A Retrospective Study on the Occurrence of Newcastle Disease (NCD) in Village Poultry in Mutasa District, Manicaland Province, Zimbabwe.

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APPROVAL FORM

The signatories confirm that they have read and recommended to the Bindura University of Science Education for acceptance of the project title: A retrospective study on the occurrence of New Castle Disease (NCD) in village poultry in Mutasa District, Manicaland Province, Zimbabwe

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CHAIRPERSON SIGN ____ ____ Date_________09/10/25__________

Declaration

I Kututwa Lynea Rangarirai (B221794B), do hereby declare that this dissertation titled, "Retrospective Study on the Occurrence of New Castle Disease (NCD) in Village Poultry in Mutasa District, Manicaland Province, Zimbabwe," is my original work and all sources cited are listed in a comprehensive list of references. This dissertation has not been submitted to any other university or used to obtain any other qualification.

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Dedication

My dedication goes to all who contributed to make my academic journey a success

Abstract

Newcastle disease is a threat to both small scale and commercial poultry farmers’ livelihoods as it lead to significant poultry mortalities. The aim of the study was to determine the spatial and temporal distribution of New Castle Disease (NCD) as well as to establish NCD vaccine coverage in Mutasa District -Manicaland Province, addressing NCD related issues in order to prevent losses due to mortalities in poultry. Areas under ward 31, 5, 6, 7, 16 and 24 were covered during the study and dip tanks in these wards were the control points and these are Ruda, Buwu, Mutarazi, Nutwell and Zongoro. Stratified random sampling method was used to select the study area. Sample size was determined using formular by Thrusfield (2007) on Veterinary Epidemiology. A total of 40 farmers were interviewed through questionnaire surveys and 92.5% being small scale-subsistence and 7.5% being commercial farmers. All farmers kept poultry and at least one livestock animal. There were no significant differences in mortalities across wards during the last outbreak with the highest poultry mortalities in ward 5(n>150). NCD vaccination across the wards was almost the same and by so, interventions should not be ward based but rather a holistic approach should be used. Farmers commended that no NCD outbreaks were recorded following vaccination of poultry birds.

Keywords; Newcastle disease, temporal spatial distribution, vaccination.

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DVS – District (Mutasa) Veterinary Services

NCD – Newcastle Disease

NDV – Newcastle Disease Virus

CHAPTER 1: INTRODUCTION

Background of the study

Poultry farming is a critical component of the agricultural sector in Zimbabwe, contributing significantly to the livelihoods of rural communities and the national economy (Zengeni., 2014). Poultry farming is significant to the economy (Zengeni 2014), food security (Ndiweni., 2013; Mutami., 2015), employment (Ndiweni., 2013; Bounds & Zinyemba., 2018) and climate chance resilience (Gororo & Kashangura., 2016) of small holder farmers in Zimbabwe in terms of providing income and protein. Increases in fast food restaurants, bars, hotels, lodges and street food stalls in Zimbabwe has increased the demand of poultry farming in small holder farmers as a lucrative business as the market is readily available (Manomano., 2022). Poultry species that are commonly raised by smallholder farmers include the village chicken broilers, commercial layers, turkeys, and guinea fowls (Gono *et al*, 2013; Gororo & Kashangura., 2016). Smallholder poultry are essential for many households, providing a source of income, food security, and employment Gono *et al*, 2013). Poultry farming offers smallholder farmers an opportunity to generate income through the sale of chickens, eggs, and other poultry products (Gono *et al*, 2013). At the same time, chickens and eggs provide a valuable source of protein which is essential for a balanced diet which improves the smallholder famers' nutrition and health (Ndiweni., 2013; Mutami., 2015). Furthermore, poultry farming creates employment opportunities for small holder farmers and their families which reduces poverty and improve the living standards in rural areas (Bounds & Zinyemba., 2018). Diversification of income and the ability to produce own food through poultry farming enable small holder farmers to be resilient to the effects of climate change and droughts as farmers reduce dependence on rain fed crops (Ndiweni., 2013).

The productivity of smallholder (village) poultry is low compared to commercial farming, and this is affected by a variety of challenges (Gobvu *et al*, 2024). One of the primary issues is inadequate nutrition, as village poultry mostly scavenge for food. The scavenging diet is typically low in protein, energy, and essential vitamins and minerals, leading to poor growth, egg production, and overall health (Sonaiya, 2007; Gono *et al*, 2013). Supplementary feeding is often limited or non-existent, further exacerbating the nutritional deficiencies (Hodzi *et al*, 2024).

Another factor that affects smallholder poultry productivity is poor (neglect type) management. Smallholder farmers often have limited knowledge and resources for proper management of their poultry flocks (Alders and Pym, 2009). Lack of routine vaccination, deworming, and other health interventions can lead to increased susceptibility to diseases and reduced productivity (Ahlers et al., 2009). Improper housing, sanitation, and biosecurity measures can also contribute to the spread of diseases and parasites (Manomano., 2019).

Among the various challenges, diseases are ranked the most important cause of reduced smallholder poultry productivity. Common diseases, such as Newcastle disease (Manomano., 2019), infectious bursal disease, and coccidiosis, can cause high mortality rates and reduced egg production (Gono *et al,* 2013). The lack of access to veterinary services and effective disease control measures further exacerbates the impact of diseases on productivity (Ahlers et al., 2009). Minimal health interventions also play a significant role in the low productivity of smallholder poultry. Smallholder farmers often have limited access to veterinary services, vaccines, and medications (Gobvu *et al*, 2024). This lack of knowledge and resources for disease prevention and treatment can lead to higher mortality rates and reduced productivity (Gobvu *et al*, 2024).

Predation is another factor that affects smallholder poultry productivity. Predators, such as hawks, snakes, and carnivorous animals, can cause significant losses in smallholder poultry flocks (Ndiweni., 2013; Mutami., 2015). Inadequate housing and lack of predator-proof measures can increase the vulnerability of poultry to predation (Alders and Pym, 2009). While, poor housing and animal welfare can also contribute to the low productivity of smallholder poultry. Smallholder poultry often lack proper housing, leading to exposure to environmental stressors, predators, and diseases (Mutami., 2015). Lack of appropriate nesting, perching, and dust-bathing areas can negatively impact the overall well-being and productivity of the birds (Gororo & Kashangura., 2016).

Studies show that the most common poultry diseases found in smallholder setups include Coccidiosis, Internal parasites, Newcastle Disease (NCD), Coryza, Avian Influenza (bird flu), Fowl Cholera, and Marek's disease (Zengeni., 2014; Bounds & Zinyemba., 2018). These diseases can be categorized into two sub-classes: endemic and epizootic. In Zimbabwe, the major epidemic poultry diseases are NCD and Avian Influenza (Bounds & Zinyemba., 2018). NCD has been reported in almost all the provinces and districts over the past 5 years including Manicaland, Masvingo, Matabeleland South, parts of Midlands, Mashonaland East, West, and Central provinces (Manomano 2019).

Endemic diseases are those that are constantly present in a particular region or population, with a relatively stable incidence and regular occurrence (Gobvu *et al*, 2024). Coccidiosis, for example, is a parasitic disease that is highly prevalent in smallholder poultry setups due to poor sanitation and hygiene (Hodzi *et al*, 2024). Endemic coccidiosis is characterized by moderate morbidity (40-80%) and low mortality (5-20%) if left unmanaged (Hodzi *et al*, 2024). Similarly, internal parasites, such as roundworms, tapeworms, and protozoa, are common in smallholder poultry and can cause reduced feed efficiency, weight loss, and poor overall health (Maumburudze *et al*, 2016). Endemic parasite infestations typically have moderate morbidity (30-60%) and low mortality (5-15%) (Maumburudze *et al*, 2016). Coryza, an infectious respiratory disease caused by the bacterium Avibacterium paragallinarum, is also considered an endemic disease in smallholder poultry setups, with moderate morbidity (30-60%) and low mortality (5-10%) (Zengeni., 2014).

In contrast, epizootic diseases are outbreaks that occur suddenly and affect a large number of animals in a specific region or population (Bounds & Zinyemba., 2018). These diseases have higher morbidity and mortality rates compared to endemic diseases (Bounds & Zinyemba., 2018). Newcastle Disease (NCD) is a highly contagious viral disease that can cause significant mortality in poultry (Hodzi *et al*, 2024). In epizootic outbreaks, NCD can have high morbidity (60-100%) and high mortality (30-100%), depending on the virulence of the strain (Hodzi *et al*, 2024). Avian Influenza, or bird flu, is another viral disease that can have devastating impacts on poultry populations. Epizootic outbreaks of highly pathogenic avian influenza can result in very high morbidity (80-100%) and mortality (50-100%) (Hodzi *et al*, 2024). Fowl Cholera, a bacterial disease caused by Pasteurella multocida, can also cause epizootic outbreaks with high morbidity (60-90%) and high mortality (30-70%) (Hodzi *et al*, 2024). Marek's Disease, a viral disease that primarily affects young chickens, can also have epizootic outbreaks with moderate to high morbidity (40-80%) and moderate mortality (10-30%) (Hodzi *et al*, 2024).

1.2 Problem statement

A number of NCD outbreaks have been reported in Mutasa district over the past 5 years (Gobvu *et al*, 2024), but, there is no conscious information on the epidemiology of the disease, precisely, the number of poultry affected, poultry mortality, and number of birds at risk and the temporal distribution of the disease. The lack of adequate information on temporal and spatial distribution of NCD, and the number of poultry at risk in affects disease control measures through inadequate vaccination. Currently the District Veterinary Services (DVS) produces an effective NCD vaccine, but very small poultry are vaccinated annually in Mutasa districts (personal observation). Consequently, poultry farmers continue to experience significant economic losses, reduced productivity and increased mortality rates among their poultry birds. Many famers in the district rely on poultry production as well as crop production and the poultry side is usually attracting losses due to these diseases.

1.3 Objectives

The overall objective of this study is to improve the productivity of smallholder poultry in Mutasa district.

Specific objectives are:

1. To determine the spatial and temporal distribution of NCD in Mutasa District
2. To establish NCD vaccine coverage in the district

1.4 Hypotheses

1. H0: NCD occurs throughout Mutasa District with outbreaks being recorded mostly during the dry season
   H1: There is no definite pattern of occurrence of NCD in Mutasa District

2. H0: NCD vaccine coverage in Mutasa District is adequate
   H1: Very few poultry in Mutasa District are vaccinated against NCD relative to the population at risk

1.5 Justification

There is need to reduce poultry morbidity and mortality due to NCD in Mutasa District. Understanding the prevalence and distribution of NCD in Mutasa District over the past 5 years can reveal patterns and trends that will inform effective disease management through vaccination and other control strategies. Information on disease prevalence is critical for prioritization of disease control measures at the DVS level. Knowledge of NCD epidemiology will provide valuable information for developing training programs to educate farmers on recognizing, preventing, and managing poultry diseases. Addressing NCD will contribute towards sustainable farming practices, improving food security and the overall resilience of small holder farmers in the district. The study can serve as a baseline for future research and monitoring efforts, enabling comparisons over time and the assessment of intervention impacts. The findings of this study will not only benefit livestock farmers in Mutasa District, but also contribute to the broader understanding of NCD dynamics in similar agricultural settings.

CHAPTER 2 LITERATURE REVIEW

2.1 Poultry Diseases in Zimbabwe

Poultry farming in Zimbabwe faces significant challenges from a variety of avian diseases that impact both commercial and smallholder sectors, affecting productivity, economic viability, and public health (Chitanga *et al*., 2017; Makuza et al., 2016; Nyangara et al., 2020). Research on backyard chicken flocks in urban Zimbabwe, such as Chitungwiza, reveals high mortality rates averaging 25%, primarily due to diseases causing respiratory and eye problems (Chitanga et al., 2017). Serological studies have shown exposure of these chickens to multiple viral and bacterial pathogens including infectious bronchitis virus (86%), reticuloendotheliosis virus (65%), infectious bursal disease virus (55%), Pasteurella multocida (52%), Mycoplasma species (33%), Newcastle disease virus (27%), and others, indicating a complex disease environment with multiple co-infections common in smallholder settings (Chitanga et al., 2017). Notably, none of the flock owners vaccinated their birds, and there was a widespread lack of veterinary advice, exacerbating disease impacts in these flocks.

Highly Pathogenic Avian Influenza (HPAI) has posed a major threat to Zimbabwe's poultry industry, especially affecting large commercial producers. Outbreaks in 2017 led to the culling of hundreds of thousands of birds on major farms, severely disrupting the supply of day-old chicks and eggs (Mupfumi et al., 2018). The Zimbabwe Poultry Association highlighted the critical need for rebuilding broiler chick production and stressed the negative repercussions on both commercial and smallholder sectors. Regional responses included heightened surveillance, quarantine measures, import bans, and awareness programs, reflecting the serious risk HPAI poses to poultry health and production sustainability in Zimbabwe and Southern Africa (Mahoro et al., 2019).

Other prevalent diseases in Zimbabwe's poultry include Infectious Bursal Disease (Gumboro), which is recognized as the most common killer in small-scale and backyard poultry, accounting for a significant proportion of reported mortalities (FAO, 2004). Fowlpox, Infectious Coryza, yolk sac infection, and coccidiosis are also frequently reported, contributing to the disease burden in both rural and urban poultry systems (FAO, 2004). Underreporting is common, particularly in smallholder settings, which complicates accurate disease surveillance and control efforts (FAO, 2004).

The challenge of managing poultry diseases in Zimbabwe is compounded by limited access to effective vaccination and veterinary services in smallholder systems. Vaccines such as those against Marek’s disease are available, but uptake remains low in rural areas (Mupfumi et al., 2018). The free-range system of indigenous chickens, which dominate Zimbabwe’s poultry population estimated at around 20 million birds, exposes them to environmental hazards and predators, as well as disease agents, especially during the rainy season when nesting conditions deteriorate (Mupfumi et al., 2018). Improvements in housing, chick management, and supplementary feeding have been suggested as practical interventions to reduce disease incidence and improve chick survival (Mupfumi et al., 2018).

From a public health perspective, infectious poultry diseases have broader implications beyond production losses. Zoonotic diseases such as Highly Pathogenic Avian Influenza, campylobacteriosis, and salmonellosis pose risks to human health and can contribute to antimicrobial resistance due to the often-indiscriminate use of antibiotics in treatment attempts (Alexander, 2000). Sustainable disease control in smallholder poultry systems requires integrated approaches including biosecurity, vaccination, improved husbandry, and the use of disease-resistant breeds. However, practical implementation remains challenging due to resource constraints and lack of access to veterinary inputs (Alexander, 2000). Ethnoveterinary practices are common and accessible alternatives, but they require further scientific validation to ensure efficacy and safety (Alexander, 2000). Multisectoral collaboration and policies targeting smallholder poultry keepers are essential to reduce disease constraints, improve livelihoods, and enhance nutrition and gender equity in rural Zimbabwe (Alexander, 2000).

2.2 Newcastle Disease (NCD) Epidemiological Overview in Zimbabwe

Newcastle disease (NCD) is a highly contagious viral disease affecting domestic and wild birds worldwide, particularly poultry such as chickens, turkeys, and other fowl (Mupfumi et al., 2018). Caused by the Newcastle disease virus (NDV), a paramyxovirus, it results in significant economic losses due to high mortality, decreased egg production, and trade restrictions (Mupfumi et al., 2018). In Zimbabwe, where poultry farming forms an essential part of rural livelihoods and national food security, understanding the prevalence of ND is critical for disease control and prevention (Mupfumi et al., 2018).

Several studies have documented the occurrence and prevalence of Newcastle disease in Zimbabwean poultry populations. The disease is endemic in the country, with sporadic outbreaks reported especially among village chickens and small-scale commercial farms.

Research conducted by Makuza et al. (2015) provides valuable insight into the seroepidemiology of Newcastle disease virus (NDV) in rural Zimbabwe. Their serological surveys across various villages revealed antibody prevalence rates ranging dramatically from 30% to 70% in indigenous chicken populations (Mupfumi et al., 2018). This substantial seropositivity is indicative of widespread exposure to NDV within backyard poultry cohorts. The findings imply that these birds have either survived previous NCD outbreaks or experienced subclinical infections, which result in the development of circulating antibodies without necessarily displaying overt clinical symptoms (Mupfumi et al., 2018). Such a high prevalence of NDV antibodies reflects the endemic nature of Newcastle disease in Zimbabwe's rural poultry sector. Indigenous chickens are often reared under traditional free-range management systems, which facilitate frequent contact among birds and increase vulnerability to infectious agents, including NDV (Mupfumi et al., 2018). The communal feeding and watering points, as well as interactions with wild birds-known reservoirs of NDV-contribute to sustained viral circulation (Alexander, 2000). In this respect, the seroprevalence figures by Makuza et al., (2015) align with patterns observed in similar ecological and production settings across sub-Saharan Africa.

Supporting literature corroborates these findings. For instance, a study by Swanepoel et al. (2011) in neighbouring countries reported NDV antibody prevalence in village chickens typically falling between 40% and 80%, underpinning the notion that indigenous poultry often endure recurrent exposure to the virus. Similarly, Mahoro et al. (2019) noted high NDV sero-positivity in free-range chickens in Rwanda, emphasizing inadequate vaccination coverage and poor biosecurity as contributing factors to persistent endemicity. The seroprevalence data are also consistent with epidemiological observations that clinical outbreaks may not always be reported or recognized in rural settings due to limited veterinary infrastructure and awareness (Madzivanyika and Makuza, 2019). Consequently, many infections might remain subclinical or go unnoticed, yet still induce an immune response. This "silent" circulation sustains the virus within the population and poses ongoing risks to naïve flocks, including commercial poultry operations that are less resilient to disease.

Moreover, the wide range in seroprevalence (30% to 70%) reported by Makuza et al, (2015) could reflect variations in local management practices, vaccination history, and ecological factors such as bird density and proximity to migratory wild birds (Chitanga et al., 2017). Areas with lower seropositivity might represent zones with less virus exposure or recent recovery from outbreaks, while higher prevalence points to intense exposure and long-term viral maintenance within the flock.

2.3 NCD Outbreak Patterns

Outbreaks of Newcastle disease (NCD) in Zimbabwe exhibit notable seasonal patterns, often peaking during the rainy season when increased humidity and bird movement facilitate viral transmission. Chitanga et al. (2017) emphasize that the rainy season creates environmental conditions that favor the survival and spread of the NCD virus, resulting in heightened outbreak intensity. Mortality rates during these outbreaks are alarmingly high, ranging between 50% and 90%, particularly in unvaccinated flocks, underscoring the devastating impact of NCD on poultry populations in Zimbabwe. This seasonality aligns with observations in other African contexts, where climatic factors such as rainfall and temperature shifts influence NCD epidemiology by affecting host susceptibility and virus persistence (FAO, 2004; Makuza et al., 2016).

Several risk factors and transmission dynamics underpin the epidemiology of ND in Zimbabwe. The predominant free-range farming system in rural areas significantly increases contact between domestic chickens and wild birds, as well as inter-flock interactions, thereby facilitating virus spread (Mupfumi et al., 2018). This extensive system, characterized by minimal confinement and low biosecurity, allows for continuous viral circulation. Vaccination coverage remains insufficient despite vaccine availability, primarily due to limited access, high costs, and inadequate farmer awareness, which perpetuates the endemic status of ND (Madzivanyika and Makuza, 2019). Poor biosecurity practices, such as lack of quarantine for new birds and inadequate sanitation, further exacerbate viral persistence and transmission within and between flocks (Nyangara et al., 2020). These factors combined create a conducive environment for recurrent ND outbreaks.

Diagnostic and surveillance efforts in Zimbabwe have improved, with serological methods like hem agglutination inhibition (HI) assays and molecular techniques such as RT-PCR increasingly employed for virus detection. Although surveillance programs remain limited in scope, they have been instrumental in identifying high-risk zones and temporal trends in ND prevalence, thereby informing targeted control measures (Tauro et al., 2021). However, the challenges of underreporting and limited resources constrain comprehensive epidemiological understanding and rapid outbreak response.

Control and prevention strategies recommended in the literature focus on enhancing vaccination campaigns, farmer education, and biosecurity improvements. Regular and widespread vaccination using thermostable and locally adapted vaccines is critical for reducing ND incidence, especially in rural settings where cold chain maintenance is problematic (Makuza et al., 2016). Educating farmers on disease recognition, vaccination timing, and basic biosecurity measures can significantly mitigate disease impact by promoting timely interventions and reducing virus transmission (Chitanga et al., 2017). Strengthening farm-level biosecurity through controlled bird movement, sanitation, and minimizing contact with wild birds is also emphasized as a key preventive measure (Nyangara et al., 2020). These integrated approaches are essential for breaking the cycle of endemic ND in Zimbabwe's poultry sector.

Newcastle disease remains a major constraint to poultry production in Zimbabwe, particularly within village and smallholder farming systems. The high seroprevalence rates and recurrent seasonal outbreaks highlight the endemic nature of the disease, driven by free-range farming practices, low vaccination coverage, and poor biosecurity. Effective control hinges on improving vaccination reach, enhancing farmer knowledge, and implementing robust biosecurity protocols. Continued surveillance and research are vital to refine control strategies and reduce the socio-economic burden of ND on Zimbabwean poultry farmers (Chitanga et al., 2017; Makuza et al., 2016; Nyangara et al., 2020).

2.4 Socio-economic contribution of Poultry farming in Zimbabwe

Poultry farming in Zimbabwe plays a vital socio-economic role, with distinct impacts observed between large-scale commercial producers and smallholder farmers. The sector is a significant contributor to the country's agricultural economy, which is projected to grow to US$13.75 billion by 2025, highlighting poultry's importance in national food security and economic development (Zimbabwe Mail, 2023; Animal Feed MEA, 2025). Large-scale poultry operations, often vertically integrated, contribute substantially to national production volumes, supplying nearly 100 million day-old broiler chicks annually despite challenges such as El Niño-induced droughts. These commercial producers have shown resilience by diversifying feed sources and maintaining steady growth in frozen poultry and table egg sales, thus supporting employment and market stability (Zimbabwe Poultry Association, 2024; Innscor, 2025).

In contrast, smallholder poultry farming, predominantly based on indigenous and free-range systems, serves as a critical livelihood source for rural households, particularly in marginalized regions like Chiredzi, Mutasa and Mwenezi districts. Projects such as the indigenous poultry value chain initiative by Nutrition Action Zimbabwe (NAZ), in partnership with government and NGOs, have empowered over 600 households through training, capacity building, and improved market access. These interventions have increased household income derived from poultry from 20% to 40%, reflecting poultry's role in poverty alleviation and food security at the grassroots level. The formation of poultry cooperatives has further enhanced collective marketing, enabling smallholders to commercialize production sustainably and improve access to inputs and markets (Chikwengo, 2025).

However, smallholder farmers face numerous constraints including limited access to veterinary services, poor biosecurity, and fluctuating market prices. Despite these challenges, participation in livestock markets has been shown to positively influence production decisions and household food security. Empirical evidence indicates that market-engaged smallholders are more likely to adopt improved inputs and practices, resulting in better dietary diversity and increased per capita food expenditure. This underscores the importance of strengthening market infrastructure, extension services, and cooperative organization to enhance the socio-economic benefits of poultry farming for smallholders (Frontiers in Sustainable Food Systems, 2023).

The poultry sector's economic significance is also reflected in its impact on related industries such as animal feed production, which depends heavily on poultry demand, accounting for 70-75% of Zimbabwe's feed production by volume and value. Fluctuations in poultry production, especially declines in smallholder participation due to low retail prices and competition from illegal imports, adversely affect feed manufacturers and the broader agricultural input supply chain. This interdependence highlights the need for policies that stabilize poultry markets and support both large and small producers to sustain the entire value chain (Feed Strategy, 2016).

Overall, the socio-economic impacts of poultry farming in Zimbabwe are multifaceted. Large-scale producers drive national production, employment, and economic growth, while smallholder poultry farming is pivotal for rural livelihoods, income diversification, and food security. Enhancing vaccination coverage, market access, farmer education, and biosecurity, alongside supportive government policies and development projects, are essential to maximize poultry's socio-economic contributions across both farming scales. Continued investment in infrastructure, capacity building, and market systems will be critical to sustaining and expanding these benefits in Zimbabwe's evolving poultry sector (Chikwengo, 2025; Frontiers in Sustainable Food Systems, 2023; Zimbabwe Poultry Association, 2024).

CHAPTER 3: MATERIALS AND METHODS

3.1 Study Site

Mutasa District is situated in Manicaland Province in eastern Zimbabwe (Figure 3.1). It is characterized by a diverse landscape that includes mountainous regions, fertile valleys and various types of agricultural land (OCHA 2021). The district benefits from relatively favorable climatic conditions for livestock farming, with a subtropical climate that includes distinct wet and dry seasons (OCHA 2021). Agriculture is a significant part of the economy in Mutasa District, with livestock farming being a crucial activity for many households (OCHA 2021).

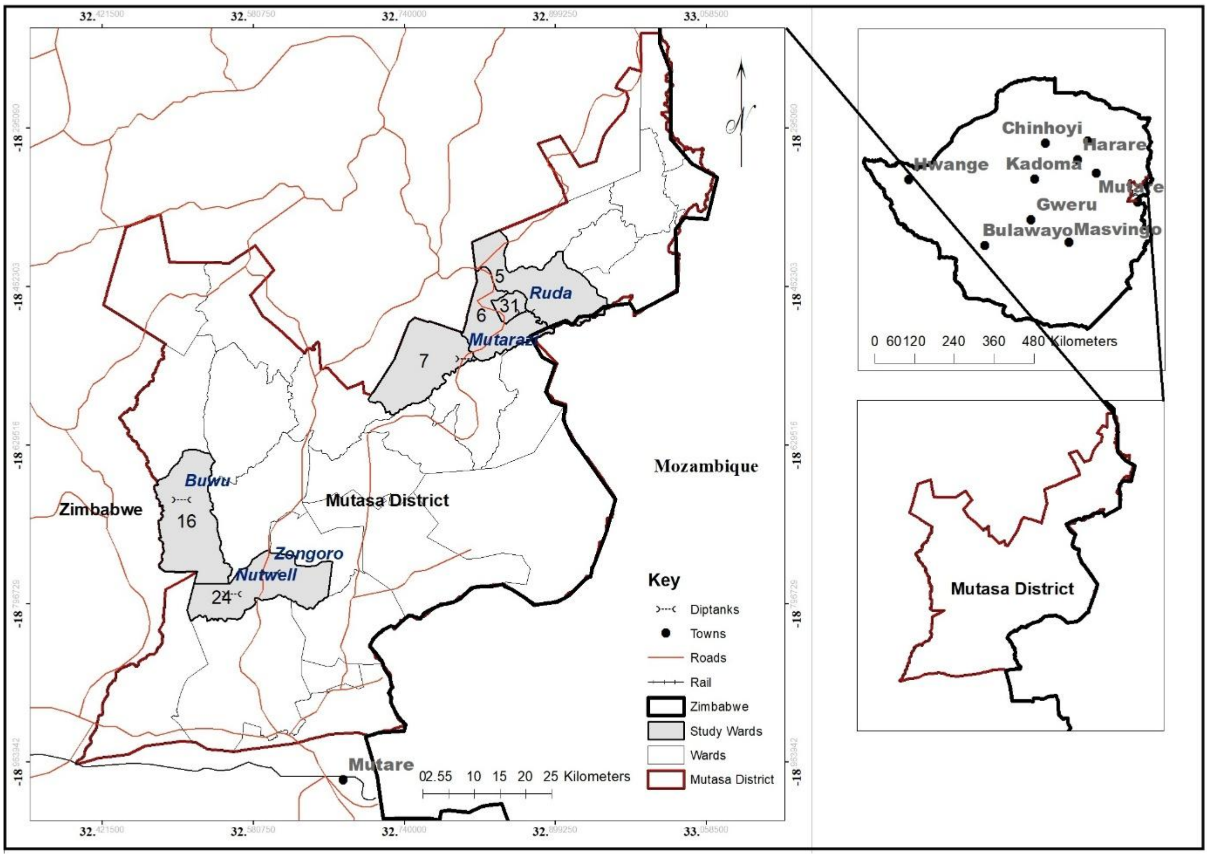

Figure 2.1; Map showing Mutasa district Study area and wards selected for study.

Commonly raised livestock includes cattle, goats, sheep and poultry. The district's agricultural practices vary, ranging from small-scale subsistence farming to larger commercial operations.

Mutasa District has a predominantly rural population engaged in farming and related activities. The socio-economic conditions of the population, including income levels, access to veterinary services, and education, play a critical role in livestock management and disease prevalence. Mutasa District primarily falls under Agro-Ecological Region I and II. Region I is characterized by high rainfall, ranging from 1000 mm to over 2000 mm per year suitable for intensive farming of crops like tea which is grown in the Eastern Highlands in Honde valley. Region II receives moderate rainfall, ranging from 750 mm to 1000 mm per year, and is suitable for maize and other cash crops such as potatoes, beans and peas which are grown in in the remaining parts of the district. The district has 49 dip tanks, 16 Veterinary Extension Officers and 16 dip attendants,2 Veterinary Extension supervisors and 1 District Veterinary Officers.

3.2 Sampling Strategy

Stratified Random Sampling: The sampling was stratified based on number of poultry famers in different wards to ensure representation from different wards. First wards were stratified according to farming system such as communal, resettlement, A1, A2, small scale commercial and large scale commercial. Wards 5, 6, 7, 16, 24 and 31 were randomly selected. Within each ward, dip tanks were used as central points and from each selected dip tank's catchment area, a random sample of 10% of farmers who own poultry were selected. These farmers were further stratified according to poultry species they own, taking into account that one farmer might own different species of poultry for household surveys.

3.3 Sample size

Sample size was determined using the following Sample Size formula by Thrusfeild (2007) on veterinary epidemiology;

$$n = \frac{z^2 \times p \times (1-p)}{e^2}$$

Where n is the sample size, z is the Z-score corresponding to the desired confidence interval (e.g 1.96 for 95% confidence interval), p is the expected prevalence of the disease as a proportion, and e is the desired precision or margin of error. In this case, the prevalence of NCD will be estimated using 95% confidence interval and margin of error of 5%, with the expected prevalence of 60% which gives a sample size of approximately 40 farmers (n~37.8)

3.4 Data Collection

3.4.1 Desk studies

Secondary data were collected from existing records such as veterinary reports and farm records to gather historical data on disease prevalence and trends over the past 5 years.

3.4.2 Primary data collection

Questionnaire surveys were done with livestock farmers, veterinary professionals and relevant stakeholders to collect primary data on current disease status, management practices, and impacts on livestock and farmers through structured questionnaires.

3.5 Data Analysis

To determine the spatial and temporal distribution of NCD in Mutasa District, shape files on dip tank locations, district and wards were obtained from Zimbabwe Geoportal website. The data was run using the Euclidean distance algorithm in Arc map 10.3. The data was converted to American Standard Code for Information Change (ASCII) files using ArcGIS 10.3 in preparation for Maximum Entropy (Maxent) modelling. Two models were prepared in Maxent using household locations of farmers who reported the presence of Newcastle disease as presence data for hot wet season and cold dry season. The outputs of the model were presented as maps and the statistics of each map were extracted using Arc Map 10.3 for Chi-squared tests of independence. To establish NCD vaccine coverage in the district, data from questionnaire interviews were put in Microsoft Excel file. Data were then imported in IBM Statistical Package for Social Sciences (SPSS) version 23 where non-parametric tests including Kruskal Wallis ‘H’ tests were run.

CHAPTER 4 RESULTS

40 poultry farmers were interviewed from 6 different wards (Table 4.1). Of the 40 farmers, 7.5% were commercial farmers (n=3) while 92.5% were small scale subsistence farmers (n=37) (Table 4.1). Ward five had the highest number of poultry farmers (n=9) while ward 3 had the least number (n= 4) (Table 4.1).

Table 4.1 Poultry Farmers and Wards Demographics

Ward	**Commercial Poultry Farmers**	**Small Scale Subsistence Farmers**	**n**	**Percentage**
Ward 5	1	8	9	**22.5%**
Ward 6	0	7	7	**17.5%**
Ward 7	1	6	7	**17.5%**
Ward 16	0	6	6	**15%**
Ward 24	0	7	7	**17.5%**
Ward 31	1	3	4	**10%**
n	**3**	**37**	**40**	
Percentage total	**7.5%**	**92.5%**	**100%**	**100%**

Respondents were aged between 20 and 54 with a mean age of 33.2 ± 2.13sd while 30% were female (n=12) and 70% were males (n =28). 70% of the farmers had high school education (n = 28), while 25% of the farmers had a tertiary education including diplomas and national certificates (n =10) and 5% had no formal education at all (n=2). All farmers kept poultry and at least one other livestock animal in all wards including cattle, goats, donkeys, rabbits and dogs. None of the farmers kept any sheep and only farmers in ward 24 kept dogs at their properties. Ward 7 farmers had the highest number of poultry (n= 1500) (Figure 4.1) with one commercial farmer and six subsistence farmers (Table 4.1) while ward 31 had fewer number of poultry (n = 98) despite having both a commercial poultry farmer and subsistence farmers (Table 4.1).

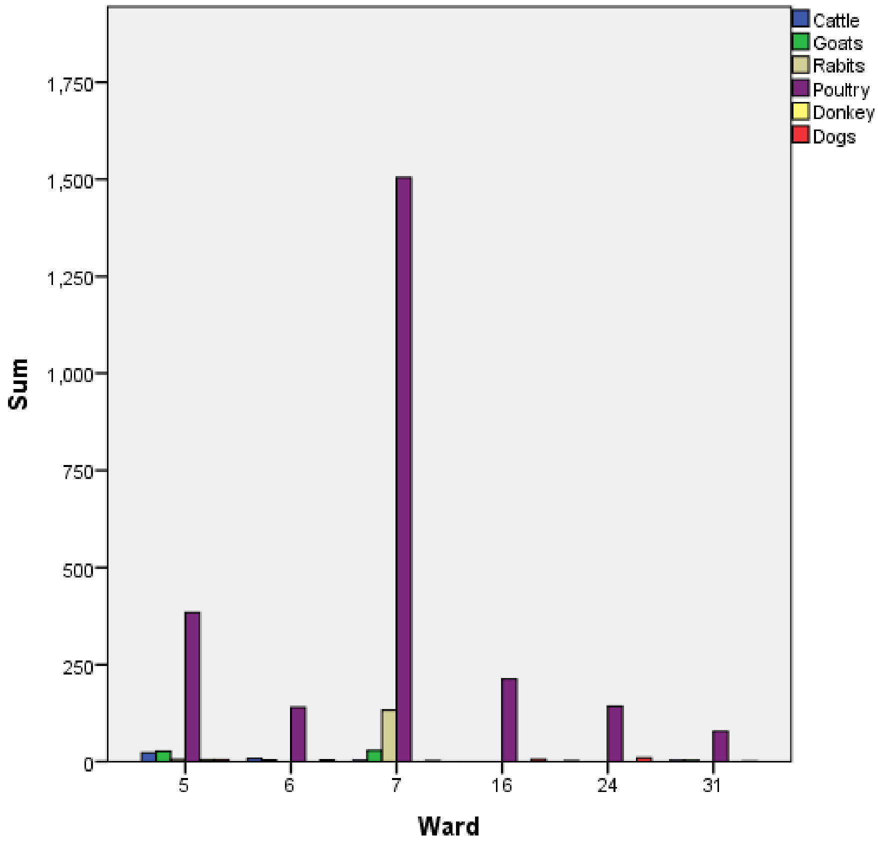

Figure 4.1; Ward based livestock composition.

Over 90% of farmers kept road runner chickens while less than 10% of the farmers kept broiler chickens (Figure 4.2a). However, 70% of farmers kept no other species of poultry besides chickens while 4% kept chickens and ducks, 17% kept chickens and turkeys and 9% kept chickens and guinea fowl (Figure 4.2b).

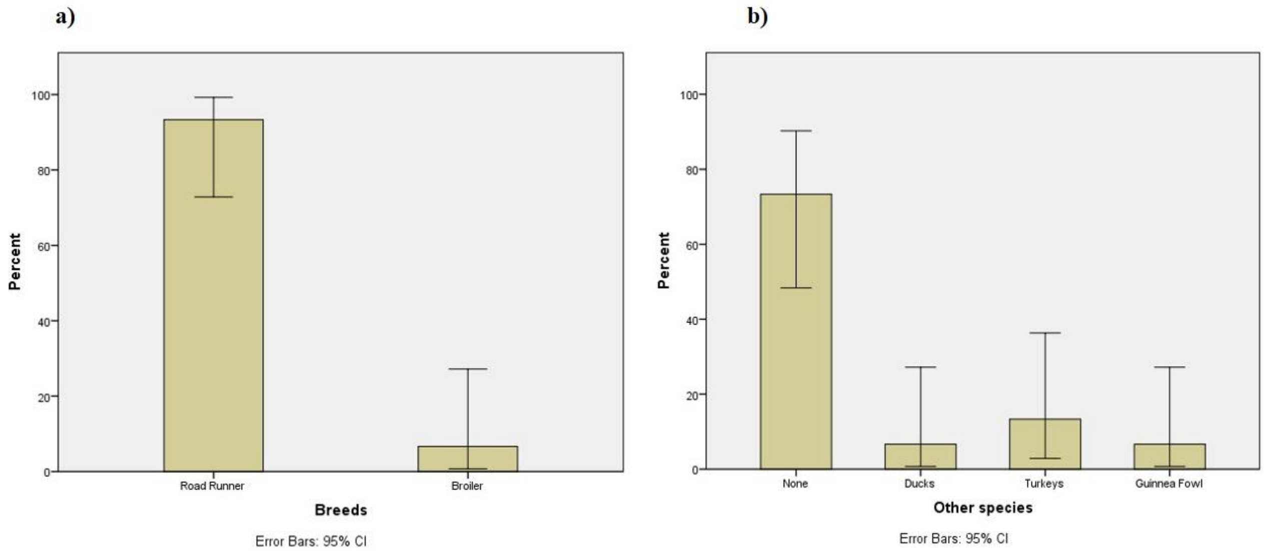

Figure 4.2 Percentage poultry breeds (a) and species (b) kept by famers in all wards.

There was a statistically significant dependence on the outbreak of Newcastle disease (NCD) and distance from dip-tanks (p = 0.034 - χ^2 test of independence) with the probability of NCD occurrence increasing with increasing distance from each distance (mean outbreak distance from nearest dip-tank (Maximum Entropy model) = 4.05 ± 2.17 sd) in the hot wet season (Figure 4.3a). In the cold dry season, there was no statistically significant dependence on the outbreak of Newcastle disease and distance from dip-tanks (p = 0.834 - χ^2 test of independence) with the probability of NCD outbreak not related to distance from dip tanks (Maximum Entropy Model) (Figure 4.3b)

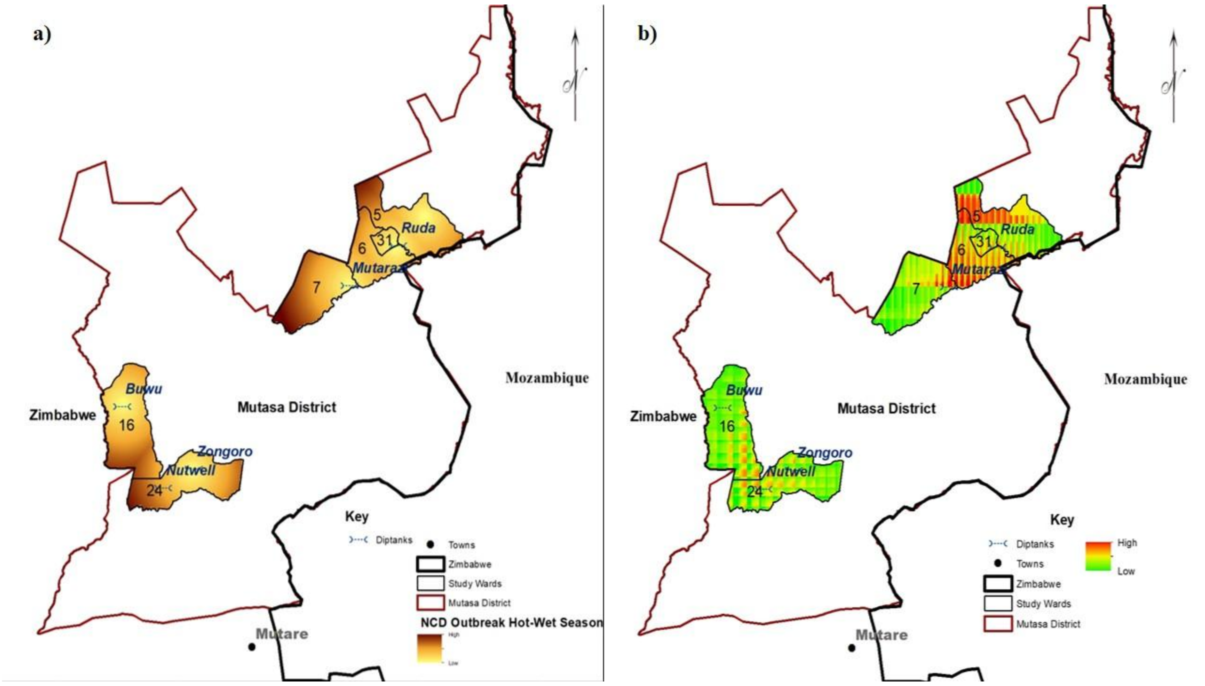

Figure 4.3 Newcastle disease outbreak probability hot wet season (a) and cold dry season (b) from Maximum entropy model.

There was no significant difference on the accessibility to veterinary assistance (p = 0.302 – Kruskal Wallis ‘H’ test) and services as the access to the services were similar across wards (Table 4.2). Regular poultry vaccination (p = 0.813), number of times the veterinary services were used (p = 0.801), mortalities during the last outbreak (p = 0.962), flock size during the last outbreak (p = 0.979) and number of birds affected (p = 0.979) showed no significant difference across wards (Kruskal Wallis ‘H’ test) (Table 4.2). However diagnostics of Newcastle disease showed a significant difference across wards (p = 0.032 - Kruskal Wallis ‘H’ test) (Table 4.2), with farmers from ward 6, 24 and 31 relying on a government veterinarian for diagnostics and farmers from ward 5, 7, and 16 relied on Self/ Neighbor with professional advice (Figure 4.4a)

Table 4.2 Kruskal Wallis 'H' test for different variables across ward at p = 0.05 significance

Variable	Wards (p value)
Veterinary assistance	0.302
Regular Vaccination	0.813
Diagnoser	**0.032***
Number of times veterinary services were used	0.801
Mortalities during the last outbreak	0.962
Flock Size during the last outbreak	0.973
Number of birds affected in the last outbreak	0.979

Although there was no significant difference in the mortalities across wards during the last outbreak, ward 5 had the highest mortalities of poultry (n>150) while ward 7 had the least mortalities (n < 50) (figure 4.4b) despite having the highest poultry number of all wards (Figure 4.1)

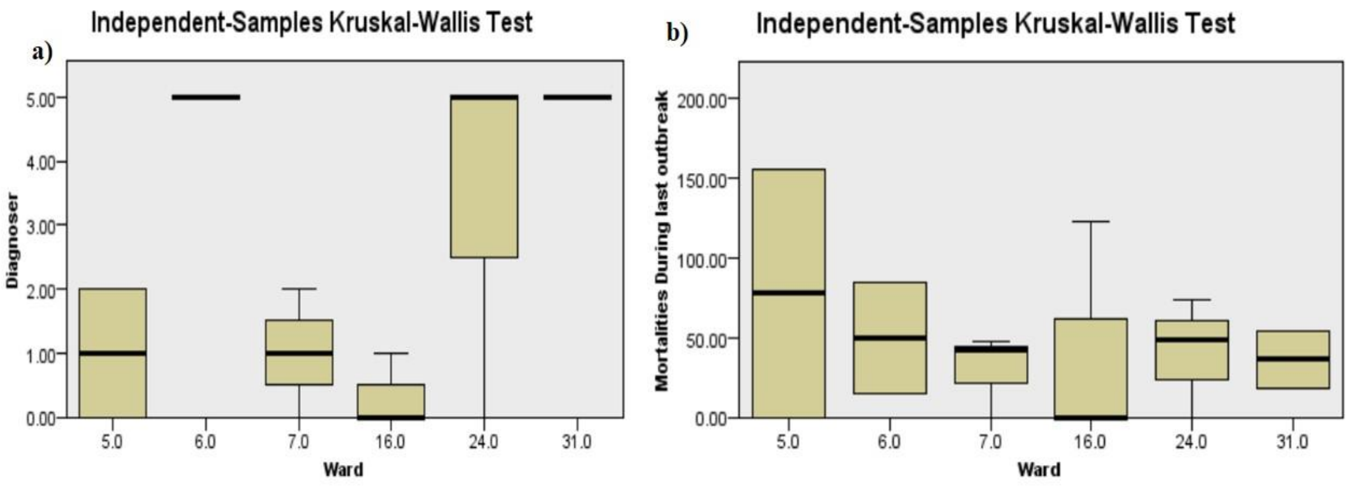

*Figure 4.4; Independent samples Kruskal test on **(a)** NCD diagnoser 1= Self/ Neighbour with professional advice, 2= Self/ Neighbour without professional advice, 3= Community Animal health service provider, 4= Government veterinarian, 5= Cooperative Veterinarian, **(b)** Mortalities during last outbreak.*

Farmers reported weight loss, nasal discharge, swelling of face, oracular discharges, greenish diarrhea, unusual posture, off feed, paralysis, unusual postures, tremors, nasal discharge, decreased feed intake, and ruffled feathers common symptoms for NCD and other poultry diseases. At the same time farmers commended the vaccination of poultry as they reported no deaths and no outbreak when poultry is vaccinated.

CHAPTER 5 DISCUSSION

The study presents results from a survey of 40 poultry farmers across 6 wards in a region, with the majority (92.5%) being small-scale subsistence farmers and only 7.5% being commercial farmers. The dominance of small-scale subsistence poultry farming is a common observation in many developing countries, where poultry production plays a crucial role in household food security and income generation (Alders and Pym, 2009; Guèye, 2000). Small-scale poultry production plays a vital role in food security, income generation, and poverty alleviation for rural households (Guèye, 2000; Mapiye et al., 2008). These small flocks, often comprising indigenous or crossbred chicken breeds, are typically reared with low inputs and under scavenging or semi-scavenging systems (Mbuza et al., 2016; Moges et al., 2010). Despite their importance, small-scale poultry farmers often face numerous challenges, including limited access to inputs, extension services, and veterinary care, as well as high disease burdens (Akinola and Essien, 2011; Chah et al., 2018).

The survey revealed a statistically significant relationship between the outbreak of Newcastle disease (NCD) and the distance from dip-tanks during the hot wet season, with the probability of NCD occurrence increasing with greater distance from the dip-tanks. This finding aligns with previous studies that have identified seasonal patterns in NCD outbreaks, often linked to environmental factors such as temperature and humidity (Terregino and Capua, 2009; Snoeck et al., 2013). The observed seasonal pattern in Newcastle disease (NCD) outbreaks, with a higher probability of occurrence during the hot wet season, aligns with findings from other studies. Snoeck et al. (2013) reported similar seasonal trends in NCD outbreaks in Cambodia, attributing them to factors such as increased virus survival and transmission during hot and humid conditions. Terregino and Capua (2009) also noted that environmental factors, including temperature and humidity, can influence the epidemiology of NCD. Additionally, changes in poultry management practices, such as increased scavenging or outdoor activity during the wet season, may contribute to the higher risk of disease transmission (Chaka et al., 2012; Abelou et al., 2019).

Newcastle disease (NCD) exerts a profound socio-economic impact on rural communities in Mutasa District, Zimbabwe, mirroring patterns observed across sub-Saharan Africa. The disease is recognized as the most significant constraint to village poultry production, leading to recurrent outbreaks that result in high mortality rates, sometimes exceeding 150 birds per household during a single event (Figure 4.4b). This is consistent with broader literature, which notes that NCD can cause mortality rates of up to 70–80% in unvaccinated flocks, severely undermining household food security and income generation (Muchadeyi et al., 2007; Mapiye et al., 2008). The seasonal dynamics observed in Mutasa, where outbreaks are more prevalent during the hot wet season, align with findings from other regions indicating that environmental stressors and increased viral transmission during the rainy season exacerbate disease spread (Alders & Spradbrow, 2001). However, the lack of a clear seasonal pattern in the cold dry season in Mutasa suggests that local management practices, such as reduced flock movement or traditional containment strategies, may play a mitigating role.

The socio-economic ramifications of NCD in Mutasa District are particularly acute for vulnerable groups, notably women, who constitute a majority of village poultry owners (58.3% in Zhombe) and depend on poultry as a primary source of protein and emergency income (Muchadeyi et al., 2007). Poultry serves as a financial safety net, enabling households to meet urgent needs such as school fees and medical expenses. Consequently, NCD outbreaks not only threaten immediate food availability but also erode the asset base of rural families, deepening poverty and reducing resilience to other shocks. This pattern is echoed in studies from Uganda and other parts of Zimbabwe, where total flock losses due to NCD have led to severe disruptions in household livelihoods (Kusina & Kusina, 1999; Mapiye et al., 2008).

Interestingly, the study found no significant differences across wards in terms of access to veterinary assistance, regular poultry vaccination, number of times veterinary services were used, mortalities during the last outbreak, flock size during the last outbreak, and the number of birds affected. This suggests that the challenges faced by poultry farmers in the region are relatively uniform, and interventions aimed at improving poultry health and productivity should consider a holistic approach rather than ward-specific strategies. This finding is consistent with previous studies that have highlighted the limited access to veterinary services and disease control measures in many smallholder poultry production systems (Ahlers et al., 2009; Boakye et al., 2016). Efforts to improve poultry health and productivity in such settings may require a holistic approach that addresses various constraints, such as limited knowledge, inadequate infrastructure, and resource constraints (Alders et al., 2014; Mapiye et al., 2008).

However, the study did identify a significant difference in the methods used for NCD diagnosis across wards. While some farmers relied on government veterinarians, others depended on self-diagnosis or advice from neighbours, with or without professional guidance. This variation in diagnostic practices could potentially impact the accuracy and timeliness of disease detection, leading to varying levels of disease control and management across the wards (Kamara et al., 2021). Despite the recognized importance of vaccination in controlling NCD, significant challenges persist in Mutasa District. The data indicate that while government-led initiatives, such as the Presidential Rural Poultry Scheme, aim to enhance vaccine coverage-targeting 2 million birds in Manicaland province-many farmers remain reliant on self-diagnosis and traditional remedies, particularly in remote wards (Figure 4.4a). This is compounded by gaps in veterinary extension services and limited awareness of vaccination protocols, with only 62% of farmers in comparable districts like Zhombe reporting that they vaccinated their flocks, often without knowing which disease the vaccine targeted (Muchadeyi et al., 2007). The reliance on informal control measures, such as the use of paraffin and tobacco reported in Goromonzi, further underscores the need for integrated extension approaches that combine vaccination campaigns with education on disease recognition and biosecurity (Alders & Spradbrow, 2001).

Infrastructure and access barriers also play a critical role in shaping the epidemiology of NCD in Mutasa. Outbreak likelihood increases with distance from veterinary service points such as dip-tanks, with a mean distance of 4.05 km reported in affected wards. This spatial disparity is consistent with findings from other rural districts, where remoteness is associated with reduced access to vaccines and veterinary support, exacerbating the vulnerability of marginalized communities (Mapiye et al., 2008). Addressing these challenges requires targeted investment in rural veterinary infrastructure and the deployment of community-based animal health workers to bridge service delivery gaps.

The reported symptoms of NCD and other poultry diseases, such as weight loss, nasal discharge, swelling of the face, greenish diarrhoea, and paralysis, are consistent with the clinical signs described in the literature (Alexander et al., 2004; Snoeck et al., 2013). The farmers' recognition of the importance of vaccination in preventing outbreaks and mortalities aligns with numerous studies that have highlighted the effectiveness of vaccination as a control measure for NCD (Alders et al., 2014; Meseko et al., 2018). However, the implementation of vaccination programs in small-scale poultry production systems can be challenging due to various factors, including logistical constraints, cost, and limited access to veterinary services (Boakye et al., 2016; Mapiye et al., 2008).

CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSION

The study has provided valuable insights concerning NCD in Mutasa District and the following conclusions were made:

- Majority of farmers are small scale subsistence farmers other than commercial farmers
- Occurrence of NCD in Mutasa is mainly during hot wet season when conditions are favorable for virus activities
- NCD outbreaks leads to high mortalities and losses in poultry production
- Challenges being faced by poultry farmers are almost the same across the district, for example inadequate poultry vaccine
- Variations on diagnoses of the disease has potential of late detection and late intervention as some farmers rely on diagnosis from themselves and neighbours without knowledge.

6.2 RECOMMENDATIONS

The following recommendations are made basing on the research findings:

- Since farmers are facing almost the same problems, intervention should not be ward based but rather cater for every farmer.
- Vaccinations should be timeously done before the onset of the disease in hot-wet season to prevent losses due to mortalities.
- Government should provide adequate NCD vaccine since no out breaks are witnessed following vaccination.
- Veterinary extension staff should give extension advice pertaining NCD to farmers for early and correct diagnosis as this results in early and prompt interventions.

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Appendix A Data collection Questionnaire

Good Day, I am Kututwa Lynea R, a student at Bindura University of Science Education doing a research on the topic "**Retrospective Study on the Occurrence of Newcastle Disease (NCD) in Village Poultry in Mutasa District, Manicaland Province, Zimbabwe.**" May you kindly spare your time to answer the following questions on Newcastle Disease? Your answers will be treated with confidentiality and privacy, and will go a long way in helping to develop strategies to fight Newcastle disease.

SECTION A. HOUSEHOLD COMPOSITION/ LABOUR AVAILABILITY

1. Enumerator Name ____________________________ Enumerator Code __________
2. Date Of Interview (Dd/Mm /Yy) /___/___/2025
3. GPS COORDINATES at Homestead: X _______________ Y _______________________
4. Try to interview the person in charge of the household/farm activities.
5. Are you interviewing this person? [___] = YES [___] = NO (tick)
6. Owner's Name ____
7. Respondent's Name ____
8. Respondent's Position In The Household [_____](Code)

1 = Head	**3** = Daughter	**5** = Hired manager
2 = Spouse	**4** = Son	**6** = Other (specify)_________________

9. Village name: ______________________________
10. Ward name: ______________________________
11. Name of the dip tank…………………………………………………………….
12. Provide the following details about the head of the household

A) *Sex [code: 1 = male, 2 = female]*	
b) *Age (years)*	
c) *Years of farming experience (years)*	
d) Ethnic affiliation	
e) Religion (code)	
f) Number of years of schooling (years)	
g) Can read and write in an official language? ***1=Yes, 0=No***	

RELIGION	**2** = Muslim	**4** = Seventh Day Adventist (SDA)	**6** = Traditional African Religion
1= Catholic	**3** = Hindu	**5** = Protestant (all except for SDA)	7 = Other(specify)____________

SECTION B - FARM ACTIVITIES, FACILITIES and LIVESTOCK

B.1 Does the household or farm **have** (**tick):**

Household assets owned (tick)	**No. owned now**	**Who owns (codes)**	**Farm assets owned (tick)**	**No. owned now**	**Who owns (codes)**	**Livestock owned (tick)**	**No. owned now**	**Who owns (codes)**
Radio [__]			Scotch cart [__]			Cattle [__]		
Television [__]			Shovel [__]			Goats [__]		
Cellphone [__]			Axe [__]			Sheep [__]		
Landline [__]			Machete [__]			Poultry [__]		
Vehicle [__]			Hoe [__]			Rabbits [__]		
Motorcycle [__]			Plough [__]			Cows [__]		
Bicycle [__]			Wheelbarrow [__]			Bulls [__]		
Refrigerator __]			Tractor [__]			Steers [__]		
Solar panels [__]			Spray pump [__]			Heifers [__]		
Generator [__]			Chaff cutter [__]			Donkey [__]		
Others [__]			Borehole [__]			Dogs [__]		
						Cats [__]		

Who owns **1**=Head	**2**=Spouse **3**= Household (All)	**4**=head's mother **5**=head's father	**6**=Son 7=Daughter	**8**=Other joint (specify codes):__ 9=Other (specify):______

B2. Household labour for livestock production

Activities	Who mainly does them
1 = Grazing and providing water to cattle	
2 = Grazing and providing water to goats and sheep	
3 = Lookinig after Poultry	
4 = Milking	
5 = Marketing milk	
6 = Taking cattle to the dip tank	
7 = Treating sick animals	
8 = Decides on when to sell cattle	
9 = Decides on when to sell goats or sheep______	
10= Decides on when to sell poultry	

Who	**2**=Female adult	**4**=Female children

1=Male adult	**3**= Male children	**5**=Hired labor

SECTION C. POULTRY PRODUCTION AND HEALTH SERVICES

1. How long have you been keeping village poultry in this area?
2. What is the approximate size of your poultry flock? ________________________________
3. What breeds of chickens do you keep in your flock? ________________________________
4. Do you keep any other poultry species besides chickens (e.g., ducks, geese, turkeys)? If yes, please specify: ________________________________
5. What is the primary purpose of keeping poultry in your household? (e.g., egg production, meat, income generation, cultural purposes) ________________________________

C.1 Rank the 3 major constrainst/challenges you have faced in poultry (in order)?

Constraint to poultry production	**Ranks (1-5)**
Poultry disease?	
Predators	
Thefts	
Lack of feed	
Lack of markets	
Poor quality of breed	

C.2 Provide more details about the animal health services that you have used for your poultry

Type of service/ treatment	Have you used in the last 12 months? 1=Yes, 0=No	Who provided the service? (codes)	Number of times service used	How much did you spend on tratment	How much did you spend on professional fees
Anthelmintics (deworming)					
Vaccination					
Tick control					
Curative treatments					
Other, specify ____________					

Who provided the service	
1= Self/ Neighbour with professional advice	4= Government veterinarian
2= Self/ Neighbour without professional advice	5= Cooperative Veterinarian
3= Community Animal health service provider	6= Project veterinarian
	7= Private veterinarian
	8= Traditional herbalist

C.3 Indicate the use and availability of **LIVESTOCK EXTENSION SERVICES**
Note: tick if **accessible**, even if not used.

Livestock extension service providers	Accessible in your area? (tick if available)	Number of visits in last 12 months	Cost in local currency/ year
Government			
Project or NGO's			
Private Practitioners			
Cooperative/ farmer group			
Others, specify:__________			

Section D: Newcastle Disease (NCD) Occurrence

D.1 What are the main diseases you have experienced in your poultry over the past 5 years?

Disease	Tick	Disease	Tick
Avian Influenza		Newcastle Disease	
Infectious Bursal Disease		Coccidiosis	
Marek's Disease		Fowl Pox	
Salmonellosis		Chronic Respiratory Disease	
Aspergillosis		Botulism	

1. Have you ever experienced an outbreak of Newcastle Disease (NCD) in your poultry flock?
Yes / No ______________________________

D.2 If yes, Who made the diagnosis/ who told you it was New Castle disease?

Diagnoser	Tick	Diagnoser	Tick
Self/ Neighbour with professional advice		Government veterinarian	
Self/ Neighbour without professional advice		Cooperative Veterinarian	

Community Animal health service provider		Project veterinarian	
Private veterinarian		Traditional herbalist	

D.3 What were the major symptoms presented by the affected birds?

Symptom	**Tick**	**Symptom**	**Tick**
Coughing		Decreased feed intake	
Sneezing		Tremours	
Nasal Disharge		Paralysis	
Labored breathing		Unusual postures	
Diarrhea		Weight loss Reduced egg production	
Swelling of face, neck or eyes		Poor growth rate	
Warts		Weight loss	
Pox lesions		Aggression or unusual social interactions	
Foul odor		Egg abnormalities	

2. If yes, when was the last time you experienced an NCD outbreak? (Provide the month and year) ______________________________

3. Since 2020, how many times have you experienced NCD in your flock? ______________________________

4. How many birds were affected by NCD during the last outbreak? ______________________________

5. What was your total flock size during the last outbreak? ______________________________

6. How many birds died from NCD during the last outbreak? (Specify species and flock number)
____
____
____
____

7. How many other people who were affected by this disease apart from yourself?

8. What month(s) of the year did you experience the last NCD out break?

Month	**Tick**	**Month**	**Tick**
January		July	
February		August	
March		September	
April		October	
May		November	
June		December	

9. What were the main symptoms observed in your birds during the last NCD outbreak? (e.g., respiratory distress, nervous system disorders, reduced egg production)
____
____

____

10. Did you seek any veterinary assistance or advice during the NCD outbreak?
Yes / No
11. If yes, what was the response and assistance provided by the veterinary authorities? ____
____
____

Section E: NCD Vaccination

1. Do you regularly vaccinate (or buy medication) your poultry against Newcastle Disease? Yes / No

2. If yes, how often do you vaccinate (or buy medication) your birds? ____
____
____

3. What is the source of the NCD vaccine? (e.g., government veterinary clinic, private veterinarian, local agro-dealer) ______________________________

4. Do you face any challenges in accessing the NCD vaccine? If yes, please specify: ____
____
____

5. What is the cost of the NCD vaccine per bird? ______________________________

6. Have you noticed any differences in the health and productivity of your flock after vaccinating against NCD? If yes, please describe: ______________________________
____
____
____

Section e: Additional Information

1. Do you have any additional comments or observations regarding the occurrence of NCD in your poultry flock / village poultry flock? ______________________________
…………………………………………………………………………………………
…………………………………………………………………………………………
…………………………………………………………………………………………
…………………………………………………………………………………………
…………………………………..

2. Would you be willing to participate in future research or extension activities related to poultry health and management? Yes / No

Thank you for your participation in this study.

APPENDIX B SPSS OUTPUT

Kututwa Lynea SPSS Output.docx