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By Ezra Ochami Aondo, Ombui Jackson N., Onono Joshua, Richard Onduso & Omasaki Simion K

*Kisii University*

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# Poultry Farming and Disease Management Practices in Small-Scale Farmers in Kisii County, Kenya

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*Abstract-* One of the most important constraints of poultry production is disease. Among the major important diseases are: viral, fungal, bacterial and parasitic infections. A cross sectional survey was carried out in small-scale poultry farmers in Kisii County, Kenya to establish the common diseases and their management practices. A structured and semi-structured questionnaire was administered to 400 households. Sampled households were obtained from a target population of 247,050 using a stratified random sampling technique. Analysis of data was performed using statistical package for social sciences (SPSS) version 16 software. Results indicated that majority of the farmers (58.8%) were male while 55% had a farm size of less than one acre. Newcastle (29.3%) was the most important poultry disease in the study area. Of the interviewed farmers' 46.6% relied on both ethno vet and conventional medicine to treat their birds. More than 65% of the farmers did not vaccinate their birds while those who vaccinated, never did it regularly. The methods of vaccines application (35%) was identified as the major challenge to poultry vaccination. Most farmers practiced proper disposal (burying) of the dead birds (34.5%) as a common biosecurity measure. Greenish diarrhea was identified by most farmers (20.3%) as the common sign of diseases in the study area. Most farmers used Aloe Vera to manage poultry diseases. We recommend that there is an urgent need for the farmers to embrace good poultry diseases management practices and the government to support them by providing subsidized vaccinations and technical support in order to develop and stimulate economic development of poultry farming in Kisii.

*Keywords: bio-security measures, ethno-veterinary, newcastle disease, vaccination.*

## I. Introduction

The global poultry industry is expected to grow continuously as demand for eggs and meat is driven by increasing populations, rising incomes and urbanization. It is the fastest growing agricultural sub-sector; especially in developing countries Kenya included (Atela et al 2016, mottet and Tempio, 2019). Poultry is a major asset, providing income and food security and play a role in cultural functions and market participation to rural households (Nduthu 2015, Lindahl et al 2019). They are preferred because of the little investment required, low input, and short production cycles compared with other livestock enterprises (Atela et al 2016). Even if most of the sector's growth has been driven by private players, public concerns about the sector's impact on the environment and human health, its contribution to climate change and to local and global economy is triggering governments' response and the development of public policies for the sector (mottet and Tempio, 2019). The sector is facing unprecedented challenges among them diseases which include; viral, fungal, bacterial and parasitic infections (Nduthu 2015, Apopo et al 2019, Lindahl et al 2019, mutinda et al 2019).

Even though effective poultry farming practices against diseases are available in most countries, the uptake by poultry farmers is often very low (Lindahl et al 2019). Poultry vaccination is the most important option to the management of most poultry diseases. However, vaccine failure and subsequent outbreaks in vaccinated chickens are a major challenge in poultry farming (Lindahl et al 2019). This could be due to the use of live vaccines which may revert to virulence resulting in disease. Further, live vaccines may become non-viable due to poor handling and yield no immune response as anticipated (Mutinda et al 2019).

Biosecurity is an indispensable tool to mitigate the spread of poultry infectious diseases but only a few poultry farmers understand and practice these measures. Biosecurity principles of isolation and containment remain the most important. However, only a few documents are available about the impact of these measures in various poultry farming settings and very little have any evidence of their feasibility and effectiveness (Silva et al 2020).

In most developing countries, farmers depend on indigenous knowledge and practices to control, prevent and cure the many infections affecting both human and their animals (Sambo et al 2015). Consequently, the use of ethno veterinary remedies using medicinal plants has gained more attention due to their accessibility, easy to prepare and administer at no cost. On the other hand, conventional drugs are either unavailable or too expensive for the small-scale resource poor farmers (Sambo et al 2015). Medicinal plants are broad spectrum and may be a future to pathogen that may develop resistance to conventional

*Author α: School of Agriculture and Natural Resource Management, Department of Animal science, Kisii University, P. O. Box 408-40200 Kisii, Kenya. e-mail: dr.ezraochami@gmail.com*

*Author σ ρ ω ¥: Faculty of Veterinary Medicine, Department of Public Health, Pharmacology and Toxicology, University of Nairobi, Kangemi, Nairobi, Kenya.*

drugs (Silva et al 2020). Farmers use garlic, green leaves, local alcohol, lemon, paper powder and butter among others as drenching, nasal application and smoking in attempt to control and cure many infections affecting their birds (Silva et al 2020).

Poultry production in Kenya suffers major setbacks due to factors such as disease and parasite infestation, high prices and poor quality of feeds, predation, and low levels of animal health and husbandry practices (Ogada et al 2016). Poultry diseases and disease management practices in Kisii, Kenya, from the farmer's perspective, have not been optimally understood and practiced, a situation that limits interventions for improvement of poultry production. The current study aimed at providing a better understanding of poultry farming and diseases management practices, and identification of constraints and opportunities for improved poultry farming in Kisii County.

## II. Materials and Methods

A cross sectional survey was conducted on 400 households distributed across nine sub-counties of Kisii, Kenya as shown in table 1 below. Stratified random sampling technique was used to select these sample size from a target population of 247,050 households. Data was collected using structured and semi structured questionnaires through direct interviews. Households were briefed about the objective of the study before starting the interviews and data collection at the farms. Information was collected based on characteristics of the farms, poultry management and farming support services provided by the Ministry of Agriculture, Livestock and Fisheries Development (MALFD) and Non Governmental Organizations (NGOs). Results of all exercises creating visual representations of data was captured on a digital camera and later transferred to the data storage laptop. Current stock, housing type and bio-security practices were identified through observations and noted for the purpose of data analysis. Data were analyzed using the statistical package for social sciences (SPSS) version 16 software and presented using descriptive statistics such as frequency and percentage.

*Table 1:* Sampling frame and sample size

| Sub-county | Zone A | Zone B | Zone C | Total population | Percentage | Sample size (Households) |
|---|---|---|---|---|---|---|
| Nyaribari Chache | 10100 | 9500 | 9112 | 28,712 | 12 | 48 |
| Nyaribari Masaba | 9050 | 8500 | 8765 | 26,315 | 11 | 44 |
| Bobasi | 11000 | 10500 | 11960 | 33,460 | 14 | 56 |
| Bomachoge Borabu | 8000 | 7500 | 7500 | 23,000 | 9 | 36 |
| Bomachoge Chache | 8550 | 8550 | 8550 | 25,650 | 10 | 40 |
| Kitutu chache south | 9050 | 10400 | 10470 | 29,920 | 12 | 48 |
| Kitutu chache north | 7900 | 7600 | 8232 | 23,732 | 10 | 40 |
| Bonchari | 8130 | 8040 | 8245 | 24,415 | 10 | 40 |
| South Mugirango | 10686 | 10560 | 10600 | 31,846 | 13 | 52 |
| Total | 82466 | 81150 | 83434 | 247,050 | 100 | 400 |

## III. Results

### a) *Description of poultry farms*

Male predominantly headed the households (62%). Over 50% of the households had a farm size of less than one acre while less than 45% had a family size of less than five members. The majority (58%) of the farmers engaged in agricultural activities. Most farmers (69.5%) used their own savings as capital to start poultry farming (Table 2).

*Table 2:* Description of poultry farms (n=400)

| Variable | Parameter | Frequency | Percentage |
|---|---|---|---|
| Head of family | Male | 248 | 62 |
| | Female | 152 | 38 |
| Family size | <5 | 180 | 45 |
| | 5-10 | 140 | 35 |
| | >10 | 80 | 20 |
| Farm size (acres) | <1 | 218 | 54.5 |
| | 1-5 | 153 | 38.3 |
| | >5 | 29 | 7.2 |
| Livelihood activity other than poultry | Agricultural (crop and livestock) | 232 | 58 |
| | Non-agricultural(Business and employment) | 168 | 42 |
| Source of funds for poultry farming | Personal savings | 238 | 69.5 |
| | Loan | 114 | 28.5 |
| | Government grants | 48 | 12 |

*b) Farmers Characteristics*

Majorities (54%) of the farmers were aged between 40 and 60 years and 58.5% of them were males. The highest academic qualification held by most farmers was tertiary education (47%), with 62.7% of them having no training on poultry farming. However, of those with training in poultry farming, 63.8% of them were trained by private service providers, 28.2% by government extension officers and 8.0% by NGOs. (Table 3).

*Table 3:* The age, sex, education level and training of poultry farmers (n=400)

| Variable | Parameter | Frequency | Percentage |
|---|---|---|---|
| Age of farmer | 20-39 | 95 | 23.8 |
| | 40-60 | 216 | 54 |
| | Above 60 | 89 | 22.2 |
| Sex of farmer | Male | 234 | 58.5 |
| | Female | 166 | 41.5 |
| Level of education | Primary | 102 | 25.5 |
| | Secondary | 110 | 27.5 |
| | Tertiary | 188 | 47 |
| Any training on poultry farming | Yes | 149 | 37.3 |
| | No | 251 | 62.7 |
| Trained by | Private service providers | 95 | 63.8 |
| | Government service providers | 42 | 28.2 |
| | NGOs | 12 | 8.0 |

*c) Common causes of mortality, poultry diseases and their signs*

The following diseases were identified as the most common in the study area. Newcastle disease (29.3%), internal parasites (16.0%) and Salmonellosis (12.8%) were the common diseases in the farmers' flocks. Marek's disease (3.0%) and infectious bursal disease (3.8%) were the least common diseases reported. Farmers (20.3%) reported seeing greenish diarrhea followed by presence of worms in the faeces (17.5%), comb lesions (14%), yellowish diarrhea, (13.3%), Ecto-parasites (12.3%), whitish diarrhea, (10.5%) and blood stained feces (8.8%). The major causes of mortality and/or loss of poultry in the farms were identified as diseases (29.5%), predators (25.0%), parasites 19.2%, accidents and injuries 14% respectively (Table 4).

*Table 4:* Common poultry diseases and their signs in the study area (N=400)

| Variable | Parameter | Frequency | Percentage |
|---|---|---|---|
| Common signs of poultry disease seen | Yellowish diarrhea | 53 | 13.3 |
| | Whitish diarrhea | 42 | 10.5 |
| | Greenish diarrhea | 81 | 20.3 |
| | Faeces stained with blood | 35 | 8.8 |
| | Paralysis | 14 | 3.5 |
| | Worms seen in faeces | 70 | 17.5 |
| | Ecto-parasites on the body | 49 | 12.3 |
| | Lesions on the comb | 56 | 14.0 |
| Common diseases of poultry | Eye coryza | 48 | 12.0 |
| | Fowl pox | 43 | 10.8 |
| | Salmonellosis | 51 | 12.8 |
| | Gumboro | 15 | 3.8 |
| | Marek's | 12 | 3.0 |
| | disease | | |
| | Newcastle disease | 117 | 29.3 |

| | | | |
|---|---|---|---|
| | Infectious bronchitis | 50 | 12.5 |
| | Internal parasites | 64 | 16.0 |
| Common causes of poultry mortality/losses | Disease | 118 | 29.5 |
| | Predators | 100 | 25.0 |
| | Theft | 28 | 7.0 |
| | Parasites | 77 | 19.2 |
| | Accidents and injuries | 56 | 14.0 |
| | Unknown | 11 | 2.8 |
| | Poisoning | 10 | 2.5 |

*d) Poultry disease management practices*

Most farmers (45%) used both conventional and traditional medicines to treat their poultry. Proper disposal of dead birds (26.9%) was practiced by majority of the farmers as a bio-security measure. Only 38.5% of farmers vaccinated their birds, with 29.3% of them vaccinating against Newcastle disease. The methods of vaccine application (35%), was a major challenge in poultry vaccination (Table 5).

*Table 5:* Farming practices related to poultry disease management (n=400)

| Variable | Parameter | Frequency | Percentages |
|---|---|---|---|
| Action taken when birds are sick | Call a veterinarian | 50 | 12.5 |
| | Treat with conventional drugs | 70 | 17.5 |
| | Treat with both conventional and traditional medicines | 180 | 45 |
| | Treat with traditional medicines | 100 | 25 |
| Biosecurity measures practiced | use of special clothing in poultry house | 103 | 25.8 |
| | use of protective boots | 41 | 10.2 |
| | proper disposal of dead birds (burying deep) | 138 | 34.5 |
| | use of foot dips | 70 | 17.5 |
| | fencing the farm | 48 | 12 |
| Do you vaccinate your birds? | Yes | 154 | 38.5 |
| | No | 246 | 61.5 |
| Diseases vaccinated against | Fowl pox | 37 | 23.8 |
| | Newcastle disease | 63 | 40.9 |
| | Gumboro | 29 | 18.7 |
| | Fowl typhoid | 25 | 16.6 |
| Challenges when vaccinating | high cost of vaccines | 117 | 29.3 |
| | vaccines not available | 71 | 17.7 |
| | storage conditions of vaccines | 72 | 18 |
| | methods of vaccines application | 140 | 35 |

*e) Ethno veterinary medicine*

Table 6 presents common ethno veterinary medicines used to manage poultry diseases. Majority (49%) of the farmers used Aloe vera to treat poultry diseases.

*Table 6:* Common medicinal plants used in poultry diseases management (n=400)

| Plants spps /local medicine | Frequency | Percentages |
|---|---|---|
| Aloe vera | 196 | 49 |
| Allium cepa | 46 | 11.5 |
| Allium sativum | 52 | 13 |
| Azadirachta indica | 62 | 15.5 |
| Capsicum frutescens | 44 | 11 |

## IV. Discussion

*a) Poultry farms characteristics*

Of the total interviewed farmers, this study revealed that the majority were males. This high proportion of males to females can be attributed to the religion and custom which play a very crucial role in the livelihoods of the people in the study area that males are the head of the family and are to provide for the households. Trainings by various stakeholders on poultry farming and change of mind set on poultry farming by the males may also have an influence in the male dominance in poultry farming. In addition, the fact that majority of the households in his study are headed by males, a common scenario in many rural families in most regions of African continent where traditions and culture demands for the establishment of marriage where males are head of families, most activities associated with income generation are controlled by men. Our findings are similar to other studies conducted by Kirui (2014) in kenya, and Terefe et al (2018) in Ethiopia who indicated that there are more males involved in poultry faming than females. However, other studies have also reported contradicting results of more females dominating poultry farming (Moige 2014, Sambo et al 2015, Atela et al 2016, Haile and Biratu 2017).

The result shows that majority of the poultry farmers were at the age range of between 41-60 years. This is the age bracket when most people have entered into marriage and they have started the family life. This therefore implies that the family needs of food and additional quick income is in increase, hence demanding the family to venture into a diversity of activities to achieve their goals. Findings of this study agree with Njenga (2017) in Kenya who reported an average age of poultry farmers to be 49 years.

Several studies have investigated factors that influence family size, these include: level of educational, the type of occupation, income level, the size of the land, family size preference, age, age at marriage, religion, security at old and sex preference among others. Most families would prefer to have a family which is easy to provide for their needs without straining them because of the increased cost of living. Our findings indicate that most of the farmers have family size of less than five members. This can be explained mainly by, the reducing land size in the study area where majority of the households had less than 1 acre of land. This result agrees with the findings of Njenga (2017) who reported a household size of 4 members. The age at which most women in Kenya get married also contributes to the number of children that they can get in their reproductive time. Through education, and women empowerment, most women get married late consequently this allows them to have a few children; this might be the case also in this study, since majority (47%) of the farmers had tertiary education. On the other hand, findings from studies done where the land holding is high have indicated higher proportions of household land size (Samkange et al 2018).

The level of education of the farmer will contribute significantly to decision making. In this study, majority of the poultry farmers had college/university education indicating that they are highly educated. Through education and continuous trainings, farmers will be better informed when it comes to decision-making, be it which farming activity to venture in, field of poultry health, management, efficiency, processing and keeping up to date with competitors. Education levels also determines the quality of farmers skills, their allocative abilities and how well they are informed about the new innovations and technologies around them and how faster they can recognize business opportunities around them (Moige 2014, Atela et al 2016). On the other hand this can also be associated with lack of employment, forcing even those who have the highest level of education to take on poultry farming since it requires low capital and input to start (mottet and Tempio, 2019). Contrary to our findings, a study by Samkange et al (2018) reported the lowest proportion of 2.9% of farmers with tertiary level education involvement in poultry farming respectively.

Diversification of enterprises venture is critical especially to low and medium income farmers as this enable them to do re-allocation of some of a farm's productive resources, such as land, capital and farm equipment among other available resources for generation of additional income in a more sustainable manner. In this study, majority of the farmers engaged in other agricultural activities such as crop and other livestock farming apart from practicing poultry farming This may be attributed to the fact that farmers usually want to add more income to their farm earnings. This result agrees with the findings of Moige (2014), who indicated that it is common for some farm household to engage in multiple farming enterprises to complement their earnings from farming occupation for their livelihood. Additionally, the favorable climatic conditions in the study area favor many farming enterprises (Moige 2014).

*b) Common poultry diseases, signs and their impact*

Diseases and parasites are the main hindrances to success in raising poultry and most common health problems can be avoided through preventative management. In this study, Newcastle disease, internal parasites and Salmonellosis were the most common diseases in the farmers' flocks. Small scale poultry farms are believed to have very limited bio-security practices, use little vaccination, often host multiple poultry species and have higher contact rates with wild birds or foraging areas frequented by wild birds, which increases their susceptibility to diseases. In

this study also, farmers practiced the extensive production system of rearing where the birds are allowed to scavenge freely, subsequently mixing with neighbor's flocks, the very low numbers of farmers who vaccinate their birds and failure of vaccines to work effectively. Our findings are in agreement with Mutinda et al (2019) and Ogada et al 2016 in Kenya who reported that diseases were the major limitation in poultry production

The results indicates majority of the farmers seeing greenish diarrhea followed by presence of worms in the faeces as the main signs of disease in their farms. This is a clear indication that farmers are able to identify signs of diseases in their flocks and initiate treatment in these areas where poultry diseases are diagnosed using clinical signs. Additionally, most farmers in the study area are literate and have been trained on poultry disease management. Our findings are not different from the results reported by Ogada et al (2016) in Kenya that in disease diagnosis, poultry farming relies heavily on the use of clinical signs due to unavailability of laboratory services. Further the study indicated that Newcastle disease was the most common disease encountered during the study time in Kenya.

Disease and predators are known to be the major causes of mortality in the poultry farming. In this study, diseases accounted for the largest proportion of overall flock mortality (29.5%) while predation contributed to 25%. Newcastle disease (29.3%), internal parasites (16.0%) and Salmonellosis (12.8%) are the most important diseases identified, while predators such as snakes, rats, dogs, cats and foxes are the main causes of losses especially in young birds. Thefts are important cause of loss of adult birds. The fact that majority of the farmers practiced free range farming where birds are left to scavenge and roam freely; it makes birds be prone to diseases and predators. A study conducted by Moige, (2014) indicated that predators and poultry diseases contributed to poultry losses which also agree with our findings.

*c) Poultry disease management*

Farmers acknowledged that diseases are the major cause for the loss of chicken. Most farmers treat their chicken themselves and only few of them have access or used veterinary services. To treat their sick chickens, most of the farmers use both conventional and local medicinal herbs, which are usually administered through drinking water, whereas few use modern medicine (Table 5 and 6). This can be explained by the high prices of poultry drugs compared with local medicinal herbs which are cheap and easy to administer and the fact that the farmer need to observe the withdrawal period during the administration of conventional drugs. This finding is similar to findings of Samkange et al 2018 in Namibia who reported the high proportions of farmers using local medicinal herbs to treat their birds when they are sick.

A small proportion (12.5%) of the farmers in the study consulted a veterinarian when the birds were sick while the rest treated their birds without the veterinary input. This can be attributed to the unavailability and high cost of veterinary services. The extension linkage between the experts and the farmers are found to be extremely weak. This is because, currently, extension services in Kenya are farmer demand driven. The result clearly reveals that provision of extension services is poor in the study area. These results also concur with the findings of Augustine et al (2014) who documented poor extension services as being among the challenges facing poultry production in Nigeria. Poor Management of poultry diseases has also been reported in various studies (sambo et al 2015, mutinda et al 2019, Silva et al 2020).

In a free-range poultry system, there are increased bio-security risks, due to more exposure to potential sources of disease and food safety pathogens. Some of the greatest bio-security risks in this kind of a production system are wild birds and animals, rodents and airborne infection and human beings. This practice is important because it prevents the spread of diseases from one farm to another. The results show that majority of the farmers practiced proper disposal of dead birds as a biosecurity measure when they died by burying them deep in the ground. The findings on a general note showed that most bio-security measures were not being implemented properly in the study area. This can be attributed to high cost of disinfectants, high cost of fencing and ignorance. This finding contradicts a report by Augustine et al (2014) that revealed that dead birds were given to pets and people willing to consume them.

The results indicate that most farmers do not vaccinate their birds against the common preventable diseases. In this study, only 38.5% of farmers vaccinated their birds. Most vaccine doses are packaged and available in big quantities which farmers cannot access them in smaller quantities. In addition to this, most vaccines are very expensive, not readily available and have complex methods of storage and application which requires animal health personnel to guide them. This is in line with the report of Augustine et al (2014) in Nigeria and Ogada et al 2016 in Kenya, who indicated that only a small proportion of farmers who make efforts to vaccinate their birds against common preventable diseases.

Few farmers did vaccination against Newcastle disease and this is because Newcastle disease is the most common disease of poultry in Kenya affecting majority of small-scale farmers hence causing huge losses (Mutinda et al 2019). Technology uptake for most farmers can be a challenge and hence hinder poultry vaccination. This is manifested in this study as farmers

indicated that the methods of vaccine application were a major challenge, due to the specific requirements of vaccines in terms of their packaging, availability, storage, transportation, and mode of application.

The use of ethno veterinary medicine in poultry disease management is becoming popular among the small-scale farmers. This is also demonstrated in this study as majority of farmers (49%) used Aloe vera to treat poultry diseases. Considering that most small-scale farmers are poorly endowed with resources, high cost of conventional drugs coupled with the fact that ethno veterinary drugs are cheap, easy to prepare and administer, this was the best alternative for them. Similar findings were also reported by Sambo et al 2015 and Silva et al 2020.

## V. Conclusion

We conclude that diseases and predation are the major cause of mortality and loss of poultry birds in the study area. Newcastle disease is the most important poultry disease encountered by small-scale farmers. Majority of the farmers in the study area manage poultry diseases using various ethno veterinary medicines. Generally, bio-security measures as a means of preventing and controlling poultry diseases was not properly implemented. A small proportion of the farmers vaccinated their birds against common preventable poultry diseases.

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*Conflict of interest*

All authors have declared that they don't have conflict of interest.

## References Références Referencias

1. Apopo A A, Kariithi H M, Ateya L O, Yatinder S B, Jane H S, Thomas D D, Catharine N W, Sonia M H, and Claudio L A 2019 A retrospective study of Newcastle disease in Kenya. Tropical Animal Health and Production, Article 52, 699-710 Retrieved February 16, 2020, from https://doi.org/10.1007/s11250-019-02059-x
2. Atela J A, Ouma P O, Tuitoek J, Onjoro P A and Nyangweso S E 2016 A comparative performance of indigenous chicken in Baringo and kisumu counties of Kenya for sustainable Agriculture. International journal of Agricultural policy and research, volume 4 Article 6, 97-104.
3. Augustine C, Mojaba D I, Neils S S, Ngiki Y U 2014. Assessment of factors affecting the implementation of Biosecurity practices by poultry farmers in Mubi area of Adamawa state, Nigeria. International journal of management and social sciences research, volume 3 Article2, 13-16.
4. Bakare A G, Shah S, Bautista-Jimenez V, Jahangeer A B, Suchindra R D and Madzimure J 2020 Potential of ethno-veterinary medicine in animal health care practices in the South Pacific Island countries. Tropical Animal Health and Production, Article 52, 2193–2203.
5. Balami G A, Ndahi J J, Zaifada A U, Mustapha M, Jarafu D J, Asogwa N Tand Hajara S 2014 A retrospective study of poultry diseases diagnosed in Maiduguri, North-East, Nigeria. Poultry, Fisheries wildlife Sciences, volume2 article 1, 1-4.Retrieved April 20, 2020, from doi:10.4172/2375-446X.1000113
6. Gabanakgosi k, moreki J C, Nsoso S J, Tsopito C, 2012 Ethnoveterinary medicine usage in family chickens in the selected four villages of Botswana. Journal of Veterinary Advances, Volume 2 Article 12, 586-594.
7. Kipkorir kirui 2014 Factors influencing performance of poultry farming projects in Bureti sub-county, kericho, Kenya, (Master's thesis).
8. Lindahl, J. F., Young, J., Wyatt, A. et al. 2019 Do vaccination interventions have effects? A study on how poultry vaccination interventions change smallholder farmer knowledge, attitudes, and practice in villages in Kenya and Tanzania, Tropical Animal Health and Production, Article 51, 213-220,
9. Macharia John Njenga 2017 An analysis of factors influencing demand for poultry and fish feeds in Kenya. (Master's thesis).
10. Moige Norah Nyaiyo, 2014. Effects of climate variability and other factors on the outbreak and spread of Newcastle Disease in Suneka Division of Kisii County. (Master's Thesis).
11. Mottet A & Tempio G (2019) Global poultry production: current state and future outlook and challenges, World's Poultry Science Journal, Volume 73 Article 2, 245-256.
12. Mutinda W. U., P. G. Mbuthia, L. W. Njagi, L. C. Bebora and P.N. Nyaga, 2019. Pathogenicity of Kenyan Infectious Bursal Disease Virus Isolates in Indigenous Chickens. International Journal of Poultry Science, Article 18, 523-529.
13. Nduthu petronilla wanjugu 2015 Social-economics influence on indigenous poultry production projects in Kenya. A case of Machakos indigenous poultry, International journal of education and research Volume 3 Article 1, 1-12.
14. Ogada S, Lichoti J, Oyier P A, Imboma T, Peng M S, Ngeiywa K J and Ommeh S C 2016 A survey on disease prevalence, ectoparasite infestation and chick mortality in poultry populations of Kenya. Livestock Research for Rural Development. Volume

28 Article #12 Retrieved June 7, 2020, from http://www.lrrd.org/lrrd28/12/omme28230.html.

15. Saba Haile and kasa Biratu 2017 Characterization of village chicken production system in Jimma and Ilu Aba zones, South West Ethiopia, International Journal of sustainable Development. Volume 10Article 3, 35-50.
16. Sambo E, Bettridge J, Dessie T, Amara A, Hebte T, Wigley P, Christley M R 2015 Participatory evaluation of chicken health and production constraints in Ethiopia. Journal of Preventive veterinary Medicine, Article 118, 117-127.
17. Samkange A, Masaire E, Madzingira O, Kandiwa E, Mushonga B, Bishi A S 2018 Characterization of poultry production and management systems in communal areas of Namibia. African journal of poultry farming. Volume 6 Article 3, 266-276.
18. Silva, Daniele Cristina de Oliveira Lima da Silva, Ângelo Giuseppe Chaves Alves, Piero Bruschi, Riccardo Bozzi, Henrique Costa Hermenegildo da Silva, 2020 Are medicinal plants an alternative to the use of synthetic pharmaceuticals in animal healthcare in the Brazilian semi-arid? Ethnobotany Research and Applications Volume 19 Article 2, 1-20.
19. Terefe B, Tsegay T G, Niraj K, Habtom K 2018 Assessment of marketing systems, customer preferences and health management of chickens in free-range and intensive poultry production systems in Minjar Shenkora District, Amhara Regional State, Ethiopia, Ethiopian Veterinary Journal. Volume 22 Article 2,14-25.