climate of Biharamulo District is typically tropical, characterised by distinct wet and dry seasons. The district experiences a bimodal rainfall pattern, with short rains falling between September and December and long rains occurring between March and June [45]. The mean annual rainfall ranges from 700 to 1200 mm, while the mean annual temperature is about 26 °C [44, 46].

Agriculture is the primary economic activity in Biharamulo, with crops such as maize, cassava, coffee, and bananas being cultivated. Fishing is also significant, particularly in communities near Lake Victoria. Cattle are the main livestock species kept in the district, where about 800,000 animals are present, contributing to 55% of all cattle in the Kagera region. The Kagera region has about 788,026 indigenous chickens, but its economic potential is not fully realized. Chicken production in the Biharamulo district holds great potential for improving livelihoods enhancing food security, especially in poor households, as cattle need more investments and grazing land [42].



Fig. 1 Map of the study area indicating study wards

Study design

A cross-sectional study design was adopted, wherein households that raise indigenous chickens were visited for interviews in April and May 2024. A mixed-methods approach involving household surveys, focus group discussions (FGDs), and key informant interviews (KIIs) was employed.

Sample size determination

The sample size for the household survey was determined based on the Yamane formula given as $n = \frac{N}{1+N(e^2)}$ where n = sample size, N = study population, and e = sampling error.

A sampling error of 5% was adopted in this study. We collected information from district livestock officers and village leaders, where the total number of local chicken farmers in the district was estimated at 3700. Based on Yamane's formula, a sample of 360 farmers was required. The 360 farmers were enrolled in the study using a simple random sampling technique. A sampling frame was

created by listing all local chicken farmers in six out of fifteen wards of the district. These wards were purposively selected based on the availability of local chicken farmers. The wards were Ruziba, Nyarubungo, Nyamahanga, Biharamulo Mjini, Kabindi, and Lusahunga (Fig. 1). Each farmer was assigned a unique identification number to facilitate random selection. A random number generator in Microsoft Excel was used to select 360 unique farmers from the list in order to reduce bias in the sampling process. The randomisation process was proportional to the number of farmers in each ward, ensuring representative sampling across the district.

Focus groups discussions

We conducted two FGDs in each ward to gain a deeper understanding of local chicken farmers' awareness and practices regarding Newcastle disease and vaccination. Participants were purposively selected to ensure diverse representation, including variations in gender, age, and farming experience. Village leaders and district livestock officers facilitated the identification of suitable participants. Each FGD comprised 8–12 farmers, making a total of 12 FGDs across the six wards. The interviews were scheduled at mutually convenient times and conducted using a semi-structured checklist to ensure all relevant topics were covered. Trained moderators facilitated the discussions, guided by a semi-structured checklist, to ensure all relevant topics were covered.

Key informant interviews

Key informants involved experts in chicken production and livestock management. They were purposively selected based on their roles and experience to provide valuable insights into Newcastle disease management practices and vaccination challenges. The key informants included 2 district livestock officers, 4 ward executive officers, 4 village leaders, and 4 local vendors of vaccines and livestock drugs, ensuring a diverse range of perspectives. Interviews were scheduled at mutually convenient times and conducted using a semi-structured guide. The thematic areas used in the FGDs and KIIs were Newcastle disease awareness, vaccination practices, barriers to adoption of Newcastle disease vaccination, and experiences.

Household survey

The household survey was conducted using structured questionnaires designed to gather comprehensive information to evaluate farmers' awareness of Newcastle disease and vaccination, vaccination methods, vaccination frequency, availability of vaccines, experience with Newcastle disease outbreaks, opinions about the effectiveness of the vaccines, challenges faced, and views on mitigating these challenges. The survey also gathered socio-demographic information about households, including gender, education level, flock size, and experience with chicken production. The questionnaire included both openended and closed-ended questions. It was administered through face-to-face interviews to facilitate clear communication and ensure that participants understood the questions. Prior to the survey, a pre-test was conducted to evaluate the questionnaire's clarity, relevance, and effectiveness. Adjustments were made to the questionnaire based on feedback obtained during the pre-testing, which improved the overall quality of the data collected during the survey. At the end of each day of data collection, responses were entered into Microsoft Excel to facilitate initial organisation.

Focus group discussions were conducted to gather indepth insights from farmers regarding Newcastle disease, vaccination practices, and the extension services available to them. The discussions provided a platform for farmers to articulate their concerns, experiences, and recommendations regarding poultry health management. Key informants were interviewed to gain deeper insights and perspectives on Newcastle disease, vaccination practices, and the availability of vaccines. This included discussions on the factors influencing farmers' behaviours regarding vaccine usage, such as their awareness of the disease, perceived efficacy of vaccination, and access to veterinary services.

The researchers obtained informed consent from all participants to ensure ethical compliance and respect for their autonomy. Enumerators explained the purpose of the study, highlighting the importance of the research in understanding Newcastle disease awareness and vaccination practices among local chicken farmers. Participants were informed about the voluntary nature of their involvement, the procedures involved, and their right to withdraw from the study at any time without any repercussions.

Data analysis

Descriptive statistics, such as percentages and frequencies, were computed in Microsoft Excel version 2019. The data was then exported to R version 4.3.2 for further analysis. The vaccination status of the farmers (yes or no) was converted into a quantitative variable, where 1 denoted yes (where the farmer vaccinated chickens) and 0 denoted no (where the farmer did not vaccinate chickens). A multivariable logistic regression model was performed to obtain the odds ratios (OR) and 95% confidence intervals of independent factors associated with Newcastle disease vaccination among farmers. The independent factors were gender and age of respondents, education level of the respondents, respondent's awareness of Newcastle disease, chicken production experience (years), whether the respondent has received training on chicken production, and whether the respondent has experienced chicken loss due to Newcastle disease. The model was assessed using the Kolmogorov-Smirnov test. Thematic analysis methods were employed to analyse data from KIIs and FGDs. The data was closely examined to identify common themes, ideas, and patterns.

Results

General information about the respondents

Three hundred and sixty indigenous chicken farmers were visited in the Biharamulo district. The age of the respondents ranged from 20 to 78 years, with the majority (60%) aged 30 to 50 years, and 67% of the respondents were male. About 44% of the respondents had a college education, 37% had primary education, and 19% had secondary education. Chicken production was on a small scale, with flock sizes ranging from 4 to 30 chickens per household, with a mean of 11 ± 4 SD. All chickens were kept under an extensive production system. Sixty-eight

Table 1 General information about the households

Question	Levels	Frequency	Percentage	
Chicken production experience (yrs.)	1–5	248	68.8	
	6–10	56	15.6	
	Over 10	56	15.6	
Have you ever received training regarding chicken production?	Yes	108	30	
	No	252	70	
Have you experienced chicken loss due to the Newcastle diseases?	Yes	288	80	
	No	72	20	
Do you vaccinate your chicken against Newcastle disease?	Never	150	41.7	
	Occasionally	210	58.3	
How often do you vaccinate your chickens against Newcastle disease?	Quarterly	64	17.8	
	Biannually	164	45.6	
	Irregularly	132	36.7	
Vaccination methods	Using herbal plants	176	48.9	
	Using manufactured vaccines	184	51.1	
Do you think vaccines are effective?	Yes	110	30.5	
	No	10	2.8	
	Not sure	240	66.7	
Challenges of Newcastle vaccination	High price of vaccines	74	20.6	
	Lack of information	280	77.7	
	Limited access of vaccines	4	1.1	
	No veterinary services	2	0.6	
What should be done to improve chicken vaccination?	Increase access to vaccines	84	23.4	
	Improve extension services	8	2.2	
	Provide education	260	72.2	
	Reduce costs of vaccines	8	2.2	

percent of the respondents were new chicken keepers, having kept chickens for 1–5 years. Those who had kept chickens for 6–10 years and those who had kept them for over 10 years each made up 32% of the respondents.

Newcastle disease awareness and vaccination practices

Table 1 provides information about awareness of Newcastle disease, vaccination practices, and challenges faced by farmers. The majority of the farmers (80%) were aware of the Newcastle disease. Eighty percent of the farmers have experienced chicken losses due to Newcastle disease. However, only 58.3% of the farmers vaccinate their chickens against the disease. The Newcastle vaccine is administered quarterly, every three months, but only 18% of the respondents admitted to vaccinating quarterly. The rest of the farmers were vaccinated either biannually or irregularly because of the lack of knowledge and unavailability of vaccines.

Further questions about vaccination practices revealed that 49% of the farmers who claimed to vaccinate their chickens actually use herbal plants, while only 51% use vaccines. Additionally, it was found that 67% of the farmers don't know whether vaccines are effective in controlling Newcastle disease. The main challenge for Newcastle disease vaccination, as identified by 78% of the farmers, is a lack of information about the importance of vaccination, followed by the high price of vaccines (21%). About 72% of the respondents believed that education was needed to improve vaccination practices. Further information is shown in Table 1.

Factors that determine the likelihood of the farmers vaccinating their chickens against Newcastle disease

Various factors were associated with the likelihood of farmers vaccinating their chickens (Table 2). These factors included age, where the likelihood of vaccinating chickens decreased with the age of the farmer (Fig. 2a). Furthermore, farmers with a college education were more likely to vaccinate their chickens than those with primary and secondary education (Fig. 2b). Additionally, farmers who were aware of Newcastle disease and those who received training in chicken production were more likely to vaccinate their chickens (Fig. 3a & b). Awareness of Newcastle disease was greater among older farmers and those with extensive experience in chicken production. However, older farmers and those with more experience

Table 2 Factors associated with the probability of a farmer vaccinating chickens against Newcastle disease

Variable	Category	OR	SE	z	р	95% CI for the OR
Intercept		16.34	0.69	7.356	< 0.001	6.1, 29.5
Gender of the respondent	Female	0				
	Male	0.92	0.33	-1.923	0.098	0.2, 2.1
Age of the respondent (yrs.)	21-30	0				
	31-40	0.98	0.51	-2.136	0.041	0.2, 1.8
	41-50	0.73	0.41	-3.134	0.001	0.1, 1.2
	Above 50	0.87	0.44	-3.981	< 0.001	0. 2, 1.5
Education level of the respondent	College	0				
	Secondary	0.48	0.29	-6.556	< 0.001	0.1, 0.7
	Primary	0.46	0.414	-7.421	< 0.001	1.2, 1.1
Respondent aware of Newcastle disease	Yes	0				
	No	0.65	0.73	-5.880	< 0.001	0.1–0.8
Received training on chicken production	Yes	0				
	No	0.65	0.47	-5.676	< 0.001	0.02-0.9
Chicken production experience (yrs.)	0–5	0				
	6–10	1.75	0.47	-1.185	0.236	0.7, 4.5
	Over 10	0.84	0.20	-2.661	0.013	0.2, 1.1
Experienced chicken loss due to Newcastle disease	Yes	0				
	No	0.6	0.44	-2.232	0.025	0.1,0.9



Fig. 2 The likelihood of chicken vaccination in relation to: (a) age of the farmer and (b) education level of the farmer

in chicken production were less likely to vaccinate their chickens (Figs. 2a and 3c) because the majority of the farmers in these categories relied on natural remedies against the disease. Lastly, the likelihood of vaccinating chickens was higher among farmers who had experienced chicken loss due to Newcastle disease (Fig. 3d).

Results from the FGDs indicate that farmers lack knowledge about vaccines and their importance in chicken production. The majority of them have never seen or used chicken vaccines, unlike those for other livestock species such as cattle and goats, which are typically administered by a veterinary officer. Some farmers have experienced chicken mortality after vaccination, which has resulted in reduced trust about the effectiveness of the vaccines. This might have been contributed by various factors, such as inappropriate administration of vaccines or poorly stored vaccines.



Fig. 3 The livelihood of chicken vaccination as affected by: (a) farmer's awareness of Newcastle disease, b farmer training, c chicken production experience and (d) previous experience of Newcastle disease outbreak

Focus group discussions and key informant interviews *Theme: barriers to vaccination uptake*

Focus group discussions and key informant interviews revealed that while many farmers were aware of vaccination as a preventive measure against Newcastle disease, several barriers hindered their ability to adopt this practice. Economic constraints and limited vaccine availability were consistently cited as significant challenges, preventing many farmers from vaccinating their poultry.

'I heard about vaccination from other farmers, but I have never tried it myself because vaccines are expensive and not available when needed'. Female farmer, Ruziba ward.

"Sometimes the vaccine works, but other times, even vaccinated chickens die." Female farmer, Lusahunga ward.

"We usually vaccinate after the chickens show signs of illness, but I'm not sure if that's enough." Male

farmer, Nyarubungo ward.

Theme: alternative approaches to disease management

Instead of using drugs and vaccines to address chicken health issues, farmers often opt for herbal remedies like ginger, *Aloe vera*, and chillies, added to drinking water, when they notice a sick chicken. Poor management practices contribute to chicken deaths and low productivity, thereby hampering the farmers' ability to afford feed and vaccines. This finding was expressed by some of the participants of the KIIs, who asserted:

'Some farmers believe that certain herbs, like neem and Aloe vera, can manage Newcastle disease symptoms, but the effectiveness isn't always guaranteed'. Livestock officer, Biharamulo Mjini.

"Some farmers can't afford vaccines or veterinary services, so they turn to herbs as a cheaper option." Vaccine vendor, male, Biharamulo Mjini. "Herbal medicine helps manage symptoms, but it cannot replace vaccination as a preventive measure." Livestock officer, male, Kabindi ward.

'We have seen birds recover after using herbal mixtures, but we can prove it's because of the herbs or natural recovery."Village leader, female, Nyamahanga ward.

Theme: vaccine accessibility and utilisation

According to local vaccine vendors, most vaccine and chicken drug purchasers are those raising exotic chicken breeds like broilers and layers. The livestock officer noted that small-scale farmers tend to favour herbal remedies over vaccines and drugs due to their easy accessibility in the local environment. Additionally, the requirement to administer Newcastle vaccines every three months imposes a financial burden on farmers, often leading to incomplete vaccination. Moreover, many vaccines are packaged for a large number of chickens, making it impractical for farmers with just a few chickens to purchase them. To address these challenges, it is suggested to implement a vaccination program wherein a single dose of a thermotolerant eye drop vaccine can vaccinate a larger number of chickens in the village under the supervision of an extension officer. Some of the participants said:

'We try to vaccinate every three months, but sometimes we miss the schedule because vaccines are not available'. Female farmer, Kibindi ward.

"Proper storage is a big issue because vaccines require refrigeration to stay effective. But many rural areas lack reliable electricity, and this forces us to transport vaccines in coolers, which isn't always practical for long distances." Female vaccine vendor, Ruziba ward.

"We try to stock vaccines regularly, but sometimes there are delays in the supply chain. When orders come late or in limited quantities, it becomes difficult to meet farmers' demands during critical vaccination periods." Male vaccine vendor, Biharamulo Mjini ward.

Discussion

Despite 80% of the farmers admitting to being affected by Newcastle disease, only 58% reported vaccinating their chickens against the disease. Several factors influenced the vaccination practices among the farmers. The farmers' decisions to vaccinate chickens were influenced by socio-demographic factors, experience in chicken production, and awareness of Newcastle disease. One of these factors was the age of the farmers, with younger farmers being more likely to vaccinate their chickens than older ones. Younger farmers typically have greater access to modern information sources, such as the internet and social media. In line with this, a study by Iddi et al. [47] in Tanzania found that the majority of young chicken farmers used mobile phones to access improved chicken farming information. Similarly, in Nigeria, a study by Falola et al. [48] found that younger farmers are more likely to use social media to gather information about chicken production compared to older farmers.

Although digital extension services are not common in Tanzania [49], social media platforms have been important sources of information about livestock production and agriculture [50, 51]. Social media platforms allow farmers to share experiences and knowledge, fostering peer learning and reducing barriers to vaccine adoption [52]. For example, a study by [50] revealed that smallscale farmers in Tanzania used social media platforms to coordinate group vaccinations to reduce the cost of vaccines. This access is particularly important because a lack of information has been identified as a major challenge in adopting effective vaccination practices. Younger farmers are also more adaptable and open to integrating new technologies and methods, including vaccination programs. A study by Terfa et al. [53] found that farmers' willingness to pay for the Newcastle vaccine decreases with age. This trend can be explained by various factors, including different risk perceptions, openness to new management practices, and access to information, which vary across age groups.

Almost half of the farmers had a college education, a level significantly higher compared to previous studies of indigenous chicken farmers in Tanzania. For example, a study by Linuma & Peter [54] found 5.5% of the farmer had college education, Msoffe & Ngulube [55] found that only 5.5% of farmers had a college education; and Ngogo et al. [15] found that 15.6% of farmers had a college education. Nevertheless, the level of education of the farmer influenced vaccination practices. Farmers with a college education were more likely to vaccinate their chickens compared to those with secondary or primary education. Farmers with higher education levels generally have greater awareness, better access to information, and a more scientific approach to farming, making them more likely to adopt vaccination practices [38, 56, 57]. In contrast, less educated farmers may face challenges related to limited knowledge, access to resources, and openness to new practices, which can affect their willingness and ability to vaccinate their poultry. This finding is in line with previous studies in Tanzania [40, 58], Kenya [39], and Ethiopia [53, 56]. Thus, improving farmers' education

levels can increase their understanding and adoption of vaccination practices, resulting in healthier poultry flocks and stable agricultural communities.

The majority of farmers were aware of Newcastle disease but lacked knowledge about available vaccines. Some of the farmers considered herbal remedies like plant extracts as vaccines. However, the effectiveness of these herbal treatments in controlling Newcastle disease was not evident. This suggests a gap in veterinary knowledge and highlights the need for better education and awareness campaigns on disease control options among rural farmers. Although plant extracts can boost chicken immunity and increase their ability to fight infections [59], the total protection of the flock is not assured [60, 61]. Although some farmers use both vaccines and herbal medicines, those who rely solely on traditional medicines are not aware of Newcastle disease [38]. In this study, the older farmers relied on herbal plants as remedies for Newcastle disease. Their familiarity with traditional practices, passed down through generations, and their personal experience, reinforced by community knowledge, make ethnomedicine a preferred choice. A similar finding was reported in South Africa by Luseba & Tshisikhawe [62], who noted that young chicken farmers did not embrace the use of ethnomedicine in livestock production. Furthermore, older farmers and those with extensive experience in chicken production have encountered vaccine failures, which may result either from the vaccine itself or from improper vaccination practices [63, 64].

Regardless of the age, the farmers who were aware of Newcastle disease were more likely to vaccinate their chickens. This finding is in line with numerous previous studies [27, 38, 39]. Being aware of the disease enables farmers to comprehend the severe impact of Newcastle disease, including high mortality rates and significant economic losses, motivating them to prioritise vaccination. Training programmes and workshops designed to educate farmers about Newcastle disease and its prevention methods enhance their knowledge and awareness. This study highlights the significance of training, as farmers who had received training were more likely to vaccinate their chickens. The importance of training in raising Newcastle disease awareness and vaccination was also demonstrated by Williams et al. [65], Waweru et al. [39], and Ipara et al. [27].

The majority of the farmers have limited experience in chicken production, having kept chickens for only 1 to 5 years. Surprisingly, farmers with little experience in chicken production were more likely to vaccinate their chickens compared to those with long experience. With less experience, newer farmers might be more cautious and therefore more likely to follow recommended preventive measures to avoid losses. On the other hand, long-term farmers might rely on traditional methods and remedies that have worked for them in the past, making them less inclined to adopt new practices like vaccination [66, 67]. Additionally, farmers with greater experience in chicken production are more likely to employ better practices in raising their flocks, reducing the likelihood of disease infection [27, 68]. If the farmers have not experienced significant disease outbreaks, they may not see the need for vaccination, believing their current methods are sufficient. Farmers' past experiences with Newcastle disease significantly influenced their decisions to vaccinate their flocks. Having previously encountered the disease, the farmers are more aware of the severe risks and impacts associated with outbreaks [27]. The increased awareness leads them to prioritise vaccination as a preventive measure, aiming to protect their chickens from future outbreaks of the disease and mitigate potential economic losses. This finding is in line with Terfa et al. [53] and Lindahl et al. [69].

The study has revealed that a significant proportion (67%) of farmers are unsure if Newcastle vaccines are effective in combating the disease. This uncertainty can be attributed to previous instances where vaccines have failed, often due to improper vaccination practices. These failures can be caused by a variety of factors, including incorrect storage of vaccines, improper administration techniques, and a lack of adherence to recommended vaccination schedules [70-72]. As a result, farmers may lose trust in the effectiveness of vaccines, believing that they do not provide adequate protection against Newcastle disease. Previous studies have demonstrated that these vaccine failures significantly impact farmers' perceptions and reduce their confidence in using vaccines as a preventive measure [40, 73, 74]. To address this issue, it is crucial to implement comprehensive training programmes for farmers. These programmes should focus on educating farmers about the correct procedures for vaccine storage, handling, and administration, as well as the importance of following vaccination schedules accurately. By ensuring the proper use of vaccines, these training programmes can enhance their effectiveness and help rebuild farmers' trust and acceptance of vaccination as a reliable method to prevent Newcastle disease.

Conclusion

The study investigated awareness and vaccination of chickens against Newcastle disease among indigenous chicken farmers. Chicken vaccination was not common, and those who vaccinated often didn't follow the required schedule. Furthermore, the majority of the farmers didn't know whether the vaccination was effective in controlling the disease. Socio-demographic factors such as the age and education level of the owner, awareness of Newcastle disease, chicken production experience, and previous experience of Newcastle disease outbreaks were associated with the likelihood of chicken vaccination. Increasing knowledge of Newcastle disease and vaccination among farmers through training is important to ensure regular and increased vaccination practices. Village vaccination programmes can reduce the cost of vaccines by allowing farmers to share them, as the majority keep very few chickens.

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Authors' contributions

Conception and design of the study was done by R.P.M., P.E.M. and A.C.K. Material preparation and data collection were performed by R.P.M. The data analysis was carried out by R. P. M., Pensia Elias Mapunda and Agnes Carol Kisanga. The first draft of the manuscript was written by Rosemary Peter Mramba, and the authors commented on previous versions of the manuscript. Rosemary Peter Mramba, Pensia Elias Mapunda and Agnes Carol Kisanga read and approved the final manuscript.

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Data availability

The datasets used in this study can be obtained from the corresponding author upon a reasonable request.

Declarations

Ethics approval and consent to participate

The participation of the respondents was voluntary, and signed consent was obtained before the interviews. Ethical clearance for conducting the study was provided by the Institutional Research Review Ethics Committee of the University of Dodoma. A research permit letter with reference number MA/84/261/70/32 was offered.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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