Participatory epidemiological assessment of factors that limit indigenous chicken productivity under free-range system in south western Kenya

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Abstract

This study used participatory epidemiology (PE) tools and laboratory investigations to assess the factor(s) that limit the productivity of the free-ranged indigenous chickens in south western Kenya. The study was conducted in three Sub-counties in Homabay County. The PE tools included secondary data summary from relevant Government and Non-Government agents within the County, Focus group discussions (FGDs) in 15 randomly study villages using interviews, ranking and visualization tools. Laboratory investigations involved both post mortem examinations and laboratory analysis on chickens that showed signs of disease and fresh carcasses. A total of 180 chickens from 55 households in 9 study villages appropriately fell under this study component.

The farmers demonstrated good understanding on certain aspects of chicken production such as relationship between seasons and disease outbreaks, egg hatchability rate and the size of incubating chicken, among others. The farmers, however, had inadequate knowledge on other important aspects of production such as disease control, feeding, housing and breeding. Diseases were the most important constraint to indigenous chicken production (causing approximately 80% of the total chicken deaths). Newcastle disease, Gumboro and fowl pox ranked as the most important indigenous chicken diseases in order of importance, based on mortality, spread within flocks and impact on household income. Bacterial and parasitic diseases were also important in the chickens. Predation of chicks by birds of prey (eagles and hawks) and animals such mongoose, wild dogs and cats ranked second most important. The third most important constraint was scarcity of feeds; others were poor animal health service delivery, inadequate farmers' skills and poor housing and breeding, in order of importance. More importantly, this study identified Gumboro as one of the most important diseases that lower productivity of the indigenous chickens. Previously the disease was assumed to be important only in the exotic chickens. This study recommends that extension packages that enhance farmers' knowledge and skills on appropriate management techniques in disease control, feeding, housing and breeding be initiated, developed and sustained. Likewise, the farmers' useful knowledge on the indigenous chicken production identified and documented by this study should be considered in future strategies aimed at productivity improvement.

Key words: *focus group discussions, indigenous chicken diseases*

Introduction

Improving productivity of the indigenous chickens; that comprise over 70% of the 32 million domesticated birds and kept mainly by the resource-poor rural families (MALF 2015) is one way of increasing the agricultural production in Kenya. The agricultural sector contributes 25-26% of gross domestic product (GDP) of which 4% is from the poultry sub-sector (KNBS 2015). Indigenous chickens contribute 71% of the total egg and poultry meat produced in Kenya (Nyaga 2007) and therefore impact significantly on the rural trade, welfare and food security of small holder farmers.

There are two distinct poultry production systems in Kenya, namely intensive and extensive. Intensive system is usually found in the urban and peri-urban areas and uses the improved (hybrid) breeds. Indigenous chickens are mainly raised in rural areas under extensive (free-range) system. The production is small-scale and most households use family labour and, where possible, locally available feed resources (MALF 2015).

Chickens under extensive system range freely during the day and find much of their own food; however some little and inconsistent grains/ kitchen left over supplements are given. Housing is done at night, mainly in human dwellings to protect the birds from wild animals and thieves (Wachira et al 2010; Okeno et al 2011). The extensive system exposes the indigenous chickens to harsh conditions such as diseases, predation, inadequate feeding, poor housing and extreme weather changes, resulting in low productivity (Ondwasy et al 2006).

Some studies in Kenya including those of Ondwasy et al (2006) and Okitoi et al (2008; 2009) have shown that a little effort in the management of the indigenous chickens in the area of housing, feeding and animal health care will be able to improve the productivity of the birds in terms of increased flock and clutch sizes, egg production and hatchability.

The indigenous chickens are easier to rear compared to other livestock that require a large capital outlay. Any efforts towards increasing the productivity of these birds will help in poverty alleviation and food security improvement for the majority of the people living in the rural areas, majority being women, children, people living with HIV and those with disability.

Productivity improvement could only be realised when real constraints are identified and effectively addressed (Okuthe 1999). The aim of this study is to determine the factor(s) that limit indigenous chicken productivity; assess and prioritize them.

Materials and methods

Study site

The study was carried out in 15 villages randomly selected from 3 sub-counties namely; Karachuonyo, Kasipul and Kabondo Kasipul in Homa Bay County. Five villages were selected from each of the 3 sub-counties. The three sub-counties that neighbour each other lie between latitudes 0^0 15’ and 45’ south, longitudes 34^0 25’ and 35^0 east.

Study design

The study ran from October to December 2013, starting with secondary data collection on indigenous chicken production situation in the 3 sub-counties from local relevant Government and Non-Government organisations. Important information from the community and other key informants on indigenous chicken production was then gathered using participatory epidemiological tools.Post mortem examinations and laboratory analysis were applied for diagnosis of diseases encountered during the study. The tools are described in later sections.

Focus group discussions

A Focus group discussion (FGD) consisting averagely 12 farmers (men and women), was conducted in each of the 15 study villages. During the FGD exercises, participants were given chance to freely present their views on indigenous chicken production with minimum restrictions. The group discussions were conducted in the local *Luo* language that was understood by all farmers participating in the exercises. Research team applied semi-structured interviews guided by checklists to facilitate the FGDs. Research team comprised of the authors and a village elder who led the team during the interviews and transect walks.

The facilitators played a more passive role of listening and learning whilst farmers played more active roles of teachers. This led to active participation by farmers in the form of production of community resource maps, seasonal calendars, Venn diagrams and constraints ranking and scoring using local materials i.e. maize and beans. The active participation resulted in a free flow of information as the farmers felt they were part of the discussion.

Key informant interviews involving local provincial administration officials, Ministry of Livestock extension officials, prominent farmers, agro-veterinary shop owners and private animal health service providers were conducted before or after the group discussions, as opportunity arose. The interviews were also guided by checklists.

The selection of participants for the discussions in every study village was random, and invitations were sent through village leaders two weeks before the exercise date. The venues for the FGDs were agreed upon after consultations between the research team and respective village leaders.

Semi-structured interviews

Semi-structured interviews guided by checklists as described by Ghirroti (1993), Chambers (1994), Catley et al (2002; 2012) and Catley (2006) were used during informal interviews, key informant interviews and focus group discussions to collect general information about the indigenous chicken production situation in the study area. The technique captured the farmers' perception and knowledge on constraints to indigenous chickens, common indigenous chicken diseases and names, disease control, feeding, housing, breeding and chicken products and utilization.

Seasonal calendar

Seasonal calendar technique as described by Catley et al (2002), Okuthe et al (2003) and Catley (2006) was used to find traditional (indigenous) season names, their period and relation with onset of different events such as chicken diseases, chicken feeds availability and agricultural activities. This tool was important in establishing relationship between risk factors and disease occurrence patterns.

Ranking tools

Participatory epidemiological scoring and ranking tools as described by Mariner and Paskin, (2003), Catley (2006), Rufael et al (2008) and Swai and Neselle (2010) that included simple ranking, proportional piling, pair-wise ranking, matrix scoring and disease impact matrix scoring, were used to identify and rank six indigenous chicken productivity constraints in order of importance. The diseases were ranked based on mortality, transmission within the flock and impact on household income. Matrix scoring technique was used to determine whether or not indigenous names of chicken diseases as applied by the community were similar to what the same diseases were in conventional veterinary system, based on clinical syndromes presented by the participants.

Venn diagrams and community resource maps

Venn diagrams and resource map tools as described by Okuthe et al (2003) were used to present important collaborators/ stakeholders in the poultry sub-sector and major features in the study villages, respectively.

Transect walk

A transect walk as described by Okuthe et al (2003) was applied for direct observation of major features within study villages, production systems, among others. The tool further triangulated data collected through other tools. The information already mentioned by the farmers was probed as and when necessary during the transect walk exercises.

Laboratory investigations

Post mortem and laboratory analysis was done on birds presenting signs of disease and freshly dead carcasses whenever opportunity arose, to diagnose the diseases. A total of 180 chickens from 55 households fell under this study component.

Post-mortem examinations and sample collection

Post-mortem examinations were done following standard procedures; according to Chalton *et al* (2006) on sick and dead chickens (fresh carcasses); and appropriate laboratory samples taken to the Virology, Bacteriology and Parasitology laboratories, Department of Veterinary Pathology, Microbiology and Parasitology, University of Nairobi, for confirmatory diagnosis.

Samples for both viral and bacterial isolations included pooled oropharyngeal-cloacal swabs, and swabs from liver and/or other organs showing pathology. The samples for virology and bacteriology were transported in minimum essential medium (MEM) and Stuart medium, respectively.

The entire gastrointestinal tract (GIT) system and the whole or part of the skin (depending on size of the bird) were collected and transported in 70% alcohol (for preservation) for the isolation of endoparasites and ectoparasites, respectively. The laboratory samples were transported and stored under recommended temperatures of 0^0 to 4^0C

Newcastle disease diagnosis

Newcastle disease serological testing

Blood from the jugular vein was collected into universal bottles without anticoagulant. Serum samples were separated from respective clotted blood samples by centrifugation at 500 rpm for 15 minutes, and then heated at 56^0C for 30 minutes to inactivate nonspecific haemagglutination inhibitors. The serum samples were then decanted, aliquoted into screw capped vials. The serum samples were used for the determination of the Newcastle antibody titres using haemagglutination- inhibition (HI) test. Titre is positive if there is inhibition at a serum dilution of 2^4 or more against 4 Hemagglutination assay (HA) units, or 2^3 or more against 8 HA units (OIE 2000). Positive serology and clinical signs in unvaccinated birds are strong diagnostic evidence of ND especially in situations where virus isolation is not possible. For the use of HI and other tests in measuring immune status of vaccinated birds, mean level of HI titres ranging from $2^4 – 2^6$ after a single live vaccine to $2^9 – 2^{11}$ with multiple programme are expected (Alexander 2003).

Newcastle disease virus isolation

A mixture of cloacal and oro-pharyngeal swabs was prepared and inoculated into Allantoic sac of 10 to 12 day-old specific pathogen free (SPF) embryonated eggs for virus isolation as described in OIE (2000) manual. Virus detection was done using haemagglutination test as described by OIE (2000).

Gumboro disease diagnosis

Diagnosis of Gumboro disease was based on post mortem findings. Haemorrhagic streaks on thigh and/or breast muscles; enlarged bursas of Fabricius; distended urinary tubules filled with urates; liver showing/exhibiting a cooked appearance (Saif et al 2003).

Fowl pox disease diagnosis

Fowl pox disease diagnosis was based on clinical findings. Proliferative lesions in the skin (cutaneous form) of the head, neck, legs and other parts of the body; that progressed to thick scabs and by lesions in the upper Gastro-intestinal and respiratory tracts (diphtheritic form) (Saif et al 2003).

Bacteriological and parasitological isolations and characterization

Bacteria were isolated and characterized according to Krieg and Holt (1994). Both ecto- and endo-parasites were characterized as per Permin and Hansen (1998).

Disease diagnosis and ranking

The farmers presented clinical signs of the diseases present in the area; these were subsequently used by veterinary specialists (investigators) to give tentative diagnosis. Farmers then ranked the diseases in order of mortality, spread and impact on household income. Where possible, samples were collected from either sick birds or fresh carcasses (fresh deaths), for laboratory confirmation of the diseases.

Weighting of constraints and disease rankings

Constraints and disease ranking were weighted by awarding scores from 1-6 and 1-3, respectively, to each respondent. Thus, the first, second, third, fourth, fifth and sixth ranking constraint was awarded 6, 5, 4, 3, 2, and 1 scores, respectively, while the first, second and third major disease was awarded 3, 2 and 1 scores, respectively. The cumulative sum of all the responses was then considered as the weighted score for the particular constraint. Thus the constraint with largest score was considered to be the most important.

Data management, quality assurance and analysis

Several methodologies were used to cross-check, validate, and analyse the data at different stages of the process of information gathering:

- Probing was done during the semi-structured interview (SSI) to determine internal consistency of the information provided by the informants. Analysis was being conducted by asking additional questions that were not in the check list initially to get clarification on certain issues.

- Triangulation was used to compare evidence collected by different methods and sources of information. The analytical process was used to explore the patterns and coherence between all information provided, as well as to understand the bias of different informants. Triangulation was very useful when comparing observations and information collected while conducting a transect walk with 1 or 2 key informants through the villages with information collected during SSI and/or a participatory mapping exercise.

Results

Participatory epidemiological study

The whole study duration, from the preparation stage to the last activity was two months. The average time for each FGD and transect walk lasted 2.5 and 3.0 hours, respectively, in each of the 15 study villages.

Response from farmers

Almost all the 12 farmers invited for the FGD in every study village turned up. A total of 180 farmers participated in the FGDs in the 15 study villages. The facilitators played a more passive role of listening and learning whilst the farmers played a more active role of teachers. This led to active participation by farmers in the form of production of community resource maps, seasonal calendars, Venn diagrams and constraint ranking using local materials such as maize and beans (as counters). The active participation was a stimulation factor that resulted in a free flow of information as the farmers felt they were part of the discussion although the dominant farmers had to be controlled by the facilitator.

Farmers' knowledge on chicken production aspects

General

Indigenous chicken production was important to the farmers in terms of rural poverty and food insecurity alleviation in all study villages. The chickens were reared under free-range system, whereby birds of all age categories fed together. Women and children did most of the daily management activities related to indigenous chickens. Most decisions to treat and dispose the chickens were done by women.

Indigenous names of chicken diseases

Farmers used clinical syndromes/signs to describe most of the diseases i.e. *aput* (pox lesions) for fowl pox, *ajujo* (drooping wings/ ruffle feathers) for Gumboro, *diep ralum* (green diarrhea) for Newcastle, *diep rachar* (white diarrhea) for fowl typhoid,*diep remo* (bloody diarrhea) for coccidiosis, *njoha* (worms) for helminthes, *okwodo* for ticks, *omboto* for flea, *oyuech* for mite and *nywogo* for lice. Matrix scoring technique marched this disease signs with conventional veterinary names.

Seasonal patterns of indigenous chicken diseases

Table 1 presents seasonal patterns of indigenous chicken diseases constructed by the FGD participants during the study. The pattern was almost similar in all the study villages, except for 3 villages that reported Newcastle disease in March to April and November to December, and 2 study villages that reported Gumboro from June to July.

Table 1. Seasonal occurrence of indigenous chicken diseases in the 15 study villages

Disease	Time of the year
Newcastle	February-May and October to December
Gumboro	March-July
Fowl pox	April- July
Fowl typhoid	As Newcastle disease
Coccidiosis	Throughout the year

Periods between December to mid-February and late June to mid-August were reportedly dry. Long rains were reported from late February to late June, while short rains were received from late August to November thus, planting and crop weeding seasons, respectively, fell within the time. Sometimes erratic rainfall came in December, but this was reportedly never much. Crop harvesting was reported in the months of August, September and January; the months of abundant food for both human and chickens. Cold weather reportedly occurred in June and July each year.

Egg incubation and hatchability rate

Semi-structured interviews during FGDs and with key informants in all the study villages revealed that farmers were well aware of the proportional relationship between the size of incubating hen to the number of eggs set for hatching and hatchability rate. All the 15 FGDs reported that bigger hens were able to incubate successfully even over 17 eggs at once with optimal hatchability rate. It is worth noting that indigenous chicken production mainly depends on hens for egg incubation.

Constraints ranking

The ranking of constraints by the FGDs was similar in all the 15 study villages with respect to diseases, predation and poor nutrition (Table 2). Diseases were ranked most important, followed by predation in chicks, and scarcity of feeds ranked third. Other constraints were, however, ranked slightly different by different villages. Ten of the study villages did ranking from fourth position as poor animal health service delivery, inadequate skills among farmers, poor housing and poor breeding; in order of importance. Three of the remaining 5 study villages, however, only ranked poor housing and poor breeding as the fourth and fifth constraints, respectively, and stopped there. One of the two remaining study villages only added poor breeding as fourth constraints to its list and stopped there. The remaining one study village only listed and ranked diseases, predation and scarcity feeds, in order of importance. Therefore, using weighting method, overall ranking of constraints was disease as the most important; the others were predation in chicks, scarcity of feeds, poor animal health service delivery, inadequate farmers' skills, poor housing and poor breeding, in order of importance (Table 2).

Table 2. Constraints ranking during FGDs in the 15 study villages

Constraints	Study villages															Score	Rank
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**		
Diseases	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	90	1
Predations in chicks	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	75	2
Scarcity of feeds	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	60	3
Poor animal health services	-	-	4	-	4	4	4	-	4	4	4	4	4	-	4	30	4
Inadequate farmers' skills	-	-	5	-	5	5	5	-	5	5	5	5	5	-	5	20	5
Poor housing	4	-	6		6	6	6	4	6	6	6	6	6	4	6	19	6
Poor breeding	5	-	7	4	7	7	7	5	7	7	7	7	7	5	7	9	7

Disease ranking

In the constraint ranking, disease emerged as the most important challenge to the indigenous chicken production. Tables 3, 4, 5 and 6 present the results of the indigenous chicken disease ranking by the participants during the FGDs in the 15 study villages. Newcastle was the most important disease in terms of mortality, spread within flock and impact on household income. Gumboro disease ranked second most important based on the same criteria, while Fowl pox ranked third. Fowl typhoid was fourth, while other important diseases/ conditions were coccidiosis, Helminthosis and tick, louse, mite and flea infestations.

Table 3. Disease ranking by the 15 study villages based on mortality

Indigenous chicken diseases	Study villages (15 in number)															Score	Rank
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**		
Newcastle *(diep ralum)*	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	43	1
Fowl typhoid *(diep rachar)*	4	4	4	4	4	4	5	2	4	4	4	4	3	3	3	5	4
Gumboro *(ajujo)*	2	2	3	1	2	2	4	3	2	2	2	3	1	2	2	27	2
Fowl pox *(aput)*	3	3	2	3	3	3	3	4	3	3	3	3	4	4	5	10	3
Coccidiosis *(diep remo)*	5	5	5	5	6	7	2	5	5	5	5	2	5	5	4	-	5
Helminthosis *(njoha)*	6	6	6	7	5	5	6	6	6	6	8	5	5	7	6	-	6
Tick infestation *(okwodo)*	7	7	7	7	7	6	7	8	7	7	7	7	7	9	7	-	7
Louse infestation *(nyuogo)*	9	8	8	8	8	8	10	7	8	8	8	8	8	8	8	-	8
Mite *(oyuech)*	8	9	9	9	10	10	9	9	9	10	10	10	9	9	9	-	9
Flea *(omboto)*	10	10	10	10	9	9	10	10	10	9	9	10	10	10	10	-	10

Table 4. Disease ranking by the 15 study villages based on transmission within the flocks

Indigenous chicken diseases	Study villages (15 in number)															Score	Rank
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**		
Newcastle *(diep ralum)*	1	1	1	3	1	4	1	1	1	3	1	1	2	1	3	27	1
Fowl typhoid *(diep rachar)*	3	4	4	4	4	1	3	4	4	4	2	4	4	4	4	7	4
Gumboro *(ajujo)*	2	2	2	2	2	2	2	3	2	2	4	3	1	2	2	27	2
Fowl pox *(aput)*	4	3	3	1	3	3	4	2	3	1	3	2	3	3	1	21	3
Coccidiosis *(diep remo)*	5	6	5	5	6	7	2	5	5	5	5	2	5	5	4	-	5
Helminthosis *(njoha)*	6	5	6	7	5	5	6	6	6	6	8	5	5	7	6	-	6
Tick infestation *(okwodo)*	7	7	7	6	7	6	7	8	8	7	7	7	7	6	7	-	7
Louse infestation *(nyuogo)*	9	8	9	8	8	8	8	7	7	8	8	8	8	8	8	-	8
Mite *(oyuech)*	8	9	8	9	10	10	9	9	9	10	10	10	9	9	9	-	9
Flea *(omboto)*	10	10	10	10	9	9	10	10	10	9	9	10	10	10	10	-	10

Table 5. Disease ranking by the 15 study villages based on Impact on household income

Indigenous chicken diseases	Study villages (15 in number)															Score	Rank
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Newcastle *(diep ralum)*	1	1	1	1	1	1	1	1	1	1	1	3	1	1	3	41	1
Fowl typhoid *(diep rachar)*	3	4	4	2	4	4	3	3	4	3	4	4	4	4	2	8	4
Gumboro *(ajujo)*	2	2	2	4	2	2	2	2	2	2	2	2	2	2	4	26	2
Fowl pox *(aput)*	4	3	3	3	3	3	4	4	3	4	3	1	3	3	1	15	3
Coccidiosis *(diep remo)*	5	6	5	5	6	5	5	5	5	5	5	5	5	5	5	-	5
Helminthosis *(njoha)*	9	9	9	9	10	7	9	9	9	10	10	10	9	9	9	-	9
Tick infestation *(okwodo)*	8	8	9	8	8	8	8	7	10	8	8	7	8	8	10	-	8
Louse infestation *(nyuogo)*	7	7	7	6	7	6	7	8	8	7	7	8	7	6	8	-	7
Mite *(oyuech)*	6	5	6	6	5	10	6	6	6	6	8	5	5	7	6	-	6
Flea *(omboto)*	10	10	10	10	9	9	10	10	7	9	9	10	10	10	7	-	10

Table 6. Overall ranking of the indigenous chicken diseases in the 15 study villages

Indigenous chicken diseases	Mortality	Transmission within the flock	Impact on household income	Scores	Rank
Newcastle *(diep ralum)*	1	1	1	9	1
Fowl typhoid *(diep rachar)*	4	4	3	1	4
Gumboro *(ajujo)*	2	2	2	6	2
Fowl pox *(aput)*	3	3	4	2	3
Coccidiosis *(diep remo)*	5	5	5	-	-
Helminthosis *(njoha)*	6	6	9	-	-
Tick infestation *(okwodo)*	7	7	8	-	-
Louse infestation *(nyuogo)*	8	8	7	-	-
Mite *(oyuech)*	9	9	6	-	-
Flea *(omboto)*	10	10	10	-	-

Disease control

The study revealed that animal health service delivery was poor in all villages. Proportional piling technique applied during the FGDs in the 15 study villages indicated that less than 30% of the indigenous chicken farmers received animal health services from either Government or private sector, while about 60% of the farmers used herbs (mainly *Aloe Vera*, pepper and sisal leaves) for the treatment and control of indigenous chicken diseases. About 6% of the farmers used human drugs (particularly tetracycline capsules and *flagyl* tablets) for the treatment of their chickens.

The same techniques showed a proportion of 30% Newcastle vaccine, 30% oral antimicrobial drugs and 30% oral multivitamin products; as products farmers bought on their own from Agro-veterinary shop for indigenous chicken disease control.

The study further established that 100% of the farmers had knowledge of the availability of Newcastle and fowl pox vaccines, while only 50% and 10% were aware of the availability of fowl typhoid and Gumboro vaccines, respectively, in the market.

Predation and housing situation

Common predators identified were the mongooses, hawks, eagles, stray dogs and cats. The hawks and eagles were found to be the second major killers of young growers and chicks after diseases. The mongooses and stray cats and dogs, though second to hawks and eagles, were important predators across all the age categories, some even ate eggs.

Only a few households had housing structures for their indigenous chickens; most of which were tiny and sketchy in make (made of pieces of old iron sheets) and were only used to shelter few birds from hot sun during the day. All households allowed their chickens of all age groups to roam about in the home stead during day time and housed them at night; either in the human dwellings or kitchens. The birds were never left alone in the chicken houses at night because the structures were not strong enough to keep away thieves and night predators.

Feeding situation

The chickens got most of their feed requirements from scavenging around the home stead, where they could eat plant leaves and seeds, insects and any other edibles within range. The birds got plenty of food during harvesting seasons i.e. in August and September, and January each year. The birds lived mainly on scavenged food during the other months of the year, except in some few households where little quantities of grains and kitchen left over was inconsistently provided as supplements. Most of the households provided drinking water for their birds throughout the year.

Laboratory investigations

Newcastle disease

Most of the sick birds had green diarrhoea and respiratory distress and on post mortem examinations, proventriculus had haemorrhages. Of the 180 chickens tested, Newcastle disease virus was isolated from 36 birds (20 %).

Gumboro disease

About 80 % of birds examined showed typical lesions for Gumboro disease at post mortem; these included haemorrhagic streaks on thigh and/or breast muscles, enlarged bursas of Fabricius, extended urinary tubules filled with urates and liver showing a cooked appearance (Saif et al 2003).

Fowl pox

Approximately 40% of the birds sampled for post mortem exhibited typical pox lesions. These included proliferative lesions in the skin of the head, neck and legs that progressed to thick scabs and diphtheritic lesions in the upper gastro-intestinal and respiratory tracts.

Parasitological isolations

Over 70% of the parasitic infestations were mixed infections (Table 7).

Table 7. Prevalence of parasitological isolations in indigenous chickens in 9 of the study villages

Parasites	**Prevalence (%)**	**Where isolated from**
Ectoparasites		
Knemidocoptes nutants (mite)	33	Scaly legs
Echinophaga gallinacea (stick tight flea)	33	Mainly around the eyes
Endoparasites		
Ascaridia galli	50	Small intestine
Heterakis isolonche	67	Caecum
Tetrameres fissispina	17	Proventriculus
Dispharynx nosuta	33	Proventriculus
Tapeworms		
Raillietina echinibothrida	33	Intestine
Flukes		
Echinostoma revolutum	16	Caecum

Bacteriological isolations

Table 8 shows the bacteria (and their respective prevalence) isolated from the indigenous birds in the study area. Respiratory involvement was mainly caused by *Pasteurella multocida* and *Klebsiella spp. Salmonella gallinarum* was also isolated from liver and spleen swabs of a few birds showing signs of peritonitis. Other bacteria isolated included: *Staphylococcus spp, Bacillus spp* and *E. coli*; they were mainly visceral. The prevalence of *Bacillus spp* and *Pasteurella multocida were* 66.7% and 50%, respectively. Most of the birds had mixed infections. Bacteriological isolation from yellowish granules observed in the abdomen in some of the chickens yielded *Bacillus* species. Some chickens had whitish diarrhoea (33%).

Table 8. Prevalence of bacterial isolates from indigenous chickens indicating organs from which isolated in 9 of the study villages

Organism	**Prevalence (%)**	**Organs isolated from**

Salmonella gallinarum)	17	Liver and spleen swab; Peritonitis
Staphyylococcus spp	17	Oro-pharyngeal swab; Liver
Pasteurella multocida	50	Oro-pharyngeal swab; Respiratory tract
Klebsiella spp	33	Oro-pharyngeal swab; Lung
Bacillus spp	67	Oro-pharyngeal swab; Lung
Escherichia coli	17	Oro-pharyngeal swab; Liver

Fungal isolation

Aspergillus fumigatus was isolated from one chicken with signs of defeathering and wounds. Screening of the chickens for mange gave negative results.

Discussion

This study identified and prioritized important constraints to indigenous chickens and at the same time determined the farmers' general perceptions on the production of the chickens in the study area. Indigenous chicken farmers were found to be quite knowledgeable on various aspects of chicken production. A matter that should always be considered in strategies aimed at improving the productivity of the birds.

It was established that indigenous chickens contribute to household income and malnutrition alleviation and are kept by almost every household in the study area. Most of these households are resource-poor and mainly depend on subsistence agriculture for a living.

This study ranked diseases as most important constraint to indigenous chicken production. The finding compares well with several others, including Okeno et al (2011) in Kenya, Aboe et al (2006) in Ghana and Yakubu (2010) in Nigeria. Predation was ranked second most important constraint agreeing with the findings by Okuthe (1999). Other important constraints identified: scarcity of feeds, poor animal health service delivery, inadequate farmers' skills, poor housing and poor breeding are typical of the free-rage indigenous chicken production in most developing countries; as reported by others including Ondwasy et al (2006) and Wachira et al (2010) in Kenya and Gondwe and Wollny (2005) in Malawi and Mohammed et al (2005) in Sudan.

The use of PE tools that captured the communities' perception was justified since previous improvement efforts based only on conventional research approaches have never borne any desired results, with productivity persistently remaining low over the years in the study area. This study therefore captured farmers' views and suggestions on possible way forward, while at the same time focusing on reasons for past failures with a view to avoid them in future productivity improvement strategies.

This study was the first to categorically construct a comprehensive seasonal pattern of major/ common indigenous chicken diseases in the study area. This information will no doubt form important basis for the formulation of indigenous chicken disease control processes in the region.

The pattern showed that most indigenous chicken diseases occurred during feed scarcity and wet and cold months of the year. Feed scarcity and extreme weather conditions are known to be stressor factors that usually compromise the immunity of the birds; making them susceptible to disease challenges (Wachira et al 2010). Planting of crops takes place during rainy seasons and most farmers prefer confining theirs birds to avoid crop destruction and conflicts with neighbours. This further worsens the situation and the birds get stressed the more since they are used to free-ranging.

Several studies including Njagi et al (2012) and Njue et al (2001) have shown that stressed birds have poor immune response to infections to the extent that, even less virulent pathogens can cause severe clinical disease in the birds that are stressed. This could lead to outbreak of some diseases.

Heavy losses currently experienced in the indigenous chicken production in the study area would only be controlled when major aspects of production such as disease control, housing and feeding are addressed. However, these aspects were still poorly being handled in the study area. For instance, the housing structures being used by most households could not keep night predators and thieves away. In certain cases due to poor housing, hens could lay and incubate their eggs on spots unknown to owners, and often ended up being eaten by wild animals or stolen (Ndegwa et al 1998). This reduces the number of eggs that could have been used for hatching, sales and home consumption.

Improving feeding on the other hand would improve productivity. Well-fed birds are resistant to most common infections and hence deaths from diseases would always go down. This was clearly demonstrated by the seasonal patterns of diseases constructed by this study. Low or no major disease incidence was reportedly occurring in the months of August, September and January; the harvesting months with plenty of food for the chickens. The birds were less stressed with competent immunity to fight infections.

The study noted that qualitative procedures enabled the investigator to fully interact with farmers, a phenomenon that enhanced the development of confidence between farmer and researcher and continuity of commitment, by stakeholders in the project. This agrees with report by Okuthe et al (2003).

Post mortem examinations and laboratory analysis results showed carriage of various viruses, bacteria, endoparasites and ectoparasites by the chickens that were studied. These organisms were associated with various pathological lesions seen at post-mortem examination. Some birds showed mixed infections of worms, in addition to the viral and bacterial loads; some had lots of worms. Parasites are known to cause stress through nutrient consumption, blood sucking and irritations.

The severity of other conditions like pneumonia, salmonellosis, may be as a result of the Gumboro disease, clinical and/or subclinical, since it destroys immune-competent cells leading to immunosuppression (Saif et al 2003). This may have been coupled with the effect of the heavy parasite burden observed. Apart from immunosuppression, stress caused to the birds as a result of viral, bacterial, endo- and ecto-parasitic heavy burdens reduces the birds' productivity, be it number of off-springs, meat or egg (Otim et al 2005; Njagi et al 2012). Thus efforts need to be made to reduce the stress so as to allow the birds yield more products. It is important to note that most of the diseases identified and prioritized by farmers using PE tools as most important indigenous chicken killers were confirmed to be so by the post mortem examinations and laboratory investigations. This strongly suggests that farmers are rich in knowledge and their opinion in production should be listened to by researchers and extension agents.

Conclusions

- Indigenous chicken production is an important undertaking in south western Kenya and plays key socio-economic role and largely contributes to community livelihood in terms of poverty and protein malnutrition alleviation.

- The chickens were reared under free-range system, whereby birds of all age categories fed together.

- Women and children did most of the daily management activities related to indigenous chickens.

- Most decisions to dispose the chickens were done by women. Although most of the indigenous chicken owners lacked appropriate knowledge on the improved indigenous chicken production, they owned valuable knowledge that should inform future strategies aimed at improving the productivity of the birds.

- This study identified diseases, predation in chicks and inadequate feeding, in order of importance, as the major constraints to indigenous chicken production. Newcastle, Gumboro and fowl pox diseases ranked most important, in that order.

- Other important constraints in order of importance were poor animal health service delivery, inadequate farmers' skills, poor housing and poor breeding. Mitigation strategies that will effectively address the identified constraints will no doubt boost the indigenous chicken production in the study area.

Implications

1. Strategy towards improving productivity of indigenous chickens should include enhancement of knowledge and skills of indigenous chicken farmers on technologies related to disease control, housing, feeding and breeding improvement. This will involve the key service providers that include the extension officers and private and public animal health service providers. The current capacity of the service providers is low in the County as a whole and therefore, more staffing should be provided by the County government. The improvement in housing implies that the farmers invest in constructing the houses that might be a challenge to resource poor poultry owners.

2. Since women and children dominated most of the activities around indigenous chicken production, extension programmes targeting women and children in the form of farmer field schools (FFS) and school agriculture clubs, respectively, should be initiated and subsequently established, developed, implemented and sustained. Gender main streaming will be key in the implementation of this recommendation and therefore resources to meet this should be provided for through the necessary arms of government both at county and national levels.

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References

Aboe P A T, Boa-Amponsem K, Okantah S A, Butler, E A, Dorward P T and Bryant M J 2006 Free-range village chickens on the Accra Plains, Ghana, Their Husbandry and Productivity, Tropical Animal Health and Production, Volume 38, pp. 235-248.

Alexander D J 2003 Newcastle disease, other avian paramyxoviruses and pneumovirus infections, In: Disease of poultry, 11th ed. Y M Saif, H J Barnes, C W Beard, W M Reid and H W Yoder (eds) Iowa State University Press, Ames, Iowa, Pp. 63-92.

Catley A, Osman J, Mawien C, Jones B A and Leyland T J 2002 Participatory analysis of seasonal incidences of diseases of cattle, disease vectors and rainfall in southern Sudan, Preventive Veterinary Medicine, Volume 53, pp. 275-284.

Catley A 2006 Use of participatory epidemiology to compare the clinical veterinary knowledge of pastoralists and veterinarians in East Africa, Tropical Animal Health and Production, Volume 38, pp. 171-184.

Catley A, Alders R G and Wood J L N 2012 Participatory epidemiology: Approaches, methods, experiences, The Veterinary Journal, Volume 191, pp. 151–160, Published by Elsevier Ltd.

Chalton B R 2006 Necropsy of the fowl, In: A J Bermudez, M Boulianne, D A Halvorson, J S Schrader, L J Newman, J E Sander and P S Wakennell (eds.), Avian diseases Manual, 6 th edition, American Association of Avian Pathologists, Pp. 232-233.

Chamber R 1994 The Origins and Practice of Participatory Rural Appraisal, World Development, Volume 22, pp. 953-969.

Ghirroti M 1993 Rapid appraisal: Benefiting from the experience and perspectives of livestock owners, World Animal Review, Volume, 77, pp. 26-37.

Gondwe T N and Wollny C B A 2005 Evaluation of Growth Potential of Local chickens in Malawi, International Journal of Poultry Science, Volume 4, pp. 64-70.

KNBS 2015 Economic survey for 2015 Ministry for State for Planning, National Development and Vision 2030

Krieg N R and Holt S G (eds) 1994 Bergey's Manual for Systematic Bacteriology, 1994 edition, Volume 1, (Williams and Wilkins, Baltimore).

Mariner J C and Paskin 2003 Manual on Participatory Epidemiology, Methods for the collection of action-oriented epidemiological intelligence, Food and Agriculture Organization of the United Nations (FAO) Animal Health Manual No. 10. FAO, Rome.

MALF 2015 Ministry of Agriculture, livestock and Fisheries, Annual report 2015, Republic of Kenya

Mohammed M D, Abdalsalam Y I, Kheir A M, Jin-yu W and Hussein M H 2005 Comparison of the Egg Characteristics of Different Sudanese Indigenous chicken types, International Journal of Poultry Science, Volume 4, pp. 455- 457.

Njagi L W, Nyaga P N, Bebora L C, Mbuthia P G and Minga U M 2012 Effect of Immunosuppression on Newcastle Disease Virus Persistence in Ducks with Different Immune status, ISRN Veterinary Science, Volume 2012, Article ID 253809, 6 pages, DOI: 10.5402/2012/253809, http://www.isrn.com/journals/vs/2012/253809 date 24/01/2012.

Njue S W, Kasiiti J L, Macharia J M, Gacheru S G and Mbugwa H C W 2001 A survey of the disease status of village chicken in Kenya, In: Livestock community and Environment, Proceedings of the 10th conference of the Association of Institutions for Tropical Veterinary Medicine, Denmark, 2001.

Ndegwa J M, Tchome P, Kabuage L, Mukiibi-Muka G and Kosgey I S 1998 Improvement of indigenous poultry production in sub-Saharan Africa, Paper presented at the International Course on Intensive Poultry Production held at Centre for International Agricultural Development Co-operation (CINADCO), Tel-Aviv Israel, 4th March 1998 to April 1998.

Nyaga P 2007 Poultry sector country review, Food and Agriculture organization of the United Nations, Animal Production and Health Division, July 2007.

Office International des Epizooties (OIE) 2000 Newcastle disease, In: Mannual of standards for diagnostic tests and vaccines, 4th ed. OIE, Paris, Pp. 221-232.

Okeno T O, Kahi A and Peters J K 2011 Characterization of Indigenous Chicken Production Systems in Kenya, Household Flock Structures, Dynamics and Breeding Practices, Tropical Animal Health and Production, DOI: 10.1007/s11250-011-9942-x.

Okitoi L O, Kabuage LW, Muinga R W, Mukisira E A, Badamana M S 2008 Nutrition and Feeding Strategies for Indigenous Chickens in Extensive Management Systems, A Review, East African Agricultural and Forestry Journal, Volume74, 1&2, 2008.

Okitoi L O, Kabuage L W, Muinga R W and Badamana B S 2009 Intake of nutrients from scavengeable resources by scavenging chickens supplemented free choice with protein and energy. Livestock Research for Rural Development. Volume 21, Article #205. http://www.lrrd.org/lrrd21/12/okit21205.htm

Okuthe S O 1999 Participatory epidemiology assessment of livestock production constraints in the Western Kenya Highlands, PhD Thesis, University of Reading, United Kingdom.

Okuthe S O, Mcleod A, Otte J M and Buyu G E 2003 Use of rapid rural appraisal and cross-sectional studies in the assessment of constraints in smallholder cattle production system in western Kenya highlands, Onderstepoort Veterinary Research, Volume 70 pp. 237-242.

Ondwasy H, Wesonga H and Okitoi L O 2006 Indigenous chicken production manual, In: KARI Technical Note No. 18, February 2006.

Otim M O, Mukiibi G M, Christensen H, Bisgaard M 2005 Aflatoxicosis, infectious bursal disease and immune response to Newcastle disease vaccination in rural chickens, Avian Pathology, Volume 34 pp. 319-323.

Permin A and Hansen J W 1998 *Epidemiology, Diagnosis and Control of poultry parasites* , In: Animal Health Manual, Rome, FAO.

Rufael T, Catley A,Bogale A, Sahle M, Shiferaw Y 2008 Foot and mouth disease in the Borana pastoral system, southern Ethiopia and implications for livelihoods and international trade, Tropical Animal Health Production.40(1), pp. 29-38.

Saif Y M, Barnes H J, Beard C W, Reid W M and Yoder H W (eds) 2003 Diseases of poultry, Iowa State University Press, Ames, Iowa.

Swai E S and Neselle M O 2010 Using Participatory Epidemiology Tools to Investigate Contagious Caprine Pleuropneumonia (CCPP) in Maasai Flockd, Northern Tanzania, International Journal of Animal and Veterinary Advances 2(4), pp. 141-147. ISSN: 2041 – 2908, Maxwell Scientific Organization, 2010.

Wachira M A, Mail S K, Munyasi J W, Nzioka M, Mwangi D M, Kaguthi P and Kithome J 2010 Uptake of improved technologies through dissemination by indigenous chicken service providers in Southern Rangeland of Kenya, In: Proceedings at the 12 th KARI Biannual Scientific Conference in November 2010, KARI headquarters, Kaptagat road off Loresho, Nairobi, pp. 1376-1382.

Yakubu A 2010 Indigenous chicken Flocks of Nasarawa State, Nigeria, Their Characteristics, Husbandry and Productivity, Tropical and Subtropical Agroecosystems, Volume 12, pp. 69-76.

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Go to top