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Prevalence of Bovine Fasciolosis and Major Risk Factors Associated with the Disease in and Around Debre Markos

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Abstract: A cross sectional study was conducted to determine the prevalence of bovine fasciolosis and associated risk factors in and around DebreMarkos town from November 2014 to April 2015. Simple random sampling technique was employed to select the study animals. A total of 384 faecal samples were collected and subjected to coprological examination. Sedimentation technique was used to detect the presence or absence of fasciola egg in the fecal sample collected. Based on the coprological examination the overall prevalence of bovine fasciolosis was 37.5%. Sex, age, peasant associations, body condition and breed were taken into consideration where 42.1% and 33.8% were recorded for female and male cattle, respectively. The prevalence that was determined from coprological examination was highest in Enerata (43.6%), followed by DebreMarkos town (40 %), Yetijan (33.3 %%) and Wonka (32.8%). However, there was no statistical significant variation ($P > 0.05$) in the prevalence of fasciolosis based on sexes and localities of the animals. The result of the study indicated that breed, age and body condition had significant difference ($P < 0.05$) as greater magnitude of infections were detected in cross breed (56.6%), adult age group (42.5%) and poor body condition (69.7%), respectively. The result of this study disclosed that the disease has a significant economic important parasitic disease in the area and confirmed the endemicity of fasciolosis at the grazing lands. In view of this, further epidemiological investigation on economic significance, prevalence, species composition and risk factor should be needed in the study area.

Key words: Bovine · Coproscopy · Debremarkos · Fasciolosis · Prevalence

INTRODUCTION

Livestock are extremely important in Ethiopia to economic development and to poverty reduction. The latest animal population census by CSA [1] shows that Ethiopia has 52 million heads of cattle, 33 million heads of sheep, 30 million goats, 5.8 million equine species, 2.5 million camels and over 42 million poultry and it is the largest in Africa.

Livestock are the main stays of the livelihood of the majority of the human population by giving draft power, income to farming communities, means of investment and important source of foreign exchange earning to the nation. Moreover, livestock are important cultural resources, social safety nets and means of saving and are also supply for crop production and transport, as source of meat, milk and egg and source of income [2]. However, the economic benefit derived from the livestock sub-sector does not commensurate with the potential and the sub-sector remained untapped. The challenge facing livestock development in Ethiopia is daunting. The potential for Ethiopia to improve the productivity of the livestock sub-sector is clear, however, a number of constraints need to be addressed. Areas in need of attention include animal health and nutrition, availability of quality support services such as extension service, upgrading and dissemination of technology, package to improve animal breeding, marketing and processing and the collection and analysis of baseline data on which to plan development [3].

The widely prevalent livestock diseases are major constraints to Ethiopian livestock development. The vulnerable of livestock production and trade to disease epidemics is undermining investment in a potentially valuable economic activity which would increase employment in rural areas, raise rural incomes and assist

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in alleviating poverty [4]. Among the many parasitic problems of the domestic animals, fasciolosis is the major disease which imposes direct and indirect economic impact on livestock production in ruminants which are the natural host for *Fasciola* infestation particularly in cattle and sheep and occasionally in man. The disease is caused by digeneantrematodes of the genus *Fasciola* commonly referred to as liver flukes.

The two species most commonly implicated as the etiological agents of fasciolosis are *Fasciola hepatica* and *Fasciola gigantica* in Ethiopia [5]. *Fasciola hepatica* and *F. gigantic* are coexist in Ethiopia; mixed infection with both species is encountered in areas between 1200-1800 m.a.s.l. both *F. hepatica* and *F. gigantica* are transmitted by the snails of the family Lymnaesidae. Infestation with fasciolosis is usually associated with grazing wet land and drinking from the snail infesting watering places [6]. Fasciolosis or liver fluke has worldwide distribution. Animal health and economic impact of fasciolosis may vary greatly from year to year, depending on the climate, management, level of infection, host immune status and age of the animal. In the endemic areas, several clinical outbreaks are frequent. The clinical manifestation of fasciolosis in infected animal has three forms: acute, sub-acute and chronic forms [7].

Bovine fasciolosis is an economically important parasitic disease of cattle in tropical and subtropical countries responsible for considerable economic losses in the cattle industry, mainly through mortality, morbidity, reduced growth rate, condemnation of fluke infected liver, increased susceptibility to secondary infections and expense due to control measures [8]. According to the study conducted by Tadele and Worku [9] and Fufa *et al.* [10] fasciolosis caused on average loss of 6300 USD per annum at Jimma and Sodo Municipal abattoir, respectively. Apart from its veterinary and economic importance throughout the world, fasciolosis has been shown to be reemerging and widespread affecting many people [11]. A number of studies have been undertaken with regard to prevalence and evaluation of the economic loss due to fasciolosis in different parts of Ethiopia [9, 10, 12-17].

In spite of the aforementioned prevailing situation and the presence of a number of problems due to fasciolosis, there is scarcity of well-documented information on the occurrence of fasciolosis among cattle in DebreMarkos, Ethiopia. So this study was designed with the aims to determine the prevalence of bovine fasciolosis and major risk factors associated with the disease in and around DebreMarkos.

MATERIALS AND METHODS

Study Area: The study was conducted from November 2014 to April 2015 in and around DebreMarkos, the capital of East Gojjam Administrative Zone, which is located in the north west of the capital city of the Federal Democratic Republic of Ethiopia, Addis Ababa at a distance of 300 Km and 265 Km to the capital of AmharaNation Regional State Bahir Dar. The Geographical location of the study area is located between 10°17'00" to 10°21'30" N Latitudes and 37°42'00" to 37°45'30" E longitudes and its elevation ranges in altitude from 2350-2500 m above sea level. The town has 1380 mm average annual rainfall and the average temperature temperatures of 18.5°C. The livestock population of the area comprises of 13, 771 cattle, 1604 equine, 7439 shoat, 15, 025 poultry and 724 beehives. The main farming system in the area is mixed farming [1].

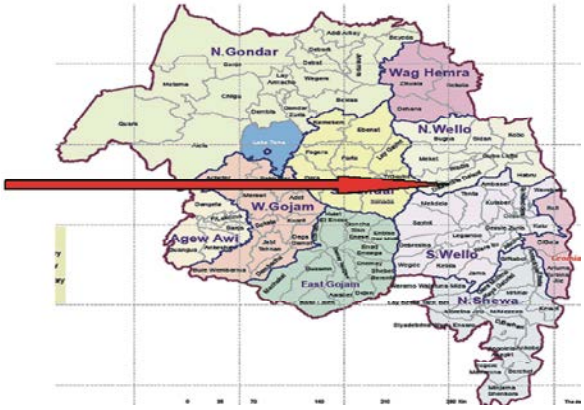

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Fig. 2: Map of study area
Source: [35](Wikipedia, 2014). Not found

Study Animals: A total of 384 heads of cattle were subjected to qualitative coprological examination. The selected animals were from both local and cross breeds of different age, body condition and sex groups in four localities (Wonka, DebreMarkos, Yetijan and Enerata). They are managed under extensive management system.

Study Design: A cross-sectional study was conducted from November 2013 to April 2014 in and around DebreMarkos town to determine the prevalence and assess associated potential risk factors of the disease.

Sampling Technique and Sample Size Determination: Simple random sampling technique was employed to select the study animals. The total number of cattle

required for the study was calculated based on the formula given by Thrusfield [18]. By rule of thumb where there is no information for an area, it is possible to take 50% expected prevalence. In this study 50% expected prevalence with 5% desired level of precision and 95% of confidence interval was used to calculate the sample size using the following formula.

$$n = \frac{196^2 . P_{exp}(1 - P_{exp})}{d^2}$$

where,

n = Required sample size
P_{exp} = Expected prevalence= 50%
D = Desired absolute precision=5%.

Therefore, the total sample size was estimated to be 384.

Study Methodology: A total of 384 fecal samples were collected during the entire period of the study, directly from the rectum of selected animal using a gloved hand and place into a universal bottle containing 10% formalin. Samples that were not processed within 24 h were stored in a refrigerator at 4°C. During sampling information on sex, breed, origin, body condition and age of individual animals were recorded. Based on the body condition, animals were grouped as poor, medium and good [19]. Age was classified as young (<5 years) and adult (>or =5 years) [20]. Samples were taken to the Sentera Veterinary College, Parasitology Laboratory as fresh as possible.

Sedimentation technique was used to detect the presence or absence of fasciola egg in the fecal sample collected as described by Antonia *et al.* [21]. To differentiate between eggs of *Paramphistomum* species and *Fasciola* species, a drop of methylene blue solution was added to the sediment where eggs of *Fasciola*s pecies show yellowish colour while eggs of *Paramphistomum* species appears white

Data Management and Analysis: All raw data generated from this study were coded and entered in MS Excel database system. Using Statistical Package for Social Science (SPSS) version 20 Computer program, data were analyzed. The prevalence of fasciolosis was calculated as the number of infected individuals divided by the number of cattle examined x 100. Categorical data were analyzed with the Pearson's Chi-square (χ^2) test to measure the association between prevalence of the parasite with the potential risk factors as a statistical tool. For all analysis, $P < 0.05$ was considered as significant differences between the parameters measured.

RESULTS

From the total of 384 fecal sample examined for fasciolosis 144 (37.5 %) were found to be positive for fasciola egg by coprological examination. The result revealed that the prevalence of bovine fasciolosis was 42.1% in females and 33.8% in males, respectively. There was no statistically significant difference between the sex and the occurrence of the disease (χ^2= 2.790, P >0.05) (Table 1).

The result showed that higher prevalence was observed in age greater than or equal 5 years (42.5%), where as relatively least prevalence was recorded in age less than 5 years (30.1%). There was statistically significant difference between the age groups and the occurrence of the disease (χ^2=6.092, P < 0.05) (Table 2).

The result revealed that higher prevalence of bovine fasciolosis was recorded in poor body condition (69.7 %) and lower prevalence was observed in good body condition respectively, (26.6%), with strong statistical significant difference between body condition score of the animal and occurrence of the disease (χ^2=33.525, P < 0.05) (Table 3).

The result revealed that higher prevalence of bovine fasciolosis was recorded in cross breeds (56.3%) than local breeds (35.8%) with statistically significant difference (χ^2= 5.101, P < 0.05) (Table 4).

The prevalence of bovine fasciolosis in different localities was found to be 43.6%, 40%, 33.3% and 32.8% in Enerata, DebreMarkos town, Yetijan and Wonka, respectively. The higher prevalence was observed. However, there was no statistically significant association (χ^2=3.300, P> 0.05) in prevalence of fasciolosis among the different localities studied (Table 5).

DISCUSSION

The present overall prevalence of fasciolosis during coprological examination collected from 384 cattle in and around DebreMarkos town was found to be 37.5%. This result is in line with the findings of Solomon and Abebe [22] in Mecha and Fogera, Yilma and Mesfin [23] Gondar, Bekele *et al*. [16] in Lemo district, Southern Ethiopia and

Table 1: Prevalence of bovine fasciolosis on sex basis

Sex	Animal examined	Positive animal (%)	Prevalence	χ^2	p-value
Male	213	72	33.8%	2.790	0.95
Female	171	72	42.1%		
Total	384	144	37.5%		

Table 2: Prevalence of bovine fasciolosis between ages.

Age	Animal examined	Positive animals	Prevalence	χ^2	p.value
Adult	228	97	42.5%	6.092	0.014
Young	156	47	30.1%		
Total	384	144	37.5%		

Table 3: Prevalence frequency of bovine fasciolosis among body condition

BCS	Animal examined	Positive animal	Prevalence	χ^2	p-value
Good	218	58	26.6%	33.525	<0.001
medium	123	56	45.5%		
Poor	43	30	69.7%		
Total	384	144	37.5%		

Table 4: Prevalence of bovine fasciolosis on different breeds

Breed	Animal examined	Positive animals	Prevalence	χ^2	p-value
Local	354	127	35.8%	5.101	0.024
Cross	30	17	56.6%		
Total	384	144	37.5%		

Table 5: Prevalence of bovine fasciolosis among different localities

Area	No. of animals examined	No.of positive animals	Prevalence (%)	χ^2	p-value
Enerata	94	41	43.6	3.300	0.384
DebreMarkos	100	40	40		
Yetijan	120	40	33.3		
Wonka	70	23	32.8		
Total	384	144	37.5		

Fikertemariam *et al.* [24] in and around Bahir Dar who reported prevalence of 37.2%, 33.42%, 34.9% and 36.72%, respectively. However, the finding was lower than reported by Dechasa *et al*. [6], Tadelle and Worku [9], Tsegaye *et al*. [15], Ephrem *et al.* [17] and Yilma and Mesfin [23] who reported a prevalence of 41.41%, 53.48%, 45.25%, 90.65% and 46.58%, respectively in different parts of Ethiopia.

Similarly [25] reported a prevalence of 49.55% bovine fascioliosis in Iran. This may be due to the expansion of animal health extension and veterinary services that means the opening of animal health post at kebeles/peasant association level and the intervention of nearby private veterinary drug shops (Pharmacies). Moreover the present study was conducted during the dry period of the year when the infection rate of fascioliosis is expected to be low, due to less availability of a suitable habitat for the snail (Intermediate host) and essential for the development of fluke eggs, miracidiae and dispersal of cercariae [26].

In contrary, the result was higher than the findings of Fufa *et al*. [10] in Soddo, Ethiopia, Abdeta *et al*. [27] in Aira and Gulliso, Ethiopia and Mellau *et al*. [28] at Arusha Tanzania, who reported a prevalence of 4.9%, 12.5% and 8.6% respectively. This may be attributed to the existence of more favorable environment for both the snail intermediate host and the parasite in the study area which has high capacity of water retention and is mostly marshy area for long periods during the dry season.

Prevalence rate of 33.8% and 42.1% was recorded in male and female animals, respectively. There was no statistically significant difference (P>0.05) between the two sexes, this signifies that sex has no impact on the infection rate and both male and female animals are equally susceptible and exposed to the disease. This could be associated with similar management, feeding practices and grazing on same pastures with similar exposure risk of infection. Similar results that support the present finding were reported by Solomon and Abebe [22], [29] Rahmato and Abie *et al*. [30]. On the contrary

the work done by Ephrem *et al*. [31] revealed high prevalence rates in the male than female. This is probably related to the management system with longer exposure of male out-door while females are kept in door during pregnancy and at the beginning of lactation.

Age of animals is one factor investigated in this study. There was a statistical significant variation (P< 0.05) between age and fasciolosis which is in consistent with the findings of other workers [32, 33]. Accordingly, the disease was highly prevalent in adult animals (42.1%) than young animals (30.1%) which could be attributed due to the fact that bovine fasciolosis is a chronic disease and the adult age reflects a much longer period of exposure to infection.

The prevalence of bovine fasciolosis in cross breeds (56.6%) was significantly higher (P<0.05) than the indigenous breeds (35.8%). This finding is in line with the findings of Fikirtemariam *et al*. [24]. The reason for significantly high prevalence of fasciolosis (P<0.05) in cross breed compared to local breeds could be due to lower resistance of cross than local breed. These cross breed animals needs supplementary feeding, good health care, sufficient water supply with defined grazing area in order to be more productive and resistance to disease, the management system must be different from local breeds, but this is not provided by the farmers, they are equally managed and equally grazed in the common grazing lands.

The association between the prevalence of fasciolosis and body conditions of the cattle was found to be statisticaly significant (P<0.05). The higher prevalence in poor body condition(69.7%) was observed compared to medium (45.5%) and good (26.6%) body conditions which is similar to the findings reported in Adwa [34] in Wolaita Sodo [14] in Jimma [30] and in Hossana [16]. The probable reason could be due to the fact that animals with poor body condition are usually more susceptible to various diseases including fasciolosis and due to reduced performance of the animals created by luck of essential nutrients and poor management by the animal owner. This may also due to the fact that poor body condition animals appear to be less competent in getting rid of liver fluke infection.

This study also revealed that there is no significant difference (P>0.05) among the different localities with respect to the prevalence of *Fasciola*eggs. This is due to similarity of agro-ecological conditions such as altitude, rainfall and temperature favoring the development of intermediate hosts and the parasite stages Local climatic condition does play a part in neighbouring areas notable variation can be observed in plain area and hill side area. However the result obtained from plain area like Enerata and DebreMarkos revealed relatively high infection

CONCULUSION AND RECOMMENDATIONS

The study was conducted on bovine fasciolosis by using coproscopical techniques in and around DebreMarkos town. There was a statistical significant variation between the prevalence of fasciolosis among animals with different body conditions, ages and breeds. However, the prevalence of bovine Fasciolosis has no significance association with sex and areas of the animals. In general it can be concluded that fasciolosis was found prevalent in the study areas. Moreover, the study area is suitable for the survival of the snail which worsened the situation for the future fasciolosis infection. This has been hindrance to the livestock production by causing remarkable direct or indirect economic losses in the study areas. There was paucity of information on control and prevention options of the disease in the study area. Hence, effective prevention and control strategies should be designed and applied in the study area. Based on the above conclusion the following recommendations are forwarded:

Strategic use of anthelminthic should be performed to reduce pasture contamination with fluke eggs.

Farmers should be aware of the transmission methods and control strategies of fasciolosis.

Further epidemiological investigation on economic significance, prevalence, species, compos ition and risk factor should be needed in the study area.

REFERENCES

1. CSA (Central Statistical Agency), 2009. Agricultural and Veterinary parasitology, survey. Report on livestock, poultry and bee hives population, private peasant holdings. Addis Ababa, Ethiopia, pp: 2.
2. DACA, 2006. Standard Treatment Guidelines for Veterinary Practice 1st ed. Chamber Printedhouse, support by U.S.A Agency for International development (USAID) and President.
3. Juyal, P. and L. Singal, 2011. Herbal immune modulatory and therapeutic approaches to control parasitic infection in livestock. Department of veterinary parasitology college of veterinary science Punjab agricultural university Ludhiana-1441004-india, pp: 1-8.

4. Shitaye, J., W. Tsegaye and I. Paulik, 2007. Bovine tuberculosis infection in animal and human population in Ethiopia: a review of veterinary Medicine, 52(8): 332-417.
5. Ahmed, E., K. Markvichitr, S. Jumwasorn, S. Koonawoothtthin and J. Achoothesa, 2007. Prevalence of Fasciola species infections of sheep in the middle awash river basin, Ethiopia. Southeast Asian Journal of Tropical Medical and Public Health, 38: 51-5.
6. Dechasa, T., W. Anteneh and G. Dechasa, 2012. Prevalence, gross pathological lesions and economic losses of bovine fasciolosis at Jimma municipal Abattoir, Ethiopia. Journal of Veterinary Medicine and Animal Health, 4(1): 6-11.
7. Dawit, K. and H. Adem, 2011. Abattoir survey on the prevalence and monitory loss associated with fasciolosis in sheep and goats. International Journal of Livestock Production, 2(9): 138-141.
8. Abdeta, D., T. Birhanu, M. Woyessa and C. Deressa, 2014. Study on the Prevalence of Bovine Fasciolosis at Aira and Gulliso District, Western Wollega Zone, Oromia Regional State, Western Ethiopia. African Journal of Basic and Applied Sciences, 6(2): 37-42.
9. Tadelle, T. and T. Worku, 2007. The prevalence and economic significance of Bovine Fasciolosis at Jimma Abattoir, Ethiopia. The internetional Journal of Veterinary Medicine, 3: 15.
10. Fufa, A., A. Loma and M. Bekele, 2009. Bovine fasciolosiscoprological, abattoir survey and its economic impact due to liver condemnation at Soddo municipal abattoir, Ethiopia, Tropical Animal Health Production, 42: 289-292.
11. Esteban, J., C. Gonzalez, F. Curtale, C. Munozantoli, M. Valero, M. Bargues, M. El-Sayed, A. El-Wakeel, Y. Abdel-Wahab, A. Montresor, D. Engeles, L. Savioli and S. Mas-Coma, 2003. Hyperendemicfasciolosis associated with schistosomiasis in villages Nile delta of Egypt. American Journal of Tropical Medicine and Hygiene, 69: 429-437.
12. Jibat, T., G. Ejeta, Y. Asfaw and A. Wide, 2008. Cause of abattoir condemnation in apparently healthy slaughtered sheep and goats at HELMEX abattoir, DebreZait, Ethiopia, Revue Medicine Veterinara, 159: 305-311.
13. Gebretsadik, B., B. Kassahun and T. Gebrehiwot, 2009. Prevalence and economic significance of Fasciolosis in slaughtered cattle in Addis Ababa Abattoir, Ethiopia. Global Veterinaria, 8: 115-118.
14. Edilawit, W., A. Mekonnen and T. Mulugeta, 2012. An abattoir survey on the prevalence and monetary loss of fasciolosis among cattle in WolaitaSodo town, Ethiopia. Advances in Biological Research, 6: 95-100.
15. Tsegaye, B., H. Abebaw and S. Girma, 2012. Study on coprological prevalence of bovine fasciolosis in and around Woreta, Northwestern Ethiopia. Journal of Veterinary Medicine and Animal Health, 4: 89-92.
16. Bekele, C., M. Sissay and D. Mulugeta, 2014. On farm study of bovine fasciolosis in Lemo district and its economic loss due to liver condemnation at Hossana municipal abattoir, Southern Ethiopia. Intenational Journal of Current Microbiology Applied Science, 3: 1122-1132.
17. Ephrem, T., B. Feyisa and M. Shiferaw, 2011. Prevalence of bovine fasciolosis and its economic significane in and around Assela, Ethiopia. Global Journal of Medical Research, 11: 2249-4618.
18. Thrusfield, M., 2005. Veterinary Epidemiology. 2nd edn University of Eidnburg. Blackwell science. UK., pp: 180-188.
19. Henonen, M., 1989. Body condition scoring as cattle in Ethiopia. MOA, pp: 45-46.
20. Melaku, A., B. Lukas and B. Bogale, 2012. Cyst Viability, Organ Distribution and Financial Losses due to Hydatidosis in Cattle Slaughtered at Dessie Municipal Abattoir, North eastern Ethiopia. Veterinary World, 5(4): 213-218.
21. Antonia, M., P. Conceiçao, M. Rute, H. Isabel, J. Costa and C. Correia, 2002. Evaluation of a simple sedimentation method for diagnosis of bovine fasciolosis. Veterinary Parasitology, 105: 337-343.
22. Solomon, W. and W. Abebe, 2007. Effects of a strategic anthihelmintic treatment intervention bovine fasciolosis: A study conducted in facility endemic area in north western Ethiopia, Ethiopia. The International Journal of Veterinary Medicine, 11: 56-68.
23. Yilma, J. and A. Mesfin, 2000. Dry season bovine fasciolosis in North Western part of Ethiopia. Review veterinary Medicine, 151(6): 493-500.
24. Fikirtemariam, A., B. Jemere, F. Yeshwas and H. Mussie, 2013. Study on the prevalence of bovine fasciolosis in and around Bahir Dar, Ethiopia. Ethiopian Veterinary Journal, 17: 1-11.
25. Ahmadi, N. and M. Meshkehkar, 2010. Prevalence and long term trend of liver fluke infections in sheep, goats and cattle slaughtered in Khuzestan, southwestern Iran. Journal of Paramedical Science, 1: 26-31.

26. Urquhart, G., J. Armour, L. Duncan, A. Dunn and F. Jennings, 1996. Veterinary Parasitology. 2nd edn. Blackwell Science, UK., pp: 103-113.
27. Abdeta, D., T. Birhanu, M. Woyessa and C. Deressa, 2014. Study on the Prevalence of Bovine Fasciolosis at Aira and Gulliso District, Western Wollega Zone, Oromia Regional State, Western Ethiopia. African Journal of Basic and Applied Sciences, 6(2): 37-42.
28. Mellau, L., H. Nonga and E. Karimuribo, 2010. A slaughter survey of liver lesions in slaughtered cattle, sheep and goat at Arusha, Tanzania. Research Journal Veterinary Science, 3: 179-188.
29. Rahmeto, A., A. Fufa, B. Mulugeta, M. Solomon, M. Bekele and R. Alemayehu, 2010. Fasciolosis: Prevalence, financial losses due to liver condemnation and evaluation of a simple sedimentation diagnostic technique in cattle slaughtered at Hawassa Municipal abattoir, southern Ethiopia. Hawassa University, Faculty of Veterinary Medicine, Ethiopia. Journal of Ethiopian Veternaria, 14: 39-51.
30. Abie, D., B. Fentahu, B. Ababu, M. Mulie, B. Murad and A. Mekonnen, 2012.An abattoir survey on the prevalence and monetary loss of fasciolosis in cattle in Jimma town, Ethiopia. Global Veterinarian, 8: 381-385.
31. Ephrem, B., M. Wassie and A. Abadi, 2012. Prevalence and Economic Losses of Bovine Fasciolosis in Dessie Municipal Abattoir, South Wollo Zone, Ethiopia. European Journal of Biological Science, 4: 53-59.
32. Yildirim, A., O. Duzlu and A. Inci, 2007. Prevalence and risk factors associated with Fasciola hepatica in cattle from Kayseri province, Turkey. Revue Medicine Veterinaria, 12: 613-617.
33. Yemisrach, A. and A. Mekonnen, 2012. An abattoir study on the prevalence of fasciolosis in cattle, sheep and goats in DebreZeit town, Ethiopia. School of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Jimma University, Jimma, Ethiopia. Global Veterinarian, 8: 308-314.
34. Mihreteab, B., T. Haftom and G. Yehenew, 2010. Bovine fasciolosis: Prevalence and its economic loose due to liver condemnation at Adwa Municipal Abattoir, North Ethiopia. Ethiopian Journal of Applied Science and Technology, 1: 39-47.
35. Wikipedia, 2014. Available athttp://www.dppc.gov.et/downloadable/map/Atlas/ET%20Admin%-Amhara.pdf [Accessed on 30 May 2014].