A Study on Prevalence and Associated Risk Factors of Gastrointestinal Nematodes of Cattle in and around Assosa Town

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Abstract: A cross-sectional study was carried out from November 2014 to April 2015 to determine the prevalence and risk factors associated with gastrointestinal nematode parasitism in cattle in and around Assosa town, Benishangul Gumuz regional state, western Ethiopia. A total of 384 fecal samples of cattle of different sexes and age groups were collected and examined for gastrointestinal nematode eggs using floatation techniques. Out of these, 105 (27.3%) animals were found positive for single and mixed gastrointestinal nematode infection. The prevalence of gastrostrointestinal nematodes based on sex of the study animals was identified and out of the total 182 female animals examined 48(26.4%) were infected by different species of gastrointestinal nematodes of which 21(43.8%), 17(35.4%), 4(8.3%), 4(8.3%), 2(4.2%) were found to be infected by *Strongyle, Ascaris, Trichuris, Strongyles and Ascaris, Ascaris and Trichuris species* respectively. Similarly, of the 202 male animals examined 57 (28.2%) were infected by different species of gastrointestinal nematodes out of which 21(36.8%), 21(36.8%), 4(7%), 4(7%), 2(3.5%), 1(1.7%) were found to be infected by *Strongyle, Ascaris, Trichuris, Strongyles and Ascaris, Ascaris and Trichuris and Strongyles, Ascaris and Trichuris species* respectively. Cattle harboring one parasite eggs were more common 90(85.7%) than those harboring two 14 (13.3%) or three 1(0.9%). Sex-wise prevalence of gastrointestinal nematodes was assessed and it was not found statistically significant ($p>0.05$). While significantly higher prevalence ($P<0.05$) of infection of study animals by gastrointestinal nematodes was recorded in calf 32(40%) than in young 28(22.6%) and adult 45(25.3%) animals. There was also statistically significant variation ($P<0.05$) among the different body conditions of study animals, where highest prevalence was recorded in poor 57(54.9%) followed by medium 31(18.7%) and good 17(14.9%) body condition. Hence, in this study body condition and age of the study animals are important risk factors associated with gastrointestinal nematode infection in the study area implying the need for participatory approach to mitigate the impact of parasitism.
[Haymanot G, Birhanu E, and Haile W. **A Study on Prevalence and Associated Risk Factors of Gastrointestinal Nematodes of Cattle in and around Assosa Town.** *Biomedicine and Nursing* 2017;3(1): 45-50]. ISSN 2379-8211 (print); ISSN 2379-8203 (online). http://www.nbmedicine.org. 6. doi:10.7537/marsbnj030117.06.

Keywords: Assosa, Cattle, Fecal, Floatation, Gastrointestinal Nematode, Prevalence, Risk factor

1. Introduction

Ethiopia is one of the richest countries in livestock population. Central statistical Authority (CSA, 2013) report shows that the country has 53, 990, 061 heads of cattle of which 558, 551 are found in the Benishangul Gumuz regional state. This sector of production is a determinant component for the overall farming systems serving as a source of draft power for the majority of rural population besides supplying products (millk and meat), by-products (manure, skin and hides) and cash income from the sale of livestock and their products (Ahmed, 2001).

Even though Ethiopia has immense resources and a home for many genetic resources, the livestock of the country are characterized by low productivity levels even below the average of Africa, leading to low per capital consumption of animal products. This is mainly due to the presence of high and wide spread prevalence of animal diseases (Gebru, 2003).

Parasitic diseases of production animals are distributed in the world. The effects of parasitism can be separated in two categories: sub-clinical (asymptomatic) and clinical (symptomatic). The sub-clinical effects include losses in animal productivity such as mild production, reduced weight gain, altered carcass composition and conception rate, where as visible disease symptoms like diarrhea, anemia, associated edema and roughness of coat are clinical effects (Eysker and ploeger, 2000).

The effect of internal parasites on cattle varies with the severity of infestation as well as age and stress level of animals. Young hosts are highly susceptible to parasites during their first exposure to pasture (Nesru, 1997). The internal parasites known to cause diseases in cattle can be grouped as helminthes and protozoa (Mckenna, 1983). Helminthiasis is considerable significance in the wide range of agro-climatic zones in sub Saharan Africa and constitutes one of the most important constraints to cattle production (ILCA, 1991).

Gastrointestinal parasite infestations are a worldwide problems for both small and large scale

farmers but their impact is greater in sub Saharan Africa in general and Ethiopia in particular due to the availability of a wide range of agro-ecological factors suitable for diversified hosts and parasite species (Fikru *et al*., 2006). They cause retarded growth, lower productivity and high economic losses, thus affecting the income of small holder dairy farming communities (Muhammad *et al*., 2010).

The low productivity is due to a number of factors among which quantitative and qualitative deficiencies in the feed resource base, diseases, poor animal performance level and insufficient knowledge on the dynamics of the different types of farming systems existing in the country (Plaizier, 1993) can be mentioned. Prevalence of gastrointestinal helminthes has been reported ranging from 0.7 to 84.1% in domestic animals from various parts of the world. There are many associated risk factors influencing the prevalence of gastrointestinal helminthes including age, sex, weather condition and husbandry or management practice (Muhammad *et al*., 2010).

Despite the immense progress made to control parasitosis, farmers in Ethiopia continue to incur significant losses due to insufficient availability of information in the epidemiology of the parasites. Furthermore, parasites appear to be a major factor to lower productivity of Ethiopian livestock sector (Fikru *et al*., 2006). To take control measures, assessment and epidemiological surveillance of nematode parasites by different diagnostic methods like fecal examination and identification of specific species of nematode is very important (Ashutosh *et al*., 2011).

Most of the studies conducted on the prevalence and distribution of gastrointestinal nematodes in the country tended to be in the central and Northern highlands and semi-arid regions of Eastern Ethiopia and little is known about the prevalence and distribution of gastrointestinal nematodes infecting cattle in and around Assosa town. Therefore, the present study was designed to assess the prevalence of gastrointestinal nematode parasites infecting cattle in and around Assosa town, to investigate associated risk factors and to forward the possible control measure.

2. Materials and Methods

2.1. Study Area

The study was conducted from November 2014 to April 2015 in and around Assosa town, capital city of Benishangul Gumuze regional state, western Ethiopia. Assosa town is located at a distance of about 678 km from the capital city, Addis Ababa. The region is found in the north- west part of the country at latitude 9 and 11°N and 34 and 35°E and at an altitude of 1401-1544 m above sea level. The average annual rainfall of Assosa district is 1330 mm and the annual ambient temperature varies from 21-31°$_C$ (NMSA, 2013). In and around Assosa town there are 71,351 head of cattle population (CSA, 2013).

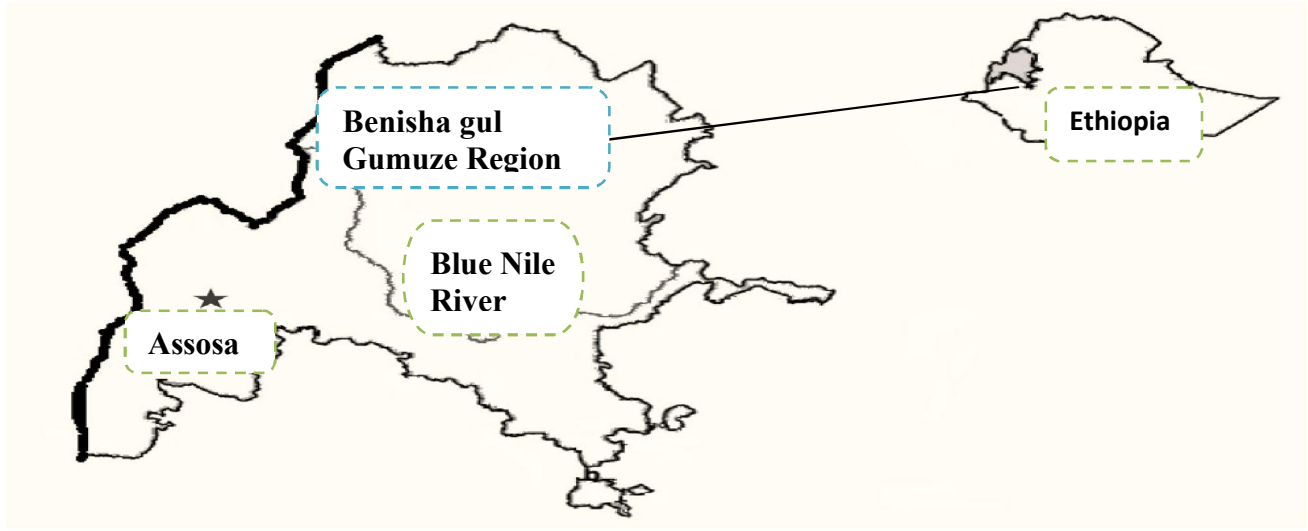

Figure 1. Map of the study area **(Source:** Tesfaye and Inger, 2007)

2.2. Study Population

2.1. Study animals and management

The study was conducted on a total of 384 cattle that were brought to Assosa Veterinary clinic from Assosa town and its surroundings rural areas. During sample collection age and sex of the animals were recorded properly. But due to the absence of written records, the age of study animals was estimated based on owners' response and by looking the dentition pattern of the animals (Frandson, 1992). Based on this study animals were classified as calf (<1 year), young (1-3 years) and adult (>3 years). Body condition scoring was made according to (Morgan *et al.* 2006)

and recorded as poor, medium or good. Study animals were animals from extensive management system.

2.2. Study Design

Cross-sectional study design was used to determine the prevalence of gastrointestinal nematode parasites in cattle during the study period and to investigate the associated risk factors.

2.3. Sampling Methods and Sample Size Determination

Systematic random sampling method was used to select study animals. Determination of the sample size was made based on an expected prevalence of 50% because there was no previous study conducted in the study area. The desired sample size for the study was calculated using the formula given by (Thrusfield, 2005) with 95% confidence interval and 5 % absolute precision. Therefore based on the above formula.

$$n=\frac{1.96^2 \text{ x Pexp } (1-\text{Pexp})}{d^2}=384$$

Where n is number of animals to be sampled, P is the expected prevalence of the disease and d is precision level (0.05).

2.4. Sample collection and examination

A total of 384 fecal samples were collected directly from the rectum of randomly selected animals using a gloved hand and placed in air and water tight sample vials. During sampling, data with regard to age, sex, body condition and date and place of sample collection were recorded for each sampled animal. Finally samples were transported to Assosa regional veterinary diagnostic, surveillance, monitoring and study laboratory for laboratory analysis.

2.5. Coprological Examination

Fecal samples were collected in polyethylene plastic labeled bags and were examined by floatation technique according to the procedure of (Urquhart *et al.,* 1987). Fecal samples were qualitatively examined on the day of collection or stored in a refrigerator at $+4°_C$ for processing the next day. Identification of the eggs was made on the basis of their morphology using keys given by (Soulsby, 1982).

2.5.1. Floatation

Fecal samples were examined according to the procedure of (Urquhart *et al*. 1987) as follow. About three grams of fecal samples were taken from each fecal sample and triturated in pistol mortar; floatation fluid of saturated salt solution was added, and placed to each of the sample tube and centrifuged at 1500 rpm for two minutes. After centrifugation the samples were removed, top layer from each sample was taken using fine pasture pipette. 2 - 3 drops from each sample were put on microscope slide and covered with slid cover and examined under ten times objective lenses of the microscope and results were recorded. Care was taken to keep the centrifuge speed low for shortest time in order to avoid damage or ruptured of the parasitic ova present in suspension (Urquhart *et al*., 1987).

2.5.2. Microscopical examination

The prepared samples on micro slides taken from floatation method were examined under a microscope at the magnifications of 10x10 for nematode eggs. Three types of eggs were observed under microscopic examination with different egg morphology. The *Strongyle* type-egg, *Ascaris* and *Trichuris* eggs were observed during microscopic examination with respective morphology of ellipsoidal or oval shaped eggs, sub globular with thick shell and lemon shape. As time delay between processing the sample and reading the count results in dramatic decline of egg numbers and change of egg appearance, a few samples were prepared at a time.

2.6. Data Management and Analysis

Data on individual animals and parasitological examination results was entered in to MS-excel spread sheet program to create a data base and screened for errors that might have occurred during the entry. The data was analyzed using stata-11(SPSS statistics 20) versions and Pearson chi-square test. Descriptive statistical tools such as frequency tables, percentages, were used to determine the association among prevalence of gastrointestinal nematode parasites infestation with body condition, sex and age of the study animals. Significant difference was considered when $P<0.05$ (Clark, 1992).

3. Results

Coprological examination conducted on 384 fecal samples revealed an overall prevalence of 27.3% of gastrointestinal nematode infection in the study area. Variation had been observed on the occurrence of different types of gastrointestinal nematode parasites. Out of 105 positive fecal samples three gastrointestinal nematode genera egg-types were detected. *Strongyle*-type egg 42(40%), *Ascaris* 38(36.2%), *Trichuris* 10(9.5%), Strongyles and Ascaris 9(8.6%), Ascaris and Trichuris 5(4.8%) and Strongyle, Ascaris and Trichuris 1(0.9%) (Table1).

The prevalence of gastrostrointestinal nematodes based on sex of the study animals was identified and out of the total 182 female animals examined 48(26.4%) were infected by different species of gastrointestinal nematodes of which 21(43.8%), 17(35.4%), 4(8.3%), 4(8.3%), 2(4.2%) were found to be infected by *Strongyle, Ascaris, Trichuris, Strongyles and Ascaris, Ascaris and Trichuris species* respectively. Similarly, of the 202 male animals examined 57 (28.2%) were infected by different species of gastrointestinal nematodes out of which 21(36.8%), 21(36.8%), 4(7%), 4(7%), 2(3.5%), 1(1.7%) were found to be infected by *Strongyle, Ascaris, Trichuris, Strongyles and Ascaris, Ascaris*

and Trichuris and Strongyles, Ascaris and Trichuris species respectively(Tables 1&2).

Table 1: Prevalence of *Strongyle*, *Ascaris* and *Trichuris* Eggs in relation to Age and Sex

Parasite Species	Age group			Sex		Total
	Calf	Young	Adult	Male	Female	
Strongyle	12(28.6%)	10(23.8%)	20(47.6%)	21(50%)	21(50%)	42
Ascaris	9(23.7%)	10(26.3%)	19(50%)	21(55.3%)	17(44.7%)	38
Trichuris	2(20%)	3(30%)	5(50%)	6(60%)	4(40%)	10
Strongyle and Ascaris	5(55.5%)	3(33.3%)	1(11.1%)	5(55.5%)	4(44.4%)	9
Ascaris and Trichuris	3(60%)	2(40%)	-	3(60%)	2(40%)	5
Strongyle, Ascaris and Trichuris	1(100%)	-	-	1(100%)	-	1
Total	32(8.3%)	28(7.3%)	45(11.7%)	57(14.8%)	48(12.5%)	105

Most of the cattle 90 (85.7%) were infected by single gastrointestinal nematode while the remaining were infected by two 14 (13.3%) and three 1(0.9%) types of gastrointestinal nematodes.

The prevalence of gastrointestinal nematode based on sex was assessed and there was no statistically significant sex-related difference (P>0.05) (Table 2). Meanwhile, significantly higher prevalence (P < 0.05) of infection of study animals with gastrointestinal nematodes was recorded in calves 32(40%) than in young 28(22.6%) and adults 45(25.3%) (Table2). There was also statistically significant variation (P<0.05) among the different body condition the study animals, where highest prevalence was recorded in poor 57(54.9%) followed by medium 31(18.7%) and good 17(14.9%) body condition animals (Table 2).

Table 2: Prevalence of gastrointestinal nematode parasites based on different risk factors

Risk factors No of Animals Examined		No of Animals positive	Prevalence	Chi-Squaretest(x^2)	P-Value
Age					
Calf	75(19.5%)	32	40%		
Young	115(29.9%)	28	22.6%	7.8	0.021
Adult	194(50.5%)	45	25.3%		
Sex					
Male	202(52.6%)	57	28.2%	0.08	0.78
Female	182(47.4%)	48	26.4%		
Body condition					
Poor	104(27.1%)	57	54.9%		
Medium	166(43.2)	31	18.7 %	54.6	0.001
Good	114(29.7%)	17	14.9%		
Total	384	105	27.3%		

4. Discussions

The current study revealed an overall prevalence of 105(27.3%) of gastrointestinal nematode infection of cattle in and around Assosa twon. This finding was lower than 41% reports made by (Cheru *et al*., 2013) in East Showa Zone of Oromia region and 66.25% (Etsehiwot, 2004) in and around Hollota town. The difference in prevalence of the present and previous findings might arise from the difference in management system of study animals, topography, deworming practices, sample size taken, variation in the study season and climatic condition of the localities that may favor or disfavor the survival of infective stage of the parasites.

In this study, the gastrointestinal nematode parasites identified were *Strongyl*e, *Ascaris* and *Trichuris* with prevalence of 42(40%), 38(36.2%), 10(9.5%) respectively. The present finding was in agreement with previous reports of 56.07%, 54% and 16.82% for respective parasites by (Tigist *et al*., 2012) in northern Gonder of Amhara region. Regarding to mixed infection, Strongyles and Ascaris 9(8.6%), Ascaris and Trichuris 5(4.8%) and Strongyle, Ascaris and Trichuris 1(0.9%) were registered. The existence of more than one nematode parasites in host animals of the study area has an additive pathogenic effect and according to (Rahmeto *et al.*, 2010), Ethiopia is a country where extremes of temperature and rainfall are experienced thus favoring the development, distribution and survival of infective stage of nematode parasites.

The present study indicated the effect of age on the occurrence of gastrointestinal nematodes with prevalence being highest in animals less than one year 32(40%) followed by adult 45(25.3%) and young 28(22.6%) cattle. This finding was in agreement with

the earlier reports in Kenya (Anene *et al.,* 1994) and (Waruiru *et al.,* 2000) which showed that the susceptibility and pathogencity of nematode infection were greater in young animals than in matured animals. Age has an effect on responsiveness or to the development of immunity causing lower worm fecundity in adult animals (Ploeger *et al*., 1994). Moreover, adult animals may acquire immunity to the parasites through frequent challenge and expel the ingested parasites before they establish infection (Fishes and Say, 1989). Generally as described above the prevalence of gastrointestinal nematodes was higher in animals under one year as opposed to matured one. Hence, matured cattle act as reservoirs of infection and constant sources of infection for the more susceptible young animals.

In this study, there were no sex-related differences in the prevalence of gastrointestinal nematodes in cattle (P>0.05). The absence of association between sexes in the prevalence of gastrointestinal nematodes in cattle is in agreement with the study conducted by (Teka, 2008) in and around Bahir Dar and (Fikru *et al*., 2006) in western Oromia where both male and female animals have equal chance of exposure to the parasites in a country where management system is mainly extensive.

The study further revealed that body condition of the study animals showed significant association with the prevalence of the parasites. Poor body condition animals have higher prevalence than medium and good body condition animals with prevalence of 57(54.9%), 31 (18.7%) and 17(14.9%) respectively. This finding was in agreement with the study carried out by (Keyyu *et al*., 2003). Therefore, the change in body condition could be the possible indicator that the animals were infected by gastrointestinal nematodes. Animal with poor body condition have low immunity for parasitic and other infectious diseases.

5. Conclusions

The overall moderately high prevalence of gastrointestinal nematodes obtained in cattle of Assosa town and its surrounding rural areas indicated the importance of the problem and its contribution to hampering the productivity, work performance and general health status of these animals. The predominant gastrointestinal parasites identified were *Strongyl*e, *Ascaris* and *Trichuris*. Due to the mixed nature of infecion of hosts by these parasites their role in reducing the productivity and the general health status cannot be under-estimated. These indicate that Assosa twon and its surrounding rural areas are favorable for the successive perpetuation of the mentioned parasites and for their subsequent transmission to susceptible host. Therefore, a strategic antehelmintic treatment should be adopted and extended to farmers taking in to account the specific situation of each agro-ecology in the region; farmers have to be educated about the impact of parasitism on the health and productivity of animals as to implement participatory approach to mitigate the impact of parasitism. Further epidemiological studies should be conducted in different agro-ecological sites in the region.

Acknowledgements:

The authors would like to extend their gratitude to Assosa Regional Veterinary diagnostic laboratory that provide unreserved help for identification of the parasites and multi-directional cooperation.

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References

1. Ahmed, M. (2001): Raw hides and skin improvement in Ethiopia. A paper presented on "technical workshop on good practice for the Ethiopian hides and skin industry". Imerial Hotel conference Hall, Addis Ababa, Ethiopia, Dec 4-7/2001.
2. Anene, B.M., Onyekwodiri, E.O., Chime, A.B. and Anika, S.M. (1994): A survey of gastrointestinal parasites in cattle of southeastern Nigeria. Preventive Veterinary Medicine. 20: 297-306.
3. Ashutosh, W., Anwar, R.K.T., Singla, L.D., Eda, S., Naveen, K. and Yogesh, K. (2011): Prevalence of gastrointestinal helminthes in Cattle and buffaloes in Bikaner, Rajasthan, India. *Veterinary World*. 4: 417-419.
4. Cheru, T., Birhanu, A., Diriba, L. and Eyob, E. (2013): Prevalence of gastrointestinal parasitism of cattle in East Showa Zone, Oromia Regional State, and Central Ethiopia. Pp. 55-62.
5. Clark, G.M (1992): Statistics and Experimental Design, A Series of Student text in Contemporary Biology 2nd ed. London: Edward. Arnold. pp. 124-142.
6. CSA (2013): Central Statistical Agency of the federal democratic republic of Ethiopia. Agricultural sample survey (2012/2013) Volume II. Report on livestock and livestock characteristics (private peasant holdings), Central Statistical Agency, Addis Ababa, Ethiopia. pp. 1-194.
7. Estehiwot, W. (2004): A study on bovine gastrointestinal helminthes in dairy cows in and around Hollota. DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine. Debre-Zeit, Ethiopia. Pp. 51-60.

8. Fikru, R., Teshale S., Reta, D. and Yosef. K. (2006): Epidemiology of Gastro Intestinal Parasitesof Ruminantsin western Oromia, Ethiopia. *International Journalof Applied Researchin Veterinary Medicine*. 4: 51-57.
9. Fishes, S.M. and Say, R.R. (1989): Manual of Tropical Veterinary Parasitology. UK. pp. 342-347.
10. Frandson, R.D. (1992): Anatomy and physiology of farm animals. Associate professor, department of anatomy and neurobiology collage of veterinary medicine and bio medical sciences. 5th ed. Colorado State University, for Collins. Colorado. pp. 306-308.
11. Gebru, H. (2003): Experience and way forward community based animal health service delivery ILCA. (1991): Hand book of African livestock statistics ILCA. Addis Ababa, Ethiopia. Pp.78.
12. Keyyu, J.D., Kssuku, A.A., Kyvsgaard, N.C. and Willingham, A.L. (2003): 3rd gastro intestinal nematodes in indigenous zebu cattle under pastoral and nomadic management systems in the lower plan of southern highlands of Tanzania. *Veterinary Research Communication*. 27: 371-380.
13. Mckenna, P. B. (1983): Parasitic causes of diarrhea in young cattle preceding of a course in dairy cattle medicine, Massey University.
14. Morgan, E.R., Torgerson, P.R., Shaikenov, B.S., Usenbayev, A.E., Moore, A.B., Medley, G.F. and Milner-Gulland, E.J. (2006): Agricultural restructuring and gastrointestinal parasitism in domestic ruminants on the range lands of Kazakhstan. *Veterinary Parasitology*. 139: 180-191.
15. Muhammad, N.K., Mohammad, S.S., Mohammad, K.K. and Zafar, A.H. (2010): Gastrointestinal Helminthiasis and associated determinants in domestic ruminants of district Tobk Singh, Punjab, Pakistan. *Parasitology Research*. 107: 787-794.
16. Nesru, H.M. (1997): Study on calf mortality of Adamitulu livestock research center. In proceedings of the 5th conference of ESAP (Ethiopia society of animal Production), Addis Ababa, Ethiopia, 57-Eysker, M, and Ploeger, H.W. (2000): Value of present diagnostic methods for GI nematode infection in ruminants, Division of parasitology and Tropical veterinary medicine Utrecht University, The Netherlands 109-116pp.
17. NMSA (National Meteorological Services Agency), (2013): Monthly report on temperature and Rainfall distribution for Kamashi Zone, Regional Metrological Office, Assosa, Ethiopia, pp: 17-19.
18. Plaizier, J.C.B. (1993): African agriculture and contribution of ruminant livestock, constraints to and opportunities for increased ruminant livestock production and productivity and strategies for research. In: Improving the productivity of Indigenous African Livestock. Vienna, Austria. pp. 7-12.
19. Ploeger, H.W., Kloosterman, A., Rietveld, W.B., Hilderson, H. and Hollanders, W. (1994): Quantitative estimation of the level of exposure to gastro intestinal nematode infection in first-year calves. Veterinary Parasitology.55: 258-315.
20. Rahmeto, A., Meberahtu, G., Solomon, M., Fufa, A. and Alemayehu, R. (2010): Gastrointestinal nematod infection in small ruminants under the traditional husbandry system during the dry season in southern Ethiopia. *Tropical Animal Health and Production*. Pp.1112-1117.
21. Soulsby, E.J.L. (1982): Helminthes, Arthropods and Protozoa of domesticated animals. 7th ed. London: Bailliere Tindal. Pp. 213-245.
22. Teka, M. (2008): A study on prevalence of Gastrointestinal Helminthes in Cattle with Patent Natural Schist soma Infection in and Around Bahir Dar, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.
23. Tesfaye, A. and Inger, N.(2007): Benishangul Gumuze Region in Ethiopia. Acenter of endemism for Chlorophytum-a description of C. pseudoccaule spp. nov. (Anthericeae). Kew Bulletin 62:129-132.
24. Thrusfield, M. (2005): Veterinary Epidemiology Singapore black well science. London. pp. 183-2016.
25. Tigist, A., Basaznew, B. and Mersha, C. (2012): Occurrence of Gastro Intestinal Nematodes of Cattle in and Around Gondar Town, Amhara Regional State, Ethiopia. pp. 28-33.
26. Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, A.M. and Jenning, F.W. (1987): Veterinary Parasitology. Longman Scientific & Technical, Department of Veterinary Parasitology. The Faculty of Veterinary Medicine, the University of Glasgow, Scotland.
27. Waruiru, R.M., Kyvsaard, N.C., Thamsborg, S.M., Nansen, P., Bogh, H.O., Munyua, W.K. and Gathuma, J.M. (2000): Prevalence and intensity of helminth and coccidial infections in dairy cattle in Central Kenya. *Veterinary Research* Communications. 24: 39-53.

3/5/2017