

## Investigation of Major Ecto-Parasite Affecting Backyard Chicken in Bishoftu Town, Ethiopia

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### ABSTRACT

Backyard poultry production are considered as sources of meat and egg production. However, Parasites are among the main pathogenic agents, threatening the health of poultry and poultry products. The current study was conducted to investigate the prevalence of ectoparasite of poultry managed under backyard system started from November 2019 to April 2020 in Bishoftu town, surroundings of four kebeles; Babogaya, Danbi, 01kebele and 05 kebele in Oromia region South east of Finfinnee. 384 chickens of different age groups, both sexes and breeds were examined. Overall, 228/384 (59.4%) of chickens were infested with species of ectoparasites that mainly grouped into lice 141(36.7%), flea 79 (20.6%), and mite 8(2.1%). The prevalence of ectoparasite infection was 56(14.6%), 51(13.3%), 58(15.1%) and 63(16.4%) in Bishoftu town, Babogaya, Danbi, 01kebele and 05 kebele respectively, the difference in the prevalence of the parasites among difference kebeles were not statistically significant ( $P>0.05$ ). The prevalence of ectoparasites infestation was higher in male 128(33.33%) chickens than females 100(26.04%) and higher in adult 150 (39.1%) than young chicken 78 (20.3%), high in local breeds 129(33.6%) than exotic breed 99 (25.8%). Seven species were identified with their attachments site, namely; *menacanthus streminus*(13.3%) was found on skin, *menopon gallinae*(12.5%) was found on skin, thigh, feather and breast, *goniodes gigas*(5.5%) was found on skin and body feather, *gonicotes gallinae* (2.9%) was found on feather, *lipeurus caponus*(2.6%) was found on wing, skin, tail feather and a single species of flea(*Echidnophaga gallinacae*) 20.6% was found on eye, comb and wattle. while a single species of mite (*ornithonyssus sylviarum*) 2.1% was found on base of feather particularly, the vent area. In conclusion, infestation of chicken with ectoparasites was important constraint in poultry production sector. Associated with lack of attention with respect to hygienic system, treatment and control practices. Based on the results it could be suggested that, good management, biosecurity and the education of farmers could be a vital measure to keep free from ectoparasites and improve the productivity of the chicken.

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### Introduction

Poultry are one of the most reared domesticated species. Poultry products are considered as the most consumed and profitable animal productions [1]. Besides providing a valuable source of protein, these products can generate income, particularly for rural women who are the principal beneficiaries and supervisors of poultry production. In fact, various scholars and rural development agencies [2] have recognized the role of indigenous poultry production in improving the nutritional status and income of many small farmers and landowners (or landless workers).

Compared to a number of other livestock species, fewer social and religious taboos are related to the production, marketing and consumption of poultry products. For these reasons, poultry products have become one of the most important protein sources for man throughout the world [3]. In addition, Village fowl play an active role in pest control and are used for traditional ceremonies and festivals [4, 5]. Traditional poultry production is often described as a low input/low output system. The low productivity is mainly caused by diseases, suboptimal management and lack of supplementary feed [6, 5].

Poultry has influenced man civilization in many ways. Eggs and meat of birds has been consumed since prehistoric time. Compared to

eggs there is no other single food of animal origin, which had been ate relished by so many people in the world and none, is served in such a variety ways. Its popularity is justified not only because it has so easily procured and has so many uses in cooking but also because it is almost unsurpassed product in nutritive excellence. Poultry meat had used extensively as a delicious food [7].

Rural poultry production is an integral part of a balanced farming system and has a unique position in the rural household economy, supplying high quality protein to the family. In addition to their contribution to high quality animal protein and as a source of easily disposable income for farm house holds, rural poultry integrate very well and in a sustainable way into other farming activities, because they require little in the way of labor and initial investment compare to other farm activities [8].

In Ethiopia, chickens are the most widespread and almost every rural family owns chickens, which provide a valuable source of family protein and income [9]. The total chicken population in the country is estimated to be 56.5 million with native chicken representing 96.9%, hybrid chicken 0.54% and exotic breeds 2.56% [10]. The most dominant chicken types reared in Ethiopia are local ecotypes, which show a large variation in body position, plumage color, comb type and productivity [11]. However, the economic contribution of the sector is not still proportional to the huge chicken numbers, attributed to the presence of many

productions, reproduction and infrastructural constraints [12, 11].

The majority (99%) of these chickens had maintained under traditional system with little or no inputs for housing, feeding or health care. Rural chicken in Ethiopia represents a significant part of the national economy in general and the rural economy in particular and contributes 98.5 and 99.2% of the national egg and chicken meat production respectively [13]. However, the traditional poultry production system is characterized by low input, low output and periodic destruction of a large portion of the flock due to disease out-breaks [14].

External parasites of poultry are very common in the tropical environment of the world since this climatic condition create conducive environment for the development of the parasites. Poor standards of poultry husbandry are also contributing factor for the abundance of the parasites [15]. In most rural areas, high prevalence of external parasite infestations in back yard chickens pose a great challenge in poultry industry since majority of external parasites are associated with poor hygiene of chicken house and lack of appropriate hygiene of chicken house and lack of appropriate parasites control measures [16].

Traditional backyard poultry husbandry exposes chickens to many types of parasites. Hence, most of the studies conducted in the different parts of Ethiopia have indicated that the proportion of chickens affected by both external and gastro intestinal parasites is high [17]. Parasitic infestations are ubiquitous and infection load results in clinical disease. Ecto parasites had regarded as a basic cause of retardation in growth, lowered vitality and poor condition of birds. They can affect bird health directly by causing irritation, discomfort, tissue damage, blood loss, toxicosis, allergies and dermatitis, which in turn reduce quality and quantities of meat and egg production. In addition, they act as mechanical or biological vectors transmitting numbers of pathogens [18].

There are several types of arthropods that constitute the major ectoparasite of poultry primarily lice, bugs, fleas, mites and ticks. The degree and types of infestation had influenced by the production method. They live on or in the skin and feathers. They had be characterized by possession of externally segmented bodies, jointed appendages, and chitinous exoskeleton [19]. The low productivity of poultry can be partly attributed to a range of factors such as suboptimal management, lack of supplementary feed; low genetic potential, high morbidity and mortality due to various diseases [20]. Ectoparasites received little attention in almost all the production systems.

In current study, there is huge of poultry farm and product of poultry. However, there is little attention on study of ectoparasite of backyard chicken. In addition, there were no recently studies conducted on external parasites of back yard in current study. Therefore, the objectives of this study were:

- To investigate the prevalence of external parasite of backyard chicken.
- To determine the species of external parasites of chicken with their predilection sites

## Materials and Methods

### Study Area

The study was conducted from November 2019 to April 2020 at Oromia region state, Eastern Shewa, Bishoftu town. Bishoftu town, is located at 9 0 N and 40 0 E. It is 47 km South East of Finfinnee, the capital city of Ethiopia. The altitude is about 1850m above sea level. It experiences bimodal patterns of rainfall with

the main rainy season extending from June to September with an average rainfall of about 800 mm. The mean annual minimum and maximum temperatures are 12.3 0C and 27.7 0C, respectively with an overall average of 18.7oC [10]. The mean relative humidity is 61.3%.

### Study Population

The chickens was kept under backyard management system owned by individual farmers was considered as a study population. Chickens were selected by including both sexes; male and female, breed; local and exotic, and different age groups were examined for the presence or absence of ectoparasite. Aging were considered on the bases of young and adult chickens for convenience of sampling, determined subjectively based on the size of crown length of spur and flexibility of the xiphoid cartilage together with observing color of the shank and growth of the spur and categorized as young grower (Less than 12months of age) and adult (Greater than 12 months of age) according to Magwisha et al. [21] together with information from the poultry farmers.

### Study Design

A cross sectional studies were conducted during collection of data to investigate ectoparasite infestation rate from selected peasant association.

### Sample size and Sample Determination

The number of poultry required for my study was determined using the formula given by Thrusfield [22] for simple random sampling and the sample size was established based on the 50% expected prevalence, 5% desire absolute precision and 95% confidence interval (CI).

$$n = \frac{1.96^2 \times P_{exp}(1 - P_{exp})}{d^2}$$

Where, n = required sample size; z=1.962; pex = expected prevalence; d = desired absolute precision. Thus, the desire sample size for Pex = 0.5 is n= 384 chicken included in this study.

### Study Method and Sampling Technique

#### Clinical and laboratory examination

Purposive sampling technique was used in the selection of kebeles in Bishoftu town and a systematic approach was implemented in the selection of peasant association or backyard poultry owner. A simple random sampling approach had employed to select a chicken for the detection and collection of ectoparasites and thus, head will examined first and followed by the neck, body sides, back, ventral part of the abdomen; wings and vent area. Randomly Selected chickens was thoroughly observed either chicken had parasite or free of parasite gently after manually restrained with caution not to allow the chicken go through neither unnecessary struggle nor stress. After restraining, external parasites collected from different parts of the body around the head, wattle, eye, comb, wing, feather, skin and vent by using naked eye and hand lenses. Sufficient care was taken to prevent damage of the morphological features needed for subsequent identification of the ectoparasites. All the collected parasites were placed in sampling bottles, which had contained 70% ethanol, were assigned with a serial number for easy identification. Likewise, bio data of each chicken like sex, breed, age, and predilection sites and managements systems were recorded on format prepared for this purpose.

Representative of ectoparasite found in body of the chickens was put in universal bottle (film holders, vial) containing 70% alcohol, predilection sites of the body were simultaneously labeled with marker. The identification of parasites, and other relevant

activities had done at AAU CVMA, parasitology laboratory. After collection, the parasites was examined and identified under the stereomicroscope by comparing their morphology with identification keys. Identifications of all ectoparasites was performed according to their morphological characteristics using, the entomological diagnostic guidelines by Wall and Shearer [23].

### Data Analysis

The data collected from each bird were stored in a Microsoft Excel spreadsheet. For statistical analysis, Chi-square test was performed, using SPSS version 20 to determine the association between the prevalence of ectoparasites infestation in relation to age, breed and sex and of the poultry. P-value less than 0.05 was considered as statistically significant.

### Result

In the present study, 384 chickens of local and exotic breed kept under backyard systems while different risk factors such as age, breed and sex of chickens were examined and 228 (59.4%) of them were found infested with different external parasites. Accordingly, three major groups of poultry ectoparasites identified were lice, fleas and mites with prevalence rates of 141(36.7), 79(20.6) and 8(2.1) respectively which was statically significant (Table 1). Lice were encountered from skin, feather, wing, thigh and breast were examined and relatively highly infesting among external parasite

of poultry in this area followed by fleas and mites respectively. However, fleas encountered were restricted to eye, comb, and wattle while mites were found on base of the feathers, particularly the vent area.

The prevalence of parasitism infestation was 56 (14.6%), 51(13.3%), 58(15.1%) and 63(16.4)% for Bishoftu town, Babogaya, Danbi, 01kebele and 05 kebele respectively, the difference in the prevalence of the parasites among difference kebeles were not statistically significant ( $P>0.05$ ). The prevalence of ectoparasites infestation was higher in male 128(33.33%) chickens than in the females 100(26.04%), although there was no statistically significant ( $P > 0.05$ ). The prevalence of ectoparasites infestation was relatively higher in adult 150 (39.1%) compared to in young chicken 78 (20.3%) Statistically, which was insignificance ( $P > 0.05$ ). In the present study, the prevalence of infestation with ectoparasites was high in local breeds 129(33.6%) than exotic 99 (25.8%) which was not statically significant ( $P>0.05$ ) table (2). Regarding on species of ectoparasites of poultry in the present study, seven species were identified. Echinophaga gallinacean was the most prevalent ectoparasite with prevalence of 79(20.6%) and Ornithonyssus sylviarum 8(2.1%) was the least. Menacanthus stremines 51(13.3%) was the second most prevalent species infesting poultry followed by Menopon gallinae 48(12.3%), Goniodes gigas 21(5.5), Gonicates gallinae 11 (2.9) and Lipeurus caponis 10 (2.6%) table (3).



Figure 1: Goniodes gigas in backyard chicken (Captured by W.K)



Figure 2: Menopon gallinae in backyard chicken (Captured by W.K)



Figure 3: Echinophaga gallinacean obtained from backyard chicken.(Captured by W.K)





**Figure 4:** Menacanthus stremiunes obtained from backyard chicken (Captured by W.K)



**Figure 5:** Gonicates gallinae in backyard chicken (Captured by W.K).



**Figure 6:** Lipeurus caponis in backyard chicken (captured by W.K)



**Figure 7:** Ornithonyssus sylviarum in backyard chicken (captured by W.K)

**Table 1: Prevalence of different external parasite encountered in backyard chicken in selected kebele's, Bishoftu town**

External parasite	No positive sample	Prevalence rate%	p-value
Lice	141	36.7	p-0.000
Flea	79	20.6	
Mite	8	2.1	
Total	228	59.4	

**Table 2: Overall Prevalence of ectoparasites of back yard chicken in selected Keeble's, Bishoftu town**

Risk factory	Category	No examined	No positive	Prevalence%	$\chi^2$	p-value
Breed	Local	195	129	33.6	7.578	0.006
	Exotic	189	99	25.8		
Sex	Female	166	100	26.04	0.091	0.763
	Male	218	128	33.33		
Age	Young	140	78	20.3	1.224	0.2690
	Adult	244	150	39.1		
Origin	Babogaya	104	56	14.6	4.87	0.181
	Danbi	94	51	13.3		
	01kebele	88	58	15.1		
	05kebele	98	63	16.4		
Total		384	228	59.4		

**Table 3: Prevalence of genes and species of ectoparasite encountered in backyard in current study area**

Parasite	Genus of parasite	Species name	Frequency	Prevalence	p-value
Flea	Echidnophaga	Echidnophaga gallinacae	79	20.6	0.000
	Menacanthus	Menacanthus stremineus	51	13.3	
Lice	Menapon	Menapon gallinae	48	12.5	
	Goniodes	Goniodes gigas	21	5.5	
	Gonicates	Gonicates gallinae	11	2.9	
	Liepeurus	Liepeurus coponis	10	2.6	
Mite	Ornithonyssus	Ornithonyssus sylviarum	8	2.1	
Total			228	59.4	

The attachment site of external parasite species were found at different parts of the chicken body table (4) 51(13.3%) of Menacanthus stremineus were collected from skin, 48 (12.5%) of Menapon gallinae were collected from skin, thigh, feather and breast, 21 (5.5%) of Goniodes gigas were collected from, skin body feather, 11(2.9) of Gonicates gallinae collected from feather, 10(2.6) of Liepeurus coponis were found on wing, skin, tail feather, 79(20.6) of Echidnophaga gallinacae were found around of eye, comb and wattle while 8 (2.1) of Ornithonyssus sylviarum were found on base of the feathers, particularly the vent area of the chicken. However, the prevalence attachment site was higher in Echidnophaga gallinacae (20.6%) when it compared with the prevalence of others species identified in current study and there was difference in statistically significant ( $p < 0.05$ ).

**Table 4: Prevalence association of ectoparasite regarding on species and attachment**

Species	Attachment	No positive	Prevalence %	$\chi^2$	(p-value)
<i>M. stremineus</i>	Skin	51	13.3	1.403	P=0.000
<i>M. gallinae</i>	Skin, thigh, feather and breast	48	12.5		
<i>G. gigas</i>	Skin, body feather	21	5.5		
<i>G. gallinae</i>	Feather	11	2.9		
<i>L. coponis</i>	Wing, skin, tail feather	10	2.6		
<i>E.gallinacae</i>	Eye, comb, wattle	79	20.6		
<i>O.sylviarum</i>	Vent	8	2.1		
Total		228	59.4		

M=menacanthus, M=menapon, G=goniodes, G=gonicates, L=liepeurus, E=echidnophaga, O=ornithonyssus, respectively.

In the present study, the parasite were identified at adult and lymph stage depending on the morphology and structural features of parasite. The study implies that, as the prevalence of adult parasite was statically significant when compared with nymph stage of parasite. From 228 positive poultry about 19(4.9%) of them are infected with nymph stage of external parasite identified in study area and about 209(54.5) of them infected with adult parasite. This table implies the impact of adult parasite is more hazardous than that of nymph stage parasite in the study area. Table (5).

**Table 5: Prevalence of parasite regarding on stage of parasite in study area**

Stage of parasite	No positive	Prevalence rate%	p-value
Adult	209	54.5	0.000
Nymph	19	4.9	
Total	228	59.4	

## Discussion

The observed overall prevalence 228 (59.4%) of ectoparasite infestation in the present study garneted with results of 57.03% Fantaye & Abishu from Maki district and (56.5%) of Zeryehun and Yohannes from wolayita zone, 56.5% of Koroglu and 55.47%. was reported by Biressaw and Michael from Eastern Hararghe Zone [24-27]. it was relatively lower than the reports higher prevalence rate of 93.7% reports by Hagos and Eshetu, in central Ethiopia and 67.95% in and around ambo town by Fraol et al [28,15]. East shoa zone Ethiopia, 78.0%, of Barsabeh, 86.67% from Bangladesh, by Shanta et al., 91.5% from Central Ethiopia

Belihu et al., 83.85% by wondimu and 100% from Nigeria Bala et al, 67.95% and 70.73% from ambo district, Tamiru et al., were reported respectively [26,29-35]. However, it was higher than the result reported 19% Al-Saffar and Al-Mawla, 41.1 % by Nandi and George, [36-37].

The difference between the current and previous prevalence rate could be due to paucity of health conditions, high population density of birds, uncontrolled feeding, inattention to treatment and control measures, sample size, season of study, management, and methods of disease control and prevention practiced in the

study area, which exposes the chickens to poor hygiene on the farm and chicken houses thus, enabling them to contract a wide range of harmful ectoparasites. In addition, the variation in the prevention and control methods of external parasites from area to area might also responsible for the variation in the prevalence of external parasites in chickens Mekuria, S. and E. Gezahegn, [38].

In the present study, lice was encountered with the highest prevalence 36.7%, when compared with other parasite recorded in current study. This is more conceded with result of 35.1% recorded by Amede et al., from east Ethiopia [39]. 33.85% reported by Wondimu et al, from Mareka Woreda of Dawuro Zone, Snnpr, Ethiopia [32]. The recorded result is higher than in recorded in Northern Tanzania 28.5% by Swai et al., and (12.5%) by Al-Saffar and Al-Mawla [40,36]. The current study is lower than different studies conducted in different section of the world. 60.9% lice infestation were reported by Saxena et al., from India and Koroglu et al., in Turkey recorded 56.5% [41,36]. The difference between reported prevalence may be due to management system, season of study and other agro ecology influencing the distribution of lice and due to less attention on culling system when the chicken are infected with the lice distribution in developing country. In addition to that, due to absence of regular attendance of chicken when they are shows discomfort feeling. Because of those factors, the prevalence of lice was variable when compared with reported and current study. Due to variation in agro-climatic and topographic conditions and species adaptability. Besides climatic conditions, these investigators did their work in different ecological locations where differences in breed and general husbandry practices would account for the difference in finding. In addition, a longer period of study might show the seasonal prevalence pattern of the parasites compared to the shorter one Clayton et al. [42].

Five species of lice were recorded during the present study; these were menacanthus streminus, menopon gallinae, goniodes gigas, gonicates gallinae, liporus caponis. Among the identified external parasite species, menacanthus streminus (13.3%) was the highest prevalence while L. caponus (2.6) was the least from current study. The prevalence of 70%, Shanta, et al. , 41.7%, Belihu, et al. and 65.33% Bersabeh et at. M. stramineus was reported, which is higher than present study [30,31,29]. These variations may be due to climatic condition, host receptor and may be due to high potential transmission between hosts.

The lowest prevalence recorded among the ectoparasites in this study was mite (*Ornithonyssus sylviarum*) which was eight (2, 1%). The current study agree with that of Nnadi and George who showed in their study that mites were the least among the ectoparasites encountered and the present study were not agree with the second highest prevalence in this study of Fufa et al from North-Eastern Nigeria, mite is considered as one of the common ectoparasites of village chicken by Adene and Dipeolu [37,43,44, 45]. This difference may, be due to differences in the weather and ecological settings of the study area, sample size and area covered.

The *Echidnophaga gallinacean* (stick tight flea) 79(20.6) has the second prevalence when compared to other ectoparasites found in present study. The prevalence of *Echidnophaga gallinacean* in the present study 79(20.6) was almost comparative when compared to the other studies carried by Solomon and Elsabet (16.5%) in Wolayta Soddo town in southern Ethiopia, Gedion (14.6%) in and around Dire Dawa. The high prevalence 269(83.5%) was reported by Wondimu et al from Mareka Woreda of Dawuro

Zone, Snnpr, Ethiopia, (71.9%) of *Echidnophaga gallinacean* reported by Swai et al. in northern Tanzania, 51.2%, was reported by Belihu et al., in Ethiopia, 75.3% was reported by Swai et al., in Tanzania and 35.7% was reported by Nnadi and George in Nigeria [46,47,32,40,31,37]. The free-range system provides a more sustainable environment for the parasites. Mungube et al reported that lack of control measures towards these parasites was a possible factor contributing to the high prevalence of the parasites [16].

In the current study the parasitic Infestation in male birds was (33.33%) almost higher in comparison with female chicken (26.04%) the deference was not statically sigificant  $P > 0.05$ . This result is agrees with the finding of reported a slightly higher rate of ectoparasites in males, compared to females [16, 31, 24]. This result disagrees with the finding of Sabuni et al., Prevalence of ectoparasites infestation in indigenouse free ranging village chicken in different agro ecological zones in Kenya and Nandi and George, Prevalence of Parasites of the Village Chicken in Nigeria, Asefa et al, Study on Prevalence of ectoparasites of Poultry in and Around Jimma Town, Prevalence of the major ectoparasites of poultry in extensive and intensive farms in Jimma, Southwestern Ethiopia by Wario et al., study on Prevalence of ectoparasites in Poultry Managed Under Backyard System in Mareka Woreda of Dawuro Zone, Snnpr, Ethiopia [48,37,49,50,32]. The observed discrepancy between the findings might be due to the setting and other factors in the studied areas.

Prevalence of the ectoparasites infestation was found to be statistically higher in adult (39.1) than in young (20.3). The present result were agree with the previous report of have also reported that adult village chickens were more infested by ectoparasites compared with younger ones [51-54]. This finding might be associated with the frequent contact of adult chickens with other species of animals and may be exposed longer to the infested environment and other source of infestation. The current study results regarding on the age of chicken were disagreement with the findings of Mulugeta et al. who reported that young chickens were more infested than adult birds [55, 15, 56].

Local breed of chicken had more of external parasite than exotic breed in present study. This is study had agreement with report of who reported that local breed (87.5%), 87.46% and (87.55%) found to be more prone than exotic breed in a study carried out in Wolayta soddo, Bishoftu and Ambo town respectively [38,31,15]. Local breed was more susceptible to external parasite because of the community were more focused in exotic breed than local, poor hygiene and minimal health care provision in local chickens. In addition, local chickens had been released and stay away from home. Thus becomes more vulnerable to ectoparasite than exotic breed. This study hadn't agreement with the report of Tolossa and Tafesse [57]. who reported 2.35% in Bishoftu in semi intensive farm and Bala et al. [33]. 100% in Nigeria free ranging chickens as exotic breed more infected than local breed. This might be due to better measures and practices related to good housing, feeding and husbandry system applied for exotic breed than local breed. In this study, adult parasite infestation were recorded higher than the lymph stage 54.5% and 4.9% respectively. This variation is due to the development of nymph stage into adult stage in a few days (3-5) and when poultry manure containing beetles is spread on fields, the flying adults often move to nearby houses and businesses and create a serious annoyance problem to the inhabitants. This is why adult parasite was more prevalence than nymph.



**Conclusion and Recommendation**

Poultry products are considered as one of the most important sources of food for humans, worldwide. Backyard poultry production has a fundamental role in capital build up, poverty, malnutrition and hunger reduction among the resource poor households in developing countries. Despite their importance, external parasites of poultry are common in the tropics because of the favorable climatic conditions for their development and the poor standards of poultry husbandry. The different species of ectoparasites identified in this study provide evidence of the existence of diverse ectoparasites fauna in the present study locations, However, in the present study lice is the most prevalent followed by flea and mites were the least. Five species of lice *M. streminus*, *M.gallinae*, *G.gigas*, *G.gallinae*, and *L.caponus*, stick tight flea (*E.gallinae*) and Mite (*O.sylviarum*) were identified. The attachment sites of external parasite in current study eye, comb, wattle, skin, thigh, feather, breast, body feather and vent were identified. Generally, in present study, backyard chickens were affected by different infestation of ectoparasite, due to the paucity of appropriate management. Therefore, based on the above conclusion the following points were taken as recommendations:

- ✓ Government and Community could be gave attention for

- local chickens to prolonged local species.
- ✓ Awareness should be created to the community on the impact of ectoparasites on poultry production
- ✓ Further research to evaluate the impact of ectoparasites on health and production performance of chicken including cost effectiveness of control strategies should be conducted
- ✓ Farmers and extension staff should be trained regarding on improved housing, feeding, disease control and improved productivity of local chicken
- ✓ Application of anti-parasitic drugs should be necessary to control of external parasite.

**Annexes**

Annex1. List of material used during collection of sample and processing of laboratory for the parasite identification.

- ✓ 70% alcohol
- ✓ Petridish
- ✓ Glass slide
- ✓ Icebox for transportation
- ✓ Labelling tape
- ✓ Sample recording
- ✓ Sampling bottle for each chicken
- ✓ Microscope

**Annex 2.**

S. code	Mgt. system	Breed	Age	Sex	result	Predilection site	Sample type	Genus name	Spp. name	Stage of parasite
1										
2										
3										

Mgt. Management  
Spp. Species

**Annex 3: Image obtained during the collection of the sample**



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