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Original Research

Prevalence of Poultry Coccidiosis and its Associated Risk Factors in and around Haramaya District, Ethiopia

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ABSTRACT

Aim

To determine the prevalence of poultry coccidiosis and identify the risk factors associated with the occurrence of the disease.

Method

A cross-sectional study was conducted on poultry coccidiosis of local and Rhode Island Red, White Leghorns, Koekoek, and bovine brown exotic breeds from November 2017 to April 2018 in and around Haramaya district, Ethiopia. Fecal examination using flotation and McMaster counting techniques were used for qualitative and quantitative studies, respectively. The study also involved a questionnaire survey for the assessment of possible risk factors.

Results

From 450 chickens examined by floatation method to detect Eimeria oocysts the result revealed 122 (27.1%) of the chickens were found positive for coccidiosis. The prevalence of coccidiosis among different age groups shows (68/214=31.8%), (54/236=22.9%) of young and adults were positive respectively. The prevalence is found statistically significant with $p<0.05$ ($p=0.034$, $\chi^2=4.493$) between different age groups. Regarding the breed prevalence (61/333=18.3%), (61/117=52.1%) Chefe and Gebsima (barley plumage color); Horro, Jarso, and Keyi (red plumage color); Naked Neck and Netch (white plumage color); Tepi and Tikur (black plumage color). Local and exotic breeds were positive respectively and the difference is statistically significant $p<0.05$ ($p=0.00$, $\chi^2=50.109$) between breeds. The study indicated also (46/168=27.4%) male and (76/282=27%) female chickens were positive but the difference between sex groups is no statistically significant difference $p>0.05$. The prevalence of coccidiosis in chickens kept in different management systems showed that (62/305=20.3%), (60/145=41.4%) were positive from extensive and intensive systems respectively. The difference is a statistically significant $p<0.05$ ($p=0.00$, $\chi^2=22.040$) among managements. From all the infected chickens most of them (96.7%) were lightly infected (<10,000 oocysts).

Conclusion

Coccidiosis is a major problem in the farm with inadequate hygienic measures and factors such as age, breed, body conditions, and biosecurity which are the most common factors that contribute for the occurrence of coccidiosis. Therefore, appropriate control strategies should be designed considering important risk factors and focus should be given to biosecurity practices in the prevention and control of coccidiosis, and in addition, further studies are needed to be conducted to identify the prevalent Eimeria species for strategic control.

Keywords

Coccidiosis; Poultry; Prevalence; Eimeria; Haramaya district.

INTRODUCTION

Poultry refers to domestic birds such as chickens, turkeys, ducks, guinea fowl, peasants, pigeons, and more recently ostriches which kept for meat or egg production.[1-3] In Africa, village poultry contributes over 70% of poultry products and 20% of animal protein intake. In East Africa, over 80% of the human population lives in rural areas and over 75% of these households keep indigenous chickens.[4] The poultry industry occupies an important position in the provision of animal protein (meat and egg) to man as well as manure for crops and generally plays a vital role in the national economy as a revenue provider and provides employment.[5-8] Moreover, poul-

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try in many parts of the modern world is considered as the chief source of not only cheaper protein of animal origin but also of high-quality human food.[9]

In developing countries, poultry production offers an opportunity to feed the fast-growing human population and to provide income for resource-poor farmers.[10] Ethiopia has a large population of chickens estimated to be 48.89 million with native chickens of non-descriptive breeds, a hybrid of chickens, and exotic breeds of chickens mainly kept in urban and peril-urban areas representing 96.6%, 0.55% and 2.8%, respectively.[11] Of the total population of chickens in Ethiopia, 99% are raised under the traditional backyard management system, while 1 % is under an intensive management system.[12]

Poultry production has been adversely affected by a variety of constraints among the constraints, poultry diseases continue to play a major central role in hampering its development.[13,14] In Ethiopia, poultry production has been hindered by different prevalent diseases from which new castle disease, coccidiosis, salmonellosis, and chronic respiratory disease are the important ones.[15]

Coccidiosis is an infectious disease of the digestive tract of poultry caused by a microscopic protozoan parasite (sporozoa) of the genus *Emeria*, phylum *Apicomplexa*,[16] which are commonly known as coccidia. In Ethiopia, coccidiosis is endemic, causing great economic losses, particularly in young growing birds in all production systems.[17] In the past years, coccidiosis used to be the most important cause of mortalities on all farms. Incidences of the disease was as higher as 80% usually occurring in the form of outbreaks.[18] It is a complex disease of poultry caused by different species of Emeria parasites. Coccidiosis affects the chickens in both clinical and subclinical forms.[19] Factors contributing to outbreaks of clinical coccidiosis include litter moisture exceeding 30%, immune suppression, sub-optimal inclusion of anti-coccidiosis in feed, and environmental and management stress such as overstocking, poor feeding systems, and inadequate ventilation.[20,21] The damaged tissue caused by coccidia results in lower feed intake, interference with normal digestion and nutrient absorption, dehydration, and blood loss.[22]

Poultry coccidian is strictly host-specific and the different species parasitize specific parts of the intestine. The disease is characterized by droopiness, paleness of the comb, diarrhoea, and occasional appearance of blood in droppings.[23] Chickens suffering from coccidiosis quickly become less productive and poor performances. Laying hens will experience a reduction in the rate of egg production.[24] It adversely affects the poultry industry throughout the world and results in a remarkable economic loss.[25]

Though nine species of Eimeria have been identified as causative agents of poultry coccidiosis, only seven of them have been reported to be pathogenic.[26,27] *Emeria tenella* (*E. tenella*) and *Emeria necatrix* (*E. necatrix*) are the most pathogenic species. *Emeria arcevulina* (*E. acervulina*), *Emeria maxima* (*E. maxima*) and *Emeria mivati* (*E. mivati*) are common and slightly too moderately pathogenic while *Emeria brunetti* (*E. brunetti*) is uncommon but pathogenic when it does occur. *Emeria mitis* (*E. mitis*), *Emeria praecox* (*E. praecox*) and *Emeria hagani* (*E. hagani*) are relatively non-pathogenic species.[23,28,29]

Therefore, the objectives of this study were:

- To determine prevalence of poultry coccidiosis in and around Haramaya.
- To identify the risk factors associated to the diseases occurrence.

MATERIALS AND METHODS

Study Area

The research was conducted in and around Haramaya, Awaday district and Harar. Geographically, Haramaya district is located in the eastern Hararghe zone of Oromiya region, Ethiopia, 14 km from west of Harar and 513 km east of Addis Ababa. The Haramaya district contains roughly 63,723 cattle, 13,612 sheep, 20,350 goats, 15,978 donkeys, 530 camels, and 42,035 chicks, according to agricultural data. The production system of the district is mixed type. Topographically, it is situated at altitude of 1600-2100 m above sea level with the mean annual temperature and relative humidity of 18 ºC and 65% respectively. A bimodal distribution pattern with peak rainfall in the middle of April and the middle of August occurs in and around the Haramaya district, with an average annual rainfall of about 900 mm. Geographically it is located 41º59'58" N latitude and 9º24'10"S longitudes.[30] The wet season begins in April and extends to the end of September, while the dry season starts in October and extends to March.

Harari Regional state is located in Eastern part of Ethiopia at distance of 525 km from Addis Ababa the capital city of Ethiopia. The total geographical area of harar town is about 343.21 km^2. It is geographically estimated at 41'59" and 58 North latitude and 9º24'10" longitude. The climate of the region is one of the most pleasant in the country. Temperature is even between 17.1 ºC-20.2 ºC. The average annual intensity of precipitation ranges between 750 mm to 2000 mm. The region is mainly categorized into two agroecological zones 90% of the land area of the region is estimated mid-high land between 1400 to 2200 m above sea level, while the remaining 10% is Kola 1500 above sea level.

Study Design and Study Animal

A cross-sectional study was conducted from November 2017 to April 2018 in and around Haramaya district, Awaday and Harar to assess the prevalence of poultry coccidiosis. The study areas are selected purposively and conventionally and close proximity to Haramaya University where laboratory analysis occur. The study chickens were selected by simple random sampling methods in case of samples from farms while sample taken from village using cluster sampling methods. The information regards age, breed, sex and short interview of owners about the management system, type housing, method of cleaning and prevention, veterinary service, the impact of diseases etc., were completed using a structured questionnaire. In this study, age was classified based on the as young (less than or equal to eight weeks) and adult (greater than eight weeks).[31]

Sampling Method and Size Determination

The study areas are selected purposively based on the close prox-

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imity to Haramaya University where the laboratory analysis is done. The expected prevalence will be assumed to be as 50% and using the Thrusfield formula,[32] the sample sizes determined as follows:

$$n = \frac{Z^2 \times (pexp \times q)}{d^2}$$

n=the required sample size
Pexp=Expected prevalence (50%)
q=(1-Pexp)
d=Desired absolute precision (5%)
1.962=the value of Z at confidences level

The expected prevalence of coccidiosis is 50%. By substituting the value in the above formula, we get the sample size 384. Accordingly, the sample size calculated is 384 poultry. However, to increase the precision; the sample size is made to be 450 chickens with the percentage of 8.6% or 66 samples was added.

Questionnaire Survey

Questionnaire survey was done in 60 respondents on the management system of different poultry production system was performed on farms, and animal owners, asked basic questions regarding information on management system (cleaning, veterinary service, method of prevention purpose of keeping, impact of the disease, all-in-all out etc) and widely used anticoccidail drugs, selection criteria, application interval, sources of drug, efficacy dosage administered.

Data Collection

Fecal samples were collected during the study period directly from the selected animals from freshly dropped feces excluding soil contamination after wearing disposable plastic gloves and placed into sample vials and transported to Haramaya University veterinary parasitology Laboratory on the same day of collection and preserved at 40 ºC refrigeration temperature until processing, that is, within 24 h. The individual bird details such as bird identification, sex, age, management system and the housing type of the farms were registered.

Parasitological Examination

Three (3) gram of feaces was suspended in 35 ml of sodium chloride floatation fluid and the suspension was poured through tea strainer in to beaker for filtration is applied to harvest oocyst.[24,33,34] The McMaster technique is used to quantify the oocyst per gram of feces (OPG).[35] The diagnosis of the oocysts in the faeces was made using 40×optical lens of the microscope. The level and severity of the infection determined by comparing OPG with the standard values light (<10.000 oocytes), moderate (10,000-15,000 oocytes) and higher (>15,000 oocytes).[36]

Data Management and Analysis

Data was collected were entered in Microsoft Excel worksheet and analysis was made by statistical package for social sciences (SPSS 20). Descriptive statistics like percentage was used to express prevalence while chi-square (χ^2) test was used to compare the association between variables and a statistically significant association between variables was considered at $p<0.05$.

RESULTS

From the total of 450 chickens examined for the presence of Eimeria the overall prevalence indicted 27.10% (122/450) of chickens harbor the parasite in the study area was Table 1.

Table 1. *The Overall Prevalence Result of the Study*

No. Chickens Examined	Result		Percentage (%)
450	Positive	122	27.1
	Negative	328	72.9

As indicated in table there is significant difference in the prevalence of coccidiosis among different breed, age and management system while sex groups do not show significant difference Table 2.

From extensive management system (62/305=20.3%) were positive and (60/145=41.4%) intensive was positive. The highest prevalence rate (41.4.1%) was observed in chicken which reared in in-

Table 2. *Prevalence of Coccidiosis Based on Animal's Related Factor and Management Factors*

Variables	Category	No. Examined	Positive	Prevalence	Chi-square (χ^2)	*p*-value
Sex	Male	168	46	27.4%	0.010	0.921
	Female	282	76	27%		
Age	Adult	236	54	22.9%	4.493	0.034
	Young	214	68	31.8%		
Breed	Local	333	61	18.3%	50.109	0.001
	Exotic	117	61	52.1%		
Managements	Extensive	305	62	20.3%	22.040	0.001
	Intensive	145	60	41.4%		
Study area	Haramaya	182	43	23.6%	3.119	0.210
	Awaday	122	40	32.8%		
	Harar	146	39	26.7%		

tensive management system and the lowest prevalence rate (20.3%) was observed in extensive management system. The difference is statistically significant $p<0.05$ ($p=0.00$, $\chi^2=22.04$) where poultry under intensive production system highly affected.

The prevalence of coccidiosis was statistically significant between age group with ($p<0.05$) in chickens aged 2 to 8-weeks (young) (31.8%) as compared to adults older than 8-weeks (22.9%) chicken, the difference found to be statistically significant with $p<0.05$ ($p=0.034$, $\chi^2=4.493$) where young age chickens are more susceptible than adult ages. But regarding sex groups the difference in the prevalence of coccidiosis was not significantly different.

The prevalence among the breed of chickens examined, infection was found to be more in the exotic chickens (52.1%) compared to the local chickens (18.3%) and the result is statistically significant with $p<0.05$ ($p=0.00$, $\chi^2=50.109$) where exotic breed are more infected with coccidiosis than local breeds. Among study areas the highest prevalence 40/122 (32.8%) was observed in Awaday area followed by Harar 26.7% and Haramaya 23.6% (Table 3).

Table 3. *Degree of Infection Based on the OPG Count*

Oocytes Count Range	Degree of Infection	No. Chickens	Percentage (%)
<10.000 oocytes	Light	118	96.7
10,000-15,000 oocytes	Moderate	2	1.6
>15,000 oocytes)	Higher	2	1.6

The present study indicate that out of all 450 chickens examined 122 chickens were positive from this positive chickens based on degree of infestation it classified into light (<10,000 Oocytes), moderate (10,000-15,000 Oocysts) and higher infestation (>15,000 Oocysts).[36] Based on the observation 96.7% of the chickens were infected by light infestation. And the rest 1.6% moderately and 1.6% were highly infected (Table 4).

Table 4. *Management System and Related Factors Assessed Based on the Questionnaire Survey of Poultry Production System in the Study Area*

Risk Factor	Category	Frequency	Percentage (%)
Frequency of cleaning house	Every12 h	10	16.7
	Once day	37	61.7
	Per week	9	15.0
	Others	4	6.7
	Total	60	100.0
Vet. Service	Yes	22	36.7
	No	38	63.3
	Total	60	100.0
Method of keeping hygiene	Chemical	10	16.7
	Simple cleaning	50	83.3
	Total	60	100.0
Method of coccidiosis prevention	Traditional	23	38.3
	Vet. Service	19	31.7
	Cleaning	9	15.0
	No action	9	15.0
	Total	60	100.0
Impact of diseases	Death	15	25.0
	Weight loss	17	28.3
	Egg production loss	17	28.3
	Management cost	1	1.7
	Weight and egg production loss	10	16.7
	Total	60	100.0
Degree of disease affect production	Low	5	8.3
	Moderate	19	31.7
	High	36	60.0
	Total	60	100
Purpose of keepings	Meat	8	13.3
	Egg	17	28.3
	Selling	17	28.3
	Other	2	3.3
	Eggs and selling	16	26.7
	Total	60	100.0

Questionnaire survey reported that out of the 60 farms which took part in the study 28.3%, 20%, 35%, 6.7% and 10% were illiterate, grade (1-8), secondary education, university degree and others respectively. Poultry management in the rural, urban and peri-urban area is free ranging and there were a poor management of chicken which feed by scavenging around the house with occasional cereal and food residuals supplement. The majority of the respondents indicated that poultry are source of income generated *via* selling the chickens and eggs.

Out of the 60 respondents 61.7% of them were practice frequent houses cleaning once in a day while few of them 15% clean per week. The method of cleaning houses was mostly by simple cleaning (83.3%) and occasionally by chemical (16.7%). Disease are among the problems mentioned by traditionally managed chickens although farmers have their own local names and ways of identifying poultry diseases, the most frequent disease they complain about was diarrhea predominantly bloody diarrhea appeared during wet season. Out of the 60 respondents 63.3% of them did not access to veterinary service. However, the rest 36.7% of them access occasionally and reported there is not enough service. Weight loss, egg production loss and death are among the major impacts reported by animal owner.

DISCUSSION

Coccidiosis is considered the most prevalent intestinal parasitic disease in commercial chicken production system worldwide and its prevalence and economic significance has been reviewed by different workers in different production system. In present study, the overall prevalence was 27.1%. The result of this research was very close to the finding of the previous reports 27.6% by Abera et al[37] from Addis Ababa poultry farm, 28% by Fesseswork[38] and 25% Dereje[39] around Debre-zeit town. It also agrees with the finding of Abadi et al[40]. Twenty-five point two four percent (25.24%) Kombolcha poultry breeding and multiplication center.[41] Twenty-five point eight percent (25.8%) in central Ethiopia,[42] Nekemte towns East Wollega, Ethiopia.

The present findings are higher than the findings of Lobago et al[43] in Debre Zeit, Central Ethiopia, 11% Garbi et al[42] from Nekemte town-19.5%,[31] in and Around Ambo town-20.5%. The varying disease prevalence may be caused by varying climatic circumstances, management practices, agro-ecological setups, and a lack of sufficient knowledge about the illness.[44,45] However this finding was lower than the report done by Gebretnsae et al[46] from Gondar town with the prevalence of 43%, Gari et al[47] with the prevalence of 61.5% in Tiyo District, Arsi Zone, Ethiopia,[48] in Iran 64%,[34] in Jammu region (India) 39.6%,[49] in Debre Zeit, Ethiopia (71.1%) and Alamargot[18] in Adiss Abeba (80%). This variation in prevalence of the disease may be due to epidemiology of coccidian infection and differences in management systems of the farms. This result might be attributed to high stocking density and absence of intervention between flock resulting in high contamination rate of poultry house with oocyst of Eimeria and lack of regular disposal of litters.[50] The other possible factors for fluctuating in prevalence can also be development of immunity against coccidiosis.

This study indicated that the prevalence of coccidiosis was statistically significantly higher in exotic birds (52.1%) than local (18.3%). The prevalence rate of the disease was significantly (p<0.05) higher in exotic (52.1%) breed than local chickens (18.3%). Similar pattern of prevalence with was reported by Gari et al,[47] who reported a higher prevalence of 25.10% in exotic breeds than 12.41% in local breeds chicken. This was also reported by Oljira et al[31] Garbi et al[42] Jatau et al[51] who also reported high prevalence of coccidian infection in exotic breed chickens as compared to the free-range local chickens. Similar reports was by Quiroz-Castañeda et al[6] and Puttalakshmamma et al[52] who reported higher prevalence of coccidiosis in exotic breed than local chickens. This were due to the fact that the exotic chickens were reared in confinement and were likely to be most exposed to the infective stages of the organism in litters and feeds while the local breeds of chickens were usually found roaming and scavenging around the surroundings. They may not come into contact with the infection or may not ingest the infective stages of the organism. The existence of genetic variation in resistance to coccidiosis among breeds and strains has been reported Ashenafi et al[41] and Mcdougald[53].

In contrary to this finding study conducted the current study did not corroborates previous reports by Ashenafi et al[41] in Ethiopia and Hadipour et al[48] who reported high prevalence in local than exotic breeds,[41] reported an overall prevalence of coccidiosis of 25.8% in scavenging chickens and indicated the importance of coccidiosis in poultry farming under a traditional husbandry system. The already immunized chickens upon re-infection become carriers and eliminate oocysts into the environment for long periods maintenance of oocysts in the farm environment, improper cleaning and disinfections methods in the native chicken houses.[48] Apart from the two there were also others who reported that there was no association between coccidiosis occurrence and breed of chickens[29] in Tiyo District, Arsi Zone, Ethiopia and Iran.[54,55]

The present study revealed the prevalence rate decrease with the age of the chickens. Chickens with 2-8-weeks of age showed the highest prevalence of coccidiosis (31.8%). On the other hand, as the age of the bird increases the birds get immunized and resistant to the infections. Higher occurrence of coccidial infection in younger chickens (31.8%) as compared to adults (22.9%) showed that coccidial infection is age related. Age difference plays a significant role in prevalence distribution of coccidia oocyst shedding. Indeed, a strong statistical association (p=0.034) was observed between the prevalence of coccidian oocyst shedding of age groups This agreed with the report of Mcdougald[26] who also found that most Eimeria species affect birds between 3-8-weeks of age, and also concurrence with previous report of Muazu et al[1] who reported 36.7% prevalence of coccidial infection among adult birds and 52.9% among the younger birds Hadas et al[56]; who reported 68.1% in young birds and 37.5% in adults. Moreover, Oljira et al[31], Bachaya et al[57], Ali et al[58] and Lawal et al[59] have also reported the predominance of coccidial infection among young birds. This could be due to under developed former immunity in young. Adult birds could have developed acquired immunity to infection due to previous repeated exposure with several coccidia species in the litter.[60,61] But this present study

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was not correlated with those of Ahmed et al,[62] Dakpogan et al[63] and Bachaya et al[64] who reported higher rate in adult chickens as compared to the young ones.

In this current study, coccidial infection was found to occur nearly equal but slightly more in male (27.4%) than in female chickens (27%). The association between the sexes was statistically not significant differences (p=0.921). This finding agrees with those of Garbi et al[42] have also reported 20.0% prevalence of coccidiosis in male chickens as compared to the female 19.27%,[45] have recorded in high prevalence of coccidiosis among male chickens (80.0%) as compared to females (70.0%). Similar reports was also seen with findings of Negash et al[16] in Addis Ababa and Gebretnsae et al[46] in Gondar who reported that a higher prevalence of poultry coccidiosis in male chickens than female chickens. However, this finding was disagreed with those of Oljira et al,[31] who also reported slight higher frequency of avian coccidiosis in female chickens (21.43%) as compared to male ones (19.38%). Absence of statistically significant difference between female and male might be due the equal chance of exposure for the coccidiosis infection.

Chickens which are managed in intensive housing system were more affected (41.4%) than extensive (20.3%) housing systems. This result in line with report of previous studies carried out by Taylor et al[65] who reported that coccidiosis was the most common problem to chickens kept under intensive management system especially those on deep litter management and also by Hadipour et al,[48] Geidam et al[66] and Elelu et al[67]. Who reported higher disease occurrence and susceptibility in intensively reared chickens. This finding is also correlated with previous reports Lunden et al,[36] and Dakpogan et al.[63] However, the current result was disagreement with the previous report in Gondar (Ethiopia) by Gebretnsae et al[46] who recorded higher prevalence of coccidiosis in chickens which are managed in backyard production system (45.7%) than floor (49.1%) and cage (25.6%) production systems. In this study, it found that there was statistically significant difference with the occurrence of poultry coccidiosis between different management system (intensive and extensive) (p<0.005). Management is concerned as the primary importance together with sanitation, environmental condition and the hygienic status of the poultry house.[68] Moreover, management of poultry houses plays a significant role in the spread of coccidiosis because coccidial oocysts are ubiquitous and are easily spread in the poultry house environment. Furthermore, due to Eimeria species high sporulation potential, it is usually very complex to control coccidia in chickens reared under intensive management conditions.[69] This could be connected with fact that birds under intensive housing could possibly get regular infection with coccidia whenever they feed on litters contaminated with sporulated Eimeria oocytes.[65,70,71]

Traditionally poultry production was considered as secondary income generation methods in addition to other agricultural activities. Mostly the participant in poultry production in the community was females and children's. This was because they were not go far away from home and they can easily look after the chicken. Even though they were poorly managed their chickens, they use as the most accessible source of Income during need of cash for emergency time. The knowledge of farmers on poultry coccidiosis and the risk factors associated to the disease was not being enough or they did not know. However, they know only the clinical signs of the diseases of diseased chickens for all type of the disease. This means they can not differentiate specific sign of disease. They also responded that there was lack of public and private veterinary services overlook the health impact on poultry production and no drugs and biological preparations for poultry were available in their stock. Therefore, farmers apply their own traditional practices to treat and control chicken diseases, which may not be usually effective.

CONCLUSION AND RECOMMENDATION

In general, this study showed that poultry coccidiosis is an important chicken health problem for poultry owners in the area. Age, breed and management systems were among risk factors that were associated with chicken coccidiosis in the study areas. Chickens of all ages can be infected with coccidiosis, but 2-8-week (young) chickens are most commonly affected. The finding also implied that, coccidiosis is one of the most important diseases under the intensive management and also display it is an economically important disease under poorly managed systems. Overcrowding, Wet and moist environment in poultry house are suitable to develop oocysts in to sporulation and could increase the risk of coccidiosis, especially in exotic breed of chickens. Therefore, based on the above conclusions the following recommendations are forwarded keep.

The house should be cleaned to keep hygienic poultry house by washing the walls, floor, and continuously disposal of the litter and disinfect the room using appropriate disinfectant in order to prevent contamination of litter. Awareness should be created about the coccidial disease and the risk factor that exacerbate the disease like overcrowding, ventilation ways of giving feed and water and effect of this coccidial disease on the economy to the farmers, poultry farm owners.

Good biosecurity practices and Anticoccidial vaccines should be given regularly for the prevention and control of coccidiosis so as to reduce the high prevalence of coccidiosis observed in this study particularly in the intensive production system.

DATA AVAILABILITY

The data will be provided upon request from the corresponding author.

REASON FOR NOT HAVING THE APPROVAL FROM ETHICAL COMMITTEE AND THE INSTITUTIONAL REVIEW BOARD

Keeping in view the public health significance of poultry coccidiosis most important diseases under the intensive management and also display it is an economically important disease under poorly managed systems. The goal of this study was to determine prevalence of poultry coccidiosis in and around Haramaya, to identify the risk factors associated to the diseases occurrence.

CONFLICTS OF INTEREST

There are no conflicts of interest in the research area or during the sample collection period for the questionnaire at the poultry farm.

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