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A survey on disease prevalence, ectoparasite infestation and chick mortality in poultry populations of Kenya

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Abstract

Backyard poultry production in Africa suffers major setbacks due to factors such as disease and parasite infestation. This has resulted to dwindling quantities of meat and eggs produced and also increased mortality rate observed in poultry birds. We carried out a study on 90 helmeted guinea fowls from Bungoma South, Teso North, Bungoma West, Mt. Elgon and Laikipia, and 296 indigenous chicken from three agro-climatic zones of Kenya; Lamu Archipelago, L. Turkana basin and Mt. Elgon catchment during the period September 2014 to January 2015.

Of the several possible diseases detected through clinical examinations, we noted that indigenous chicken that showed Newcastle disease clinical signs were the most common with Lamu Archipelago recording the highest number of cases (83%) while L. Turkana basin recorded the lowest (9%). Low Newcastle disease prevalence was mainly attributed to superior innate immunity by indigenous chicken unaffected by poultry improvement programs and also effective vaccination. Mites, lice, fleas, and ticks were confirmed as the common types of ectoparasites affecting poultry. Mites were the most common (43%) followed by lice (40%), fleas (37%) and ticks (2%). Wild guinea fowl populations were found to be less affected by ectoparasite infestation when compared to the domestic populations. Poor husbandry was the main cause of high ectoparasite infestation observed. We report that chick mortality rate is highest during the first week mainly due to diseases, predation, poor feeding and lack of proper housing. However, it reduces with the growth of the poultry birds over time. There was no significant relationship between chick mortality rate and the different agro-climatic zones. We also noted that most farmers prefer disease-resistant poultry when compared to other traits such as body size, egg yield, and growth rate.

This study outlines how prevalent Newcastle disease is irrespective of the agro-climatic zone. It also confirms the high intensity of ectoparasite infestation in indigenous chicken and domesticated guinea fowls. All these factors that negatively impact on poultry production are mainly centered on poor husbandry.

Keywords: *indigenous chicken, Newcastle virus, production*

Introduction

Poultry farming is economically important to poor rural farmers as a major source of protein and income. Some of the common poultry types in Kenya include chicken, duck, turkey, geese and guinea fowl (Nyaga 2007). There are three main poultry keeping systems applied in Kenya; intensive, semi-intensive and free-range system. The intensive system encourages the confinement of poultry birds in houses where all requirements are provided for. The semi-intensive system allows the birds to roam under a specified caged space and finally the free-range system encourages the birds to roam around other homesteads scavenging for food. Most rural farmers, however, rear these poultry types under free-range system hence are often plagued with several problems such as diseases, parasite infestation, and low levels of animal health and husbandry practices (Sabuni et al 2010). This ultimately leads to low production.

In Kenya, indigenous chickens contribute 76 % of the total egg and poultry meat produced and therefore, influencing significantly on the rural trade, welfare, and food security of the smallholder farmers (MOALF 2010). The helmeted guinea fowls are the main species of guinea fowls domesticated in Kenya and are mainly reared for meat, egg and feathers (Adeola et al 2015; Panyako et al 2015). These two poultry birds are greatly affected by diseases mainly parasitic and viral. Parasitic diseases cause little mortality but low production whereas viral diseases, such as Newcastle, have led to major losses in the poultry industry due to increased mortality rate. Newcastle disease is economically important in sub-Saharan Africa, responsible for calamitous losses experienced by poultry farmers (Ommeh 2013). Newcastle disease outbreaks can cause mortality as high as 100% especially in chicken (Njagi et al 2010). A lot of studies have been conducted and measures implemented to curb Newcastle disease but the success rate is still low. Commercial breeds are more susceptible to this disease than indigenous breeds, a fact that has been linked to evolutionary mechanisms that may have led to genetic variation at innate immune genes (Sigei et al 2015). One of the candidate genes associated with viral disease resistance has been the mx gene. Polymorphisms present in this gene have continuously been under study as they have been believed to be the reason why some poultry populations are less susceptible to Newcastle disease than others (Ommeh et al 2010).

Ecto-parasites, despite their devastating effects, are often overlooked (Amede et al 2011). Some of the ectoparasites common in poultry are mites, lice, fleas and ticks (Ikpeze et al 2008). They are known to suck blood thereby causing irritation and discomfort.

They also compete for feed, serve as carriers of poultry diseases and pathogens thus can directly affect bird health (Bhat et al 2014). Ecto-parasites affect the productivity potential of indigenous chickens and helmeted guinea fowls thus should be given more attention. Although guinea fowls are known to be more disease resistant to diseases than chicken, parasite infestation is still a main concern (Okaeme 1988).

Mites are among the most common of all the ectoparasites observed in poultry. Some of the species found on the skin of most poultry birds include *Dermanyssus gallinae, Ornithonyssus sylviarum* and *Ornithonyssus bursa* (Ikpeze et al 2008). Mites of the family *Dermanyssidae* (chicken mite, northern fowl mite, and tropical fowl mite) are the most economically important of the many external parasites of poultry (Salam et al 2009). Heavy infestations of mites in chicken results to decreased reproductive potential in males and egg production in females. Lice species affecting chicken are *Menacanthus stramineus, Menopon gallinae, Cuclotogaster heterographus, Lipeurus caponis, Goniodes gigas* and *Goniocoites gallinae* (Salam et al 2009). The stick tight flea (*Echidnophaga gallinacean)* is the only flea commonly affecting chicken. The fowl tick (*Argas persicus*) is known to affect chickens, turkeys, pigeons, ducks and geese in tropical and sub-tropical countries (Mungube et al 2008).

Similar studies on ectoparasite prevalence have already been done in Kenya but only in a few selected areas such as Embu, Mbeere and Taita hills (Oguge et al 2009; Sabuni et al 2010). Therefore, this study was aimed at determining the prevalence of ectoparasites in indigenous chicken and helmeted guinea fowls from different agro-climatic zones in Kenya that haven't been studied before. Using information from the local veterinary offices and farmers, the study was also to determine the diseases that are frequently present in the various agro-climatic zones, chick mortality rate of indigenous chicken and traits that farmers would want to be improved in chicken.

Materials and methods

Study area

The study was carried in the following areas Busia, Bungoma, Trans Nzoia, West Pokot, Turkana, Laikipia, and Lamu. The selection of the study areas was based on the contrasting climatic conditions experienced in these regions. Moreover, these areas are also least affected by poultry improvement programmes that are run by the government and non-governmental organizations. Most poultry farmers in these study areas also practice traditional free-range system, which is characterized by poor management when it comes to handling disease and ectoparasite infestation. Busia, Bungoma, Trans Nzoia and highland areas of West Pokot are located in the Mt. Elgon catchment which is at an altitude of 1800-3000m above sea level. According to the agro-climatic zones of Kenya which range between zones I-VII, Mt. Elgon is found in zone I and II (Moraa et al 2015). It experiences an annual rainfall of 800-2000mm and a temperature range of 0°C-22.0°C. Laikipia plateau lies within zones IV-VI. It experiences an annual rainfall of 300-600 mm and an annual temperature range of 16°C-19°C. Turkana and lowland West Pokot are in the L. Turkana basin, which is at an altitude of 360

m. This region experiences an annual rainfall of less than 800mm and is one of the hottest regions in Kenya with a maximum annual temperature of 42°C. Lake Turkana basin lies within zone VI and zone VII. Lamu Archipelago lies in zone IV at an altitude of around 6m. It experiences an annual rainfall of 800mm and an annual temperature range of 24.1°C- 29.2°C (Moraa et al 2015).

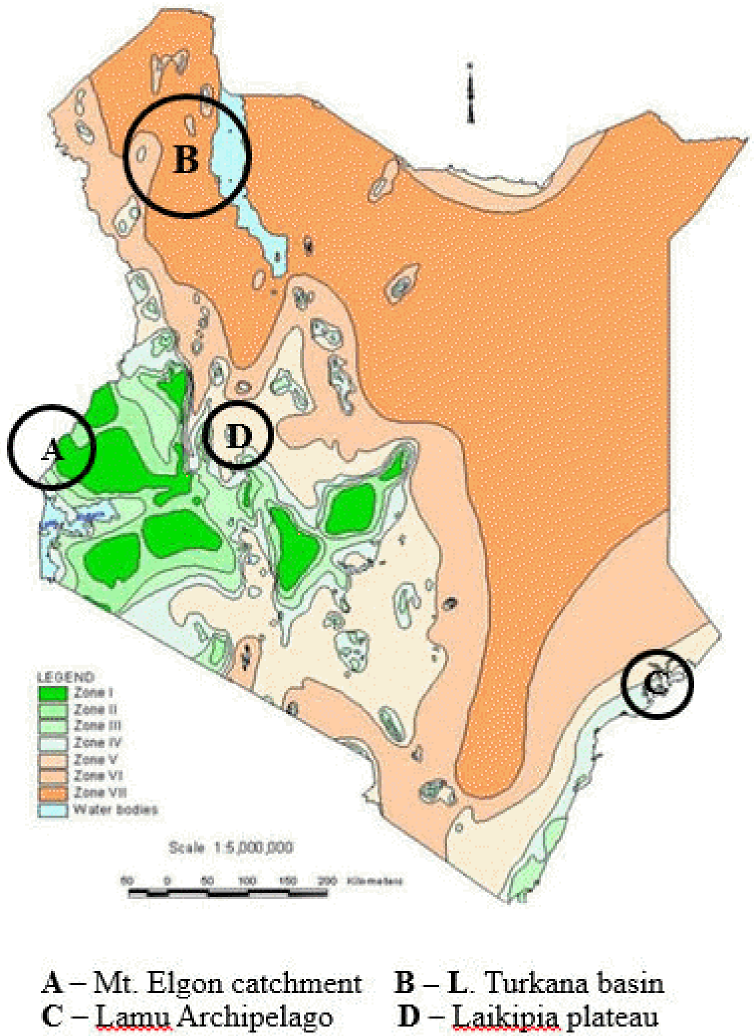

Figure 1. Map of sampled locations (source; www.infonet-biovision.org)

Table 1. Summary of sampled locations (indigenous chicken)

Agro-climatic zone	Number of samples
Mt. Elgon catchment	99

L. Turkana basin	94
Lamu Archipelago	103
Total	**296**

Table 2. Summary of sampled locations (helmeted guinea fowl)

Agro-climatic zone	Location	Species	Number of samples
Mt. Elgon catchment	Bungoma South	Domestic	13
Mt. Elgon catchment	Teso North	Domestic	18
Mt. Elgon catchment	Bungoma West	Domestic	18
Mt. Elgon catchment	Mt. Elgon	Domestic	21
Laikipia plateau	Laikipia Central	Wild	20
	Total		**90**

Permits

Ethical clearance to sample wild guinea fowls was provided under the permit number KWS/BRM/5001 from the Kenya Wildlife Service. Permit number RES/POL/VOL.XXVII/162 from the director of Veterinary Services, Ministry of Agriculture, Livestock and Fisheries in Kenya allowed the sampling of domestic chicken and guinea fowls.

Data collection

The study was carried out from September 2014 to January 2015. We used a cross-sectional study approach during sampling. We randomly selected households based on willingness to participate in the study. Interviews were done to ensure that the sampled chickens were unrelated and reared under the backyard free-range system i.e. the chickens are indigenous, unaffected by poultry improvement programs and no vaccinations are given. Local veterinary officers from regions that were confirmed to be experiencing a Newcastle disease outbreak were present to help us identify affected farms, which were highly considered. Sick chickens from such farms were sampled. Farmers' interviews and clinical observation of the poultry birds were conducted with the help of veterinary and local agricultural extension officers. Questionnaires were used to determine the history of disease in the farms and surrounding areas. We carried out the examination of the skin for ectoparasites as described in the Ministry of agriculture, food and fisheries 1986 manual (MAFF 1986).

Data analysis

We entered and analyzed the data from our study in Ms-Excel (2013) and the exported results were presented in bar graphs and tables. We used R software version 3.3.0 to compute means of various qualitative traits with respect to the different agro-climatic zones. We also conducted ANOVA tests to check the variance.

Results and discussion

Disease prevalence

Backyard poultry farming relies heavily on the use of clinical signs in disease diagnosis. This is due to scarce laboratory resources that are useful in the proper diagnosis of diseases such as Newcastle. For a definitive diagnosis of Newcastle disease, both virus isolation and laboratory characterization are required. In cases where the disease is known to be present in an area, use of clinical signs for diagnosis can be considered, especially for village chickens (Alexander et al 2004). We were able to note that Newcastle disease was the main disease encountered during our time of sampling. Lamu Archipelago recorded the highest number of chicken that showed the classical Newcastle disease signs whereas L. Turkana basin recorded the lowest. In Kenya, this disease is normally prevalent during some seasons, especially cold and dry periods. This was confirmed by farmers through the interviews, an observation that was also stated by Nyaga (1985).

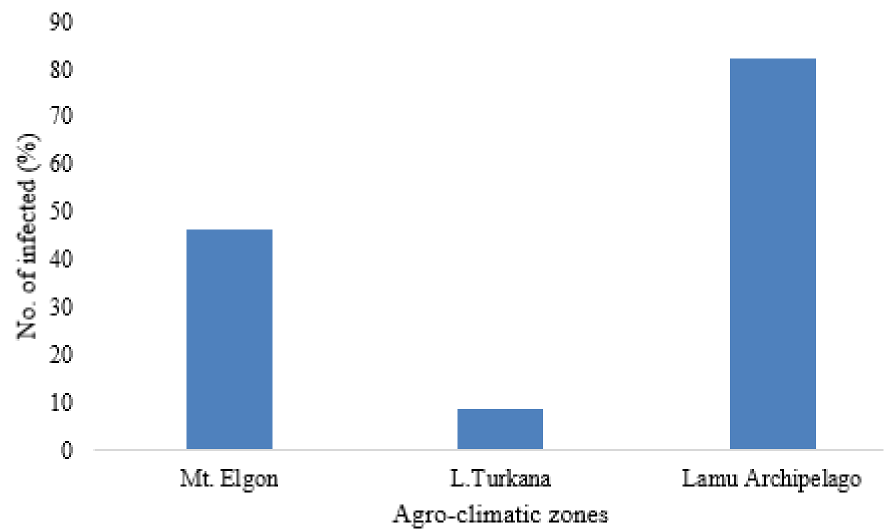

Figure 2. Percentage of sampled indigenous chicken infected with Newcastle disease

Innate immunity against viral diseases such as Newcastle is crucial as the first line of defense whenever there is an outbreak. Mx proteins present in poultry birds are well known for their antiviral activity. An A/G Single Nucleotide Polymorphism (SNP) at position 1,892 of the Mx gene coding sequence has been linked to susceptibility/resistance to avian viral infection *in vitro* (Ommeh et al 2010).

According to Ommeh et al (2010), indigenous village chickens have maintained both A and G alleles by natural selection for disease resistance through a balancing selection mechanism. Both alleles are important for innate immunity development in chicken and could explain the low number of Newcastle disease cases observed in L. Turkana basin. Factors such as inbreeding can lead to loss of significant alleles such as the A and G alleles of the mx gene that are vital for disease resistance. Therefore, regions that experience a lot of inbreeding are likely to have high chicken mortality as a result of viral disease outbreaks. In addition, Kemboi et al (2013) confirmed that Newcastle virus is endemic in some regions in Kenya, a finding that was earlier reported by Njagi et al (2010). This also explains why this disease is very common in some areas as some healthy chicken that had survived a previous outbreak and other poultry species act as carriers (Awan, Otte & James 1994).

High prevalence of Newcastle disease as observed in Lamu Archipelago can also be attributed to little or no vaccination done to the chickens by the farmers. Vaccinations are important in the fight against Newcastle disease virus, therefore, lack of continuous vaccinations makes it nearly impossible for the disease to be managed (Byarugaba et al 2014). Mt. Elgon, Lamu Archipelago, and L. Turkana regions have poor terrain thus inaccessible to most local extension officers who in turn are unable to provide vaccines effectively. From the interviews, most of the rural farmers use traditional herbal medicines to treat their chicken, which doesn't work well against viral infections. We were also able to observe that the free-range system in which most indigenous chickens are raised highly contributes to the spread of this disease from farm to farm leading to high mortality rates.

Ectoparasite infestation in indigenous chicken

We noted that most of the regions showed a high percentage of ectoparasite infestation, clearly indicating how common the problem is, hence should not be overlooked as was suggested by Amede et al (2011). Ectoparasites are known to be rampant in warmer regions as the environment favors parasitic life cycles (Sabuni et al 2010). This could explain the high ectoparasite infestation in L. Turkana basin and Lamu Archipelago. The unexpected high parasite infestation observed in Mt. Elgon which is generally a cold environment can be attributed to sampling during the months of December and January, which are generally hot and dry months thereby encouraging ectoparasite reproduction and multiplication. Indigenous chicken are known to roam around homesteads scavenging for food leading to spread of these ectoparasites when they come into contact with infested birds (Sabuni et al 2010). Mungube et al (2008) stated that some of these ectoparasites are known to hide in poor hygiene poultry houses and thus poor husbandry and lack of ectoparasite control measures were possible factors contributing towards their high prevalence. The study showed that mites, fleas, and lice are the most common ectoparasites affecting indigenous chicken. Mites were the most common of all ectoparasites observed similar to (Amede et al 2011) followed closely by fleas. This was also confirmed by the number of chicken observed that were suffering from scaly leg mite.

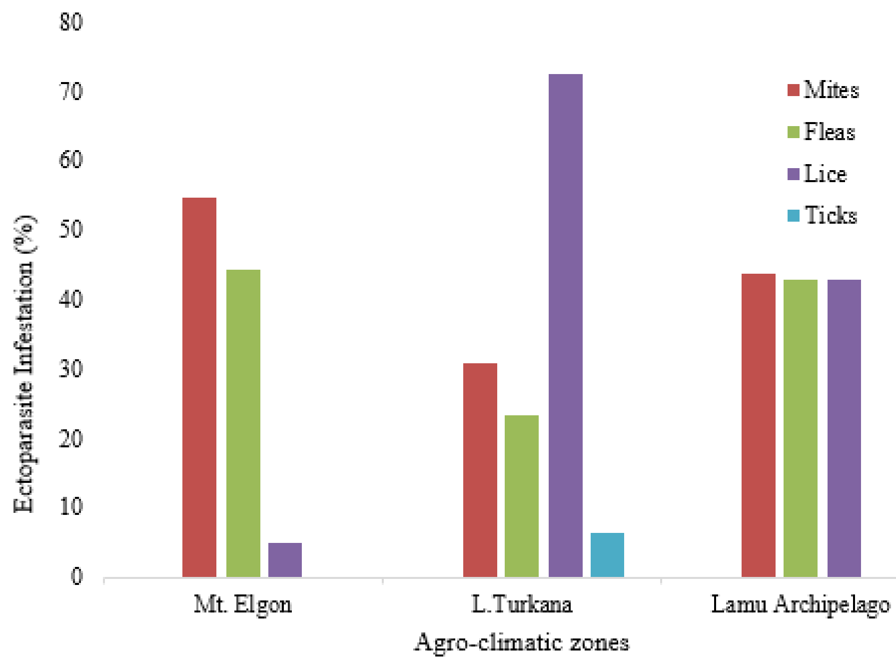

Figure 3. The percentage of sampled chicken infested by ectoparasites

Ectoparasite infestation in helmeted guinea fowl

We observed that Bungoma West and Teso North populations had the highest percentage of ectoparasite infestation with Mt. Elgon population following closely. Bungoma South domestic guinea fowl population and Laikipia Central's wild guinea fowl population didn't have ectoparasites. Wild guinea fowl populations are free to roam around while domesticated populations are reared mostly in rural low-income homesteads with poor husbandry and also interact with other birds infested with ectoparasites. This observation among other factors could explain why wild guinea fowl populations are less prone to ectoparasite infestation when compared to their domestic counterparts. Bungoma South is generally cooler and forested compared to Teso North and Bungoma West and could explain the lack of ectoparasite infestation in this domesticated population. Mites and fleas were the most common ectoparasites observed.

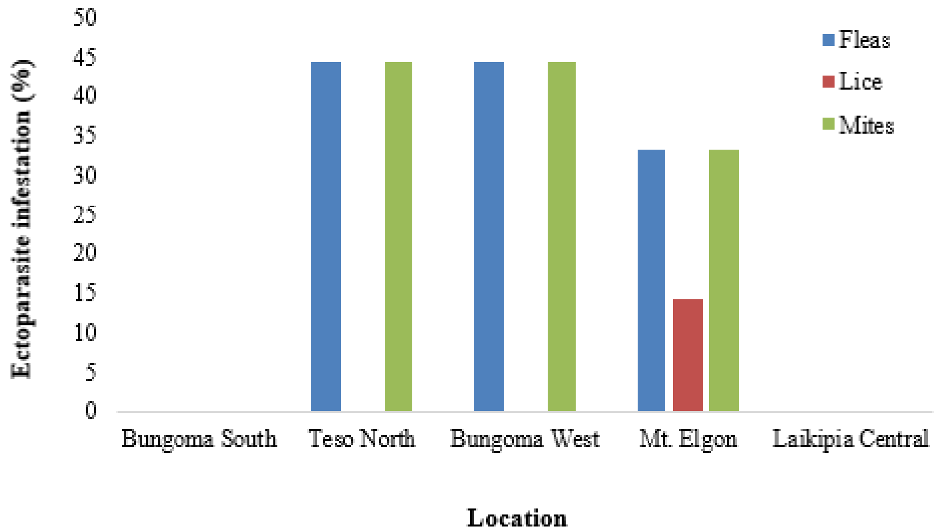

Figure 4. The percentage of sampled helmeted guinea fowls infested by ectoparasites

Chick mortality rate in indigenous chicken

We observed that indigenous chicken populations from L. Turkana basin experienced the highest mean number of chick deaths in the first week after hatch whereas Mt. Elgon catchment populations experienced the least mean number of chick deaths. The mean number of chick deaths continues to reduce over time and in places such as L. Turkana basin, no deaths were reported on the fourth week. The first week after hatching is usually a high-risk period. The high chick mortality rates observed in all the agro-climatic zones during the initial weeks after hatch can mainly be attributed to diseases and poor management, as was suggested by Muhammad et al (2010) and Chou et al (2004) respectively. Factors such as poor quality hatch (Muhammad et al 2010) and predation by birds of prey also play a role especially in areas near forests such as Mt. Elgon catchment. Stress and nutrition may also play a smaller role towards chick mortality when compared to disease (Muhammad et al 2010). The chicks continue to develop their immune system as they grow thereby reducing the number of chick deaths as observed in week 4. The ANOVA test results showed that there was no significant relationship between Chick mortality rate and the various agro-climatic zones.

Table 3. Mean number of chick deaths for week 1, 2 and 4

	Agro-climatic zone	n	mean	sd	*p*
	Mt. Elgon	99	0.465	1.19	
Chick Death Week 1	L. Turkana	94	0.723	1.33	0.306
	Lamu Archipelago	103	0.515	1.18	
	Mt. Elgon	9	0.232	1.37	
Chick Death Week 2	L. Turkana	94	0.16	0.592	0.243

	Lamu Archipelago	103	0.0291	0.219	
	Mt. Elgon	99	0.0909	0.454	
Chick Death Week 4	L. Turkana	94	0.00	0.00	0.321
	Lamu Archipelago	103	0.0971	0.721	

Traits to improve

Farmers from L. Turkana basin were mainly interested in production traits such as body size, egg yield, and growth rate. L. Turkana basin receives little annual rainfall that is not enough to sustain good farming. Therefore, livestock play a crucial role in ensuring food security leading to increased interest in production traits. From what we also observed, indigenous chickens from L. Turkana basin are characterized by a smaller body size compared to other chickens from other agro-climatic zones. Farmers from Mt. Elgon catchment preferred disease resistance trait followed by improved production but showed the least interest in improved growth rate in chicken. The results from the interviews to some extent show that poultry diseases are the main concern to most poultry farmers.

Conclusions

Newcastle disease is still the main disease affecting indigenous chicken and a major concern to rural farmers. Although some farmers make an effort in ensuring vaccinations of their poultry, free range system still poses a challenge in terms of management of the disease. The endemicity of the disease in some regions adds to the list of challenges experienced. Even though our study relied on the use of clinical examinations and reports from the local government veterinary offices for diagnosis of Newcastle disease, we strongly suggest the use of virus isolation and laboratory characterization methods.

Mites, lice, and fleas were the common ectoparasites observed in the study regions. The observed overall prevalence of mite infestation was higher than that of lice or fleas. Most of the chickens examined suffered from mite infestation, thus indicating that mite was the most common ectoparasite.

Chick mortality rate was highest during the first week. The mortality rate continues to decrease as the chicks grow due to their improved immune system. Finally, disease resistance and increased production are the main traits farmers prefer. This is due to the heavy losses experienced through high mortality rates caused by diseases such as Newcastle.

Implications

New and improved Newcastle disease management systems should be developed and employed. Appropriate ectoparasite control measures have to be practiced to mitigate the effect of infestation by poultry pests. Mortality rate studies should be conducted more often so as to better understand the main factors contributing to mortality of chicks other than disease, especially during the first crucial four weeks.

Acknowledgements

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