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LOSS ASSESSMENT AND QUANTIFICATION OF INDIGENOUS CHICKENS UNDER EXTENSIVE FREE-RANGE MANAGEMENT SYSTEM CASE STUDY OF HOST COMMUNITIES OF NJALA UNIVERSITY MAIN CAMPUS, SIERRA LEONE

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ABSTRACT

Indigenous chickens on free range faced huge challenges from predators and parasitoids (disease) leading to high mortality and loss especially among chicks affecting number of chicks reaching maturity.

Loss assessment and quantification was done in host communities of Njala University using structure interview questionnaires, informal discussions with rearers and personal observations and rearing experiences of the research team.

Results concluded that predators and parasitoids (diseases) greatly affects indigenous chicken population growth, a threat to household animal protein nutrition security and income loss to the farmer and farm family. Loss quantification result attributed more loss to parasitoids/disease than predators in the referenced communities. Newcastle disease and flying predators (Hawks and crows) were recorded as the main cause of mortality and loss of birds. This implies that there is a need for serious intervention in disease control and advisory services on good husbandry practices in order to minimize losses and improve chicken production and productivity.

Key words: mortality, predators, parasitoids, mutilation

1. INTRODUCTION

Indigenous chickens are normally reared under extensive free-range management in Sierra Leone. In most rural settings, indigenous chickens especially young chicks are faced with huge challenges from predators and parasitoids (disease) leading to high losses and mortality especially among chicks and to an extent low number of chicks reaching maturity (Bongani and Masuku 2013).

The extensive free-range system is predominantly used in rural Sierra Leone with the use of local breeds of different poultry species mixed, with chickens being the dominant poultry type. This production type is practiced by many Sierra Leoneans (approximately 90% of poultry keepers) in urban towns, rural settings and village communities, with little or no form of investment by the owners other than ownership of the birds.

The production system is characterized by scavenging for food in and around the fringes of their location for feed resources, and solely depend on scavenging feed-based resources comprising of kitchen wastes and left overs, broken field grains, insects, worms and waste water as described by (Sonaiya *et. al.,* 2007) with no form of feed supplementation in most cases and is directly correlated to the amount of chicken population in the area. Indigenous chickens are highly adapted to the harsh scavenging conditions, poor nutrition and disease and/or parasite challenges (Magothe *et al.,* 2012). The traditional poultry husbandry practices in Africa have the following characteristics as documented (Kondombo, 2005), (a) the birds range freely during the day and are usually gathered at night into a basic shelter to avoid losses through predators, (b) the feed is limited to what the birds can find by themselves (insects, seeds, kitchen wastes), but sometimes a supplement is given depending on the availability of the feedstuffs used in the household, (c) the productivity of indigenous chickens production systems in general and the free range system in particular is known to be low and (d) high mortality rates are registered.

There is little or no form of care for birds aside from housing them in nylon rice sacs at night and in some instances, with most birds reared in remote rural areas sleep in trees, kitchen roofs and abandoned buildings. No form of medication or vaccination is done, hence entire flock are at times wipe out by seasonal diseases outbreaks notably from Newcastle disease.

There is indiscriminate mating with dominant males always bullying for mating rights, hence dilution and disappearance of valuable ecotypes (Nyandebo *et. al.,* 2022c). The hens seeks and prepare their own nests in dark corners in kitchens, dilapidated buildings and holes underneath trees where the eggs are protected from rain. In most cases, the nests located underneath tree roots ends up in fatality whenever it is discovered by snakes. In some cases, all the eggs are swallowed if sitting/incubation is not initiated at the time of discovery by snakes. In instances where the hen had commenced incubation of her eggs, it is normally killed by the snake especially the black cobra. Most matured mother hen's usually lay between 9-12 eggs per laying clutch. The hen sits on her eggs, incubate and hatch her eggs with approximately 80% hatchability and raise her chicks under natural harsh conditions (Nyandebo *et. al.,* 2022c). The newly hatched chicks are prone to predators especially flying predators like Hawks and Crows; land predators like fox, snake, rats, black ants etc.; diseases; inclement weather especially during the peak of the raining season (Ochieng *et. al.,* 2013) and accidental deaths. All these tends to reduce the number of chicks that reach maturity and rearing age.

There are several reports of low productivity with a decreasing trend on extensively managed free-range indigenous chicken production systems (Fisseha *et al.,* 2010), Mapiye *et al.,* 2008). It is however worth noting that, the little output obtained from keeping. Very weak Biosecurity is still recorded and requires improvement at all levels. In addition, (Bongani and Masuku, 2013) documented the following constrains highlighted by farmers as: fencing material, chicken housing and equipment and high disease incidences, no organized market, predation, low productivity of indigenous chickens, poor vaccinations to control diseases, slow growth and late maturity of indigenous chickens, no credit facility to purchase equipment, theft, low market prices and high mortality rates in addition to poor management of the chicken (prevailing diseases and predators, lack of proper health care, poor feeding, and poor marketing information) (Dinka *et. al.,* 2010).

These resulted in low productivity of these chickens. These findings were in line with that reported by (Kryger, 2010) who also noted low productivity of scavenging chicken compared with commercial chicken. Principally due to high chick mortality rates (estimated 70 per cent) before reaching the age of six weeks owing to a combination of diseases, predation and lack of adequate feeds and proper management.

Most attempts to improve indigenous chickens either through cross breeding with exotic cock or exotic hens and cocks to run with the indigenous stock was identified as a major threat in erodingand dilution of the indigenous chicken genetic resources (Dinka *et. al.,* 2010; Nyandebo *et. al.,* 2022c) and disappearance of valuable ecotypes of indigenous genes. Establishing a constructive breeding program to address constraints related to poultry production is essential. However, the chicken genetic resources in the Amhara region of Northwest Ethiopia are becoming very sensitive due to the high rate of genetic erosion as a result of a high incidence of Newcastle disease (Dinka *et. al.,* 2010).

The predators include primarily birds like hawks and crows that prey on chickens, and wild mammals such as cats and foxes, which prey on mature birds as well as chicks (Tadelle and Ogle, 2001). Aerial predators such as birds of prey (locally known as "Culullee") account for 34%, cats and dogs (16.3%), and wild animals (15%) were identified as the major causes of village poultry in the rift valley of Oromia, Ethiopia (Dinka *et. al.,* 2010). (Halima, 2007) also reported that predation is one of the major constraints in village chicken production in northwest Ethiopia

From keen observation of indigenous hen, loss can be assessed as preventable (predators) by the indigenous hen' instinctive and inherent ability to timely detect and respond to predators (Nyandebo *et. al.,* 2022c) by instituting alarming chirp/alert noise thereby either scarring off the predators and or alerting the chicks to seek safe seclusions. The non-preventable loss by mother hen constitutes the aspect of parasitoids (diseases) most of which she also succumbs to. Non preventable losses are not quantified in most cases in rural homes as a result of lack of records.

2. MATERIALS AND METHODS

Description of the study Area

This research was conducted in five villages hosting Njala University (Bonganema, Foya, Mokonde, Mosongo and Taiama) in the Kori Chiefdom, Moyamba District in the Southern Province of Sierra Leone. Like in any other part of the country, Moyamba district is subjected to two distinct seasons; rainy and dry seasons. The rainy season is often experience in May to October and the dry season is prevalent in November to April which is usually accompanying by a short lived harmattan period which occurs around December to February months. The study area was stratified into five villages (Bonganema, Foya, Mokonde, Mosongo and Taiama) all in the Kori Chiefdom, Southern Sierra Leone.

Taiama, the chiefdom headquarter town of Kori Chiefdom is one of the five study locations and is approximately 118 miles east of Freetown and like Mokonde lying on the banks of River Taia. Kori Chiefdom is host to Njala University, Sierra Leone Agricultural Research Institute (SLARI), a radio station (Njala Radio MHz 95.2), Taiama Health Center and Njala hospital which serve surrounding villages and few banking institutions.

The climate of Kori Chiefdom is mainly tropical with high temperature ranges from 24oC to 27oC for the greater part of the dry season. The vegetation consists of farm bush, grassland and inland valley swamps.

Kori chiefdom has been an iconic place for agricultural development in the country and to international researchers as Njala University is the largest agriculture based educational and research institute in the country. This may be the reason why the main industry in the chiefdom is agriculture which is believed to employ majority of its inhabitants.

3. SAMPLING AND DATA COLLECTION METHODS

Data collection methods

This study uses primary data collection methods utilized purposeful structured open and close ended questionnaires in a bid to generate more information, focus group discussion and key informants' interviews of indigenous poultry keepers. The respondents were randomly interviewed until the targeted number was reached before moving to the next village.

Sample size

A total of 250 poultry farmers, 50 from each village, targeting local chickens' caretakers, owners and household heads irrespective of gender were randomly selected using random numbers from those households that reared at least one to five indigenous chickens in the year.

Scope of the research

Research scope was hinged on phenotypic characterization of indigenous chickens' population in host communities of Njala University, Njala campus

Statistical analysis

Descriptive statistics such as mean, range, frequency and percentage were calculated and the surveyed data were analyzed using Statistical Package for Statistical Package for Social Sciences (SPSS) version 16 (SPSS Inc., Chicago, Illinois, USA, 2007). The descriptive statistics (mean, SD) for numerical survey data were subjected to procedures of SPSS to conduct student sample T-Test.

4. RESULTS AND DISCUSSIONS

Variable	Bonganema (50)		Foya (50)		Mokonde (50)		Mosongo (50)		Taiama (50)		Overall (250)	Overall Mean	P-Value
	n	%	n	%	n	%	n	%	n	%	n		
Possible cause of mortality of local chickens													
Diseases	25	50.0	27	54.0	20	40.0	21	42.0	20	40.0	113(45.2%)	1.828	0.172
Predators	11	22.0	14	28.0	18	36.0	19	38.0	26	52.0	88(35.2%)		
Water runoff	8	16.0	4	8.0	10	20.0	8	16.0	2	4.0	32(12.8%)		
Accident	3	6.0	3	6.0	2	4.0	2	4.0	2	4.0	12(4.8%)		
All of the above	3	6.0	2	4.0	0	0.0	0	0.0	0	0.0	5(2.0%)		
Loss quantification from predator base													
Hawk	30	60.0	27	54.0	35	70.0	40	80.0	28	56.0	160(64.0%)	1.948	0.092
Rodents	2	4.0	8	16.0	2	4.0	2	4.0	2	4.0	16(6.4%)		
Fox	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0(0.0%)		
Snake	18	36.0	15	30.0	13	26.0	8	16.0	20	40.0	74(29.6%)		
Approximate number of local chickens produced per year													
1-10	15	30.0	10	20.0	3	6.0	6	12.0	10	20.0	44(17.6%)	2.288	0.243
11-20	25	50.0	25	50.0	10	20.0	18	36.0	13	26.0	91(36.4%)		
>20	10	20.0	15	30.0	37	74.0	26	52.0	27	54.0	115(46.0%)		
Approximate number of local chickens reaching maturity													

1-10	20	40.0	28	56.0	30	60.0	25	50.0	30	60.0	133(53.2%)	1.628	0.228
11-20	20	40.0	17	34.0	10	20.0	20	40.0	10	20.0	77(30.8%)		
>20	10	20.0	5	10.0	10	20.0	5	10.0	10	20.0	40(16.0%)		

Table 1: Multivariant table on mortality cause (s), common predators and approximate productivity of local chickens under extensive management system in the study areas

Loss assessment and mortality quantification, attributed to predators, diseases and accidental death

Table 1-Multivariant table on mortality cause (s), common predators and approximate productivity of local chickens under extensive management system in the study areas presents cause and quantification of mortality in the study areas. There was no significant difference among the five communities in their response. Hence, P-Values = 0.172, 0.092, 0.243 and 0.228 respectively with all greater than $\alpha = 0.05$. 45.2% of the respondents confirmed the presence of seasonal disease outbreaks as the major cause of mortality in the study areas, followed by predators 35.2%. This finding was in accordance with (Aberra, 2010 and Bushra, 2012) who reported that diseases are the major limiting factor to rural household poultry growth. About 12.8% and 4.8% of the respondents reported that adverse weather condition (runoff water) and accidental death (trampling, vehicles and motor bikes) respectively as other causes of mortality of indigenous birds that are extensively rear, while 2.0% of the respondents claimed that their birds experience all forms of causes of death in the study areas. This implies that there is need for serious intervention in disease control and advisory services in order to minimize losses and improve chicken production and productivity. It was also revealed that predation is also an economically important constraint in indigenous chicken production under extensive free-range management system. This is in line with report of (Halima, 2007). In the focus group discussions, it was captured that housing young chicks and rearing them intensive will greatly reduce loss, which was in accordance with in (Tadelle and Ogle, 2001).

Predator loss quantification

Aerial predators (Hawk) and to a lesser extent crow were identified as main nuisance to indigenous chicken population growth accounting for 64% of loss attributed to predators in the study areas. This was in line with (Dinka *et. al.,* 2010; Halima, 2007; Hunduma *et. al.,* 2010; Tadelle and Ogle, 2001) who reported that predators such as birds of prey (34%), cats and dogs (16.3%) and wild animals (15%) were identified as the major causes of loss in village poultry.

Snakes were reported to account for 29.6% loss of eggs, chicks and adult birds in some instances. The snake swallowed entire clutch of eggs (10-12) before and during incubation, and all the chicks hatched (in the event of late discovery of nests). Its attack is usually during quiet times at night, and is persistent day in and out until the entire flock in that location is destroyed or the predator eliminated by the chicken owner.

Loss to rodents (giant rats) accounts for 6.4% with night time attack usually in dark secluded areas where the chicks nest. Loss is widely envisaged among chicks mostly in the form of amputation or mutilation of limbs

Interestingly, the fox was not implicated by the respondents in this research either because it is mistaken as a rodent, or hardly detected during it attack due to the presence of forest or bush cover that shadow the predator. From keen observation, loss from the fox is huge with broad daylight attack on all ages of chickens', straying chicks are the most vulnerable during quiet times of the day when owners are not around. With the adult chickens', loss from the fox can be in the form of mutilation of limbs, killing and partial eating with the remaining part of carcass discovered after decomposition or collection by dogs in nearby bushes. Residents close to bush/forest cover are more prone to attack from this predator.

Loss from the black ant is insignificant and as such, most farmers hardly consider their aspect of loss. As with other predator types, attack is mainly during odd hours of the night with predisposing factors listed as unkempt environment, nearby bush/forest cover, waste water from fish and meat around dwelling quarters among others. Their attack is irregular and normally coincide with the raining season as another predisposing factor. Attack is most severe on young brood chicks often in the form of amputation and killing in some instances of even adult birds

Chicken/chick loss to most predator type's result in disappearance of the prey leading to reduction of the existing population.

Figure 1: Leg muscles of indigenous cockerel partly chopped off by fox in researcher premise (Njala University Senior Staff quarters' SSQ-W8)

From focused group discussions and close observation of predators, it can be inferred that the more successful their attack, the more intense is their rate of attack. Attack success is also correlated to the available tree cover and cloudiness that usually shadow the predator. For the hawk in particular, the attack rate and intensity coincide with the period of raising their own brood on maggots of decomposing harvested prey.

Disease loss quantification

Disease loss quantification on indigenous chickens is hard to document under extensive free-range system due to lack of recording/data by owners, similarities in presenting signs and symptoms and lack of knowledge on the common disease's conditions prevailing/endemic to the area in question. Focused discussions with respondents however pinpoint one fatal disease condition (Newcastle) that is seasonal nationwide and characterized by high morbidity and mortality of over 90% or more communities' flock whenever it strikes. Clinical presenting signs reported were twisted neck, torticolis, ruffle feathers, in coordinated gait, off feed, marked thriftiness, watery diarrhoea, blindness and madness in some partially recovered birds etc. Newcastle is thus a respected killer and destructor of entire community indigenous chicken flock.

Chick survival rate in relation to hatchability

From the multivariant table, the study result revealed that chick survival rate was highest for hens with low number of chicks/hen 53.3%, 30.8% and 16% for (1-10), (11-20) and (>20) respectively and this was consistent with the five communities. This result can be attributed to high protection level of indigenous hen with low chick population than when the population is high. This implies that the more the chicks per hen, the more vulnerable are the indigenous hens in executing their inherent and instinctive functions (finding feed resources and teaching her young to feed; and protective function to timely detect and respond to predators), that renders mother hen vulnerable and caught off guard in certain instances especially by flying predators and the fox (Nyandebo *et. al.*, 2022c)

Matrix on loss type (predators and parasitoids) and rate of prevention by the (indigenous hen and owner)

Loss type (from)	Indigenous mother hen	Owner
Parasitoids (diseases)	No	Yes
Predators	Yes	Yes

Under the extensive free-range system, predators and parasitoids (mainly Newcastle disease) posed great challenge to the population of indigenous chickens in Sierra Leone and most part of Sub Sahara Africa. My personal keen observation reveals that most of these losses can be prevented by either the owner and or the indigenous hen.

Loss to parasitoids is not under the control of the indigenous hen and hence cannot do anything in her ability to prevent such loss (Non preventable). The owner on the other hand can prevent parasitoids loss to a certain extent, through "Good husbandry practices (housing, cleaning of night time shelter, timely vaccination against endemic diseases and feed supplementation)".

Loss to predators (Preventable loss) can be prevented by the owner and indigenous hen to a certain extent:

Indigenous hen:

- Inherent and instinctive ability to timely detect and respond to predators attack.
- Alarming chirps to notify chicks and owner in the event of noticing a predator
- Not straying far away to isolated bushy areas.

However, it is worth noting that the indigenous chicken is helpless against the crawling predators like snakes.

Owners:

- Weaning day old and brooding chicks in confinement
- Confinement and feeding chicks till weaning
- Feed supplementation to free roaming and natural brood indigenous hen on free range
- Cleaning of nearby bush and trashes

The owner can likewise prevent loss to adverse weather conditions and accidental deaths by also adopting the practices listed above.

5. CONCLUSIONS

From the study, it can be concluded that predators and parasitoids (diseases) greatly affects indigenous chicken population growth, a threat to household animal protein nutrition security and income loss to the farmer and farm family. Loss quantification attributed more loss to parasitoids/disease than predators in the referenced communities. Newcastle disease and flying predators (Hawks and crows) were recorded as the main cause of loss. This implies that there is need for serious intervention in disease control and advisory services on good husbandry practices in order to minimize losses and improve chicken production and productivity.

Recommendations

The following are being proffer to minimize loss for increase profitability of indigenous chicken production. Based on the fact that indigenous chicken is helpless in her inherent and instinctive protection ability against disease and crawling predators,

- Weaning day old, chicks brooding and feeding in confinement
- Feed supplementation to free roaming and natural brood indigenous hens under extensive free-range
- Cleaning of nearby bush and trashes

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