

Epidemiological Survey on Gastrointestinal Parasitic Zoonosis in Cattle of Sirajganj District, Bangladesh

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Original Research Article

ABSTRACT

This study was conducted to evaluate the zoonotic gastrointestinal parasitic infections in cattle at Sirajganj district of Bangladesh during the period from February, 2016 to November, 2016 by coproscopy examination. A total of 150 fecal samples of cattle were collected from the study areas, which examined and found 41 (27.33%) were positive for gastrointestinal parasitic infections that has zoonotic importance. The prevalence of parasitic infection was significantly higher in female (33.7%) than in males (19.4%). The prevalence of parasite was recorded higher in cross breed than in indigenous cattle which are statistically significant ($p \leq 0.05$). In case of age groups, the highest rate of infection was observed in adult of >1 years (28.5%) and the lowest in calves aged ≤ 1 year (25.4%). Moreover, the prevalence of gastrointestinal parasites were higher in poor body conditioned cattle (36.3%) than that of malnourished (34%) and healthy cattle (22.4%). In case of management system, the prevalence of parasitic infections was higher in cattle reared in free range (40.0%) than cattle reared in semi-intensive (28.5%) and intensive system (25.5%). Furthermore, parasitic infections were higher in summer (36.5%) followed by winter season (25.5%) and rainy season (15.7%). A significant correlation ($P=0.00$) has been found between diarrheic non-diarrhea cattle. Finally, prevalence was significantly ($P=0.02$) higher in cattle with no previous history of anthelmintic use. From this study, it is concluded that gastrointestinal parasitic infection is a major threat to cattle health and production at Sirajganj district irrespective of age, sex, management system, breed, season, diarrheic and anthelmintic usage.

Keywords: Cattle; faeces; gastrointestinal parasites; prevalence; Sirajganj District.

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1. INTRODUCTION

Zoonotic diseases represent an important threat to the health and well-being of human population. The geo-climatic conditions together with the water logged and low lying areas in Bangladesh are conducive to parasitic disease in domestic ruminants [1]. In Bangladesh there are many constraints in cattle production, among them malnutrition and parasitism are the major limiting factor [2]. Asian Development Bank report [3] clearly mentioned that the loss of productivity of animals in terms of morality, milk, meat, generation loss and other productive traits due to parasitism (50%) in Bangladesh. The prevalence of parasitic infection depends on ecology, geographical and climatic condition prevailing in Bangladesh [4].

Echinococcosis is also known as cystic echinococcosis, is an important zoonotic helminth of human and animals throughout the world [5]. Among the helminth, *Fasciola gigantica* is the most common zoonotic parasite prevalent in ruminants, reported from different areas of Bangladesh [6,7,8]. Islam reported about 62% intestinal schistosomiasis infections in cattle of Mymensingh district, Bangladesh [9]. Giardiasis is another recognized zoonotic parasitic disease reported in calves which is present in soil, food, and water that have been contaminated by infected feces [10]. Balantidiosis associated with diarrhea in cattle [11] and water buffaloes [12] has been reported from Bangladesh but its zoonotic significance has not been evaluated under local conditions.

In Bangladesh, Sirajganj the main cattle farming areas and cattle population is comparatively higher than other regions of Bangladesh. Cattle form an integral part of the economic, social and culture of those areas in Bangladesh, for the purpose of mainly milk and beef production.

FAO [2009] reported that losses from internal parasites might be as high as 30% of the market value. Considering all these points, the aim of this study was determine the prevalence and identify of gastrointestinal parasites of cattle in different areas of Sirajganj district.

2. METHODOLOGY

This research work was conducted in the laboratory of Microbiology and Parasitology Department, Faculty of Animal Science and Veterinary Medicine, Sher-e-Bangla Agricultural University.

2.1 Ethics Statement

All samples were collected from randomly selected individual cattle of different households. Therefore, no endangered species were involved. Since faecal samples were collected directly from the rectum of the animals and also after natural defecation of the animals from the floor, no permission regarding laws on animal protection was required. We had received permission from the farm owners to collect the samples.

2.2 Study Area, Period and Population

Geographically Sirajganj district is low lying area in Bangladesh. A huge number of cattle population (about 8,68,644 number) reared there. Its geographical coordinates are in between 24°04' and 24°25' north latitudes and in between 89°31' and 89°31' east longitudes. Sirajganj has an area of 2,498 sq.km (964 sq miles) including riverine areas, and it represents around 1.7 percent of the total area of Bangladesh. The annual average temperature of the district reaches a maximum of 34.6 °C, and a minimum of 11.9 °C. The annual rainfall is 1610 mm (63.4 in) [13]. The climatic condition of Sirajganj district is highly favorable for parasitic and its vector growth, development and transmission. In this study area, the mean annual rainfall of the study area is 1200 mm and the rain is monomodal with rainy season occurring from July to October. The annual average minimum and maximum temperature is 10°C and 30°C, respectively. The research activities were carried out for a period of ten months, from February to November, 2016. Although there were six seasons in Bangladesh but only three seasons are distinct in the study area such as winter (February), Summer (March-June), and Rainy (July-October). Coproscopy examination was conducted in the Laboratory of Microbiology

and Parasitology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. The cattle were selected randomly irrespective of condition/nutritional status, breed and level of husbandry from the different households of Ullahpara and Shahjadpur upazilla at Sirajganj district. Most of the cattle in the rural areas were reared in intensive system. The age of the cattle was determined interrogating the farmers or by examining the teeth. The nutritional status of the animals was determined by visual observation. We had considered about 150 cattle of different stages of maturity and breed. During collection of samples, the age, sex, body condition, season, breed, level of husbandry of cattle, diarrheic consistency and history of anthelmintic use was recorded.

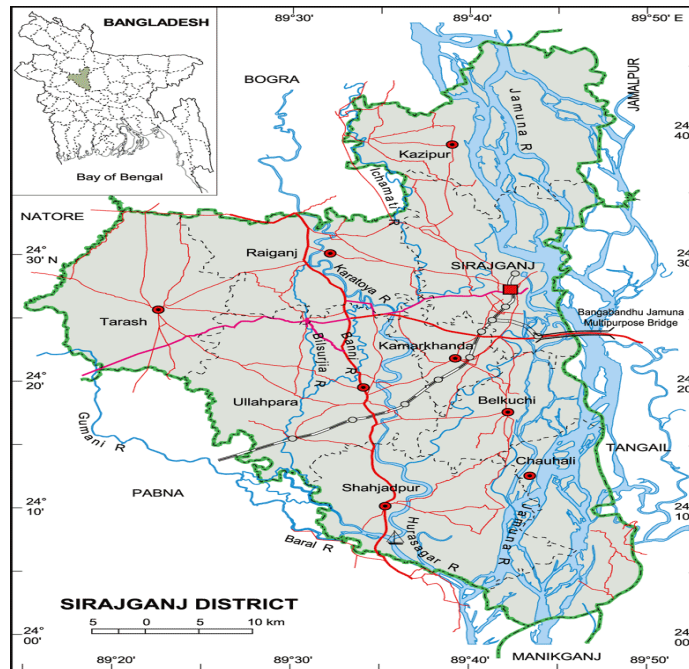


Fig. 1. Map of Ullahpara and Shahjadpur upazilla of Sirajganj district

2.3 Sample Collection and Preservation

After taking all the relevant information, the fecal samples were collected directly from the rectum of the animals. Before collection, the animals were restrained properly and all possible hygienic measures including wearing of apron, hand gloves and gumboot were used to avoid contamination. Fresh fecal samples were also collected from the ground just after defecation. The samples were placed in suitable leak-proof plastic containers, tightly closed, labeled and transported to the laboratory for examination. About 20-25g of feces was collected from each cattle and preserved in 10% formalin. Each sample was kept in separate polythene bag, tied carefully and numbered properly. The correctly labeled and properly numbered polythene bags containing the fecal samples with all required information was send to the laboratory and examined as early as possible. The fecal samples were examined macroscopically for their consistency as watery, loose, soft or formed and then categorized as either diarrhoeic or non diarrhoeic. Additional epidemiological information of each sampled from individual animals or farm was collected using a data collection sheet.

2.4 Identification of Parasites

The sedimentation and floatation technique as described by [14] was used to detect the presence of nematode, cestode and trematode eggs, and coccidian oocysts in the samples. Identification of *Fasciola* spp was done as described by [15].

2.4.1 Direct smear method

A drop of water was taken on a glass slide. A small amount of faeces was spread out and a thin smear was made. The coarse particles were discarded gently. Then a cover slip was placed over the smear.

2.4.2 Differential flotation technique

2-3g of faecal sample was taken in a beaker to which 50ml water was added. With the help of a spatula, the sample was stirred and filtered with a tea strainer. The filtered sample (15ml) was then poured into plastic test tube and centrifuged at 1500 rpm for 5 min. The tube was taken out and the upper part of the water was removed with the help of a dropper. The tube was filled with saturated sugar solution and centrifuged at 1500 rpm for 5 min. More sugar salt solution was added up to the tip of the tube. A cover slip was placed over the top of the tube so that the sodium chloride touches the cover slip for a few minutes and then the cover slip was placed on a slide and examined at 10× to 40× objective under light compound microscope.

2.4.3 Sedimentation technique

3-5g of faecal sample was taken in a beaker to which 50ml water was added. The sample was mixed properly and then the sample was filtered using a tea strainer and the filtered sample was poured in a plastic test tube and centrifuged at 1500 rpm for 5 min. The tube was taken out and the upper part of water was removed with the help of a dropper. A drop of the deposited materials was taken out from the test tube with the dropper and placed on the slide, and finally examined the slide under microscope at 10x or 40x. After that, identified the parasites by their characteristic morphological features of eggs as observed under light compound microscope 10x objective.

2.5 Statistical Analysis

Animal and laboratory data subsequently entered into MS excel (Microsoft office excel-2013, USA). Data management and data analysis were done by STATA version-14 (STATA Corporation, College Station, Texas). The prevalence of zoonotic gastrointestinal parasites associated with different categorical variables (sex, age, breed, season, management and stool/faeces consistency) compared for statistical significance using chi-square (χ^2) test. A *P* value of ≤ 0.05 was considered as statistically significant.

3. RESULTS AND DISCUSSION

3.1 Overall Prevalence of Gastrointestinal Parasitic Infections in Cattle

During the study period 150 cattle were examined through fecal sample examination, of which 41 cattle were found infected with one or more species of zoonotic gastrointestinal parasites indicating an overall prevalence of 27.33%. From this study, it was observed that the prevalence of zoonotic gastrointestinal parasites (27.33%). The helminthes identified were the snails borne trematode, namely, *Fasciola gigantica*(16.66%), *Schistosoma indicum*(6%), nematodes including *Trichostrongylus axei*(4.66%), *Strongyloides papillosus*(2.66%), *Trichuris spp* (3.33%) and protozoa including *Balantidium coli* (7.33%) and *Giardia sp* (4%). From this study, it was observed that the prevalence of *Fasciola gigantica*(16.66%) was the highest whereas *Strongyloides papillosus*(2.66%) infections were the lowest (Table 1).

Table 1. Overall prevalence of individual parasite among the gastrointestinal parasites in Cattle

Types of zoonotic gastrointestinal parasites	No. of Cattle affected N= 150	% Prevalence
<i>Fasciola gigantica</i>	25	16.66
<i>Balantidium coli</i>	11	7.33
<i>Schistosoma indicum</i>	9	6
<i>Trichostrongylus axei</i>	7	4.66
<i>Giardia spp</i>	6	4
<i>Trichuris spp</i>	5	3.33

<i>Strongyloides papillosus</i>	3	2.66
Total	41	27.33

N = Total animals examined.

Table 2. Association of different categorical variables with the prevalence of gastrointestinal parasites in Cattle

Sl. No.	Variable	Category (N)#	Positive (n)	% Prevalence (95% CI)	P-value
1	Sex	Male (67)	13	19.4 (10.75-30.89)	0.05*
		Female (83)	28	33.7 (23.71- 44.94)	
2	Breed	Indigenous (65)	12	18.4 (09.91-30.02)	0.03*
		Cross (85)	29	34.1 (24.17-45.20)	
3	Age	Calf (3-12 months) (59)	15	25.4 (14.98-38.44)	0.67
		Adult (> 12 m) (91)	26	28.5 (19.58-38.99)	
4	Body condition Score(BCS)	Good (89)	20	22.4 (14.29-32.55)	0.26
		Medium(50)	17	34 (21.20-48.76)	
		Poor (11)	4	36.3 (10.92-69.20)	
5	Management system	Intensive (98)	25	25.51 (17.23-35.31)	0.60
		Semi-intensive(42)	12	28.57 (15.71-44.58)	
		Free range(10)	4	40 (12.15-73.76)	
6	Season	Winter(90)	23	25.5 (16.94-35.83)	0.20
		Summer (41)	15	36.5 (22.12-53.06)	
		Rainy(19)	3	15.7 (03.38-39.57)	
7	Diarrhea	Yes (71)	29	40.8 (29.31-53.15)	0.00*
		No (79)	12	15.1 (08.10-25.03)	
8	Use of Anthelmintic	Yes (77)	15	19.4(11.33-30.08)	0.02*
		No (73)	26	35.6 (24.74-47.69)	
9	Total	150	41	27.3(20.38-35.20)	

(N)#, total observation in each category; *Significance was determined when $P \leq 0.05$; CI, Confidence Interval; Good; healthy Body Condition, Medium; Malnourish, protruding rib and Poor; Cachectic, severe protruding rib with prominent pin bone.

In this study, overall prevalence of zoonotic gastrointestinal parasitic infections in cattle was recorded 27.33% at Ullahpara and Shahjadpur upazila, Sirajganj, Bangladesh. This finding is not supported by Saifuzzaman[16] who recorded 86.19% cattle infected with various helminthes. But the result was supported by Nath *et al.* [17] revealed that calves were infected with *Strongyloides papillosus*(6.44%), *Trichuris* spp. (01.56%) and *Fasciola gigantica* (0.66%) parasites found in Mirsarai upazila, Chittagong.

In this study, 16.66% infection with *Fasciola gigantica*, 4.66% cases with *Trichostrongylus axei*, 6% infection with *Schistosoma indicum*, 3.33% infection with *Trichuris* spp, 2.6% infection with *Strongyloides papillosus*, 4% infection with *Giardia* spp. and 7.33% infection with *Balantidium coli* were recorded. This finding is supported by Youn H [18] who stated the major zoonotic parasitic infections, caused by intestinal protozoa, helminths and arthropod parasites are among the most prevalent infections in humans and animals in developing countries. For the species of *Fasciola*, the results of this study are in less accordance with the finding of Okiluddin and Singh [19,20] who recorded 21.88% and 19.3% fascioliasis in cattle in 1996 and 2009, respectively. Samad MA [6] studied among the trematode parasites of zoonotic importance, only *Fasciola gigantica* in ruminants that is supported my study. Mondal *et al.* [21] mentioned that calves grazing in grassland were infected by some parasites like *Trichostrongylus* spp. and *Trichuris* sp.

On the other hand, the rate of infection which is found in this study is much lower than the earlier findings of Gupta, Afroz [22,23] who recorded 70%, and 31.14% fascioliasis respectively in cattle in Bangladesh and India. Kabir *et al.* [7] studied that the overall prevalence of hydatidosis was highest (26.01%) followed by fascioliasis (20.74%). Among the trematode parasites of zoonotic importance, only *Fasciola gigantica* in ruminants [6,7,8] have been reported from Bangladesh. Ntonifor *et al.* [24] reported that some of the gastrointestinal parasites of cattle in his study were zoonotic which includes

Trichostrongylus spp. (9.7%), *Strongyloides* spp. (9 %), *Trichuris* spp. (18.4%). This was in agreement with the current findings.

In the current study, an overall prevalence of *Schistosoma indicum* was found to be 6%. This finding is relatively lower than the earlier findings of Anwar [25] who recorded 13.7% of cattle infected with *Schistosoma indicum* in Bangladesh. However, Islam *et al.* [9] mentioned *Schistosoma* spp. which causes dermatitis in humans has been reported from Bangladesh. Islam recorded 62% intestinal schistosomiasis infection in cattle. Akter *et al.* [26] studied that cows, heifer and calves in Muctagacha upazilla, Mymensingh were infected by some zoonotic parasites like *Trichostrongylus* sp, *Strongyloides* spp and *Fasciola gigantica*.

The method of transmission for *B. coli* is likely to occur in environment with overcrowding and poor personal hygiene. It is transmitted primary by eating food or drinking water that has been contaminated by human or animal feces containing *B. coli* cysts. Balantidiosis associated with diarrhea in cattle Alam *et al.* [27] and water buffaloes Islam *et al.* [12] and pigs has been reported from Bangladesh but its zoonotic significance has not been evaluated under local conditions. In overall prevalence the *Balantidium coli* were found in (7. 33%). The finding is much lower than the earlier findings Roy [28] who reported higher prevalence of *Balantidium coli* (38.82%) in cattle. The variations in the findings with the earlier reports might be due to the difference in the sample size, selection of samples, animal breed, study period and place of study, climatic conditions of the study area, management factors, history of anthelmintic use.

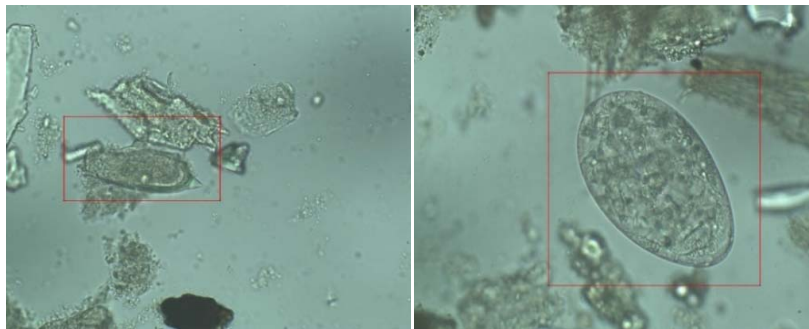


Fig. 3. Egg of *Schistosoma indicum* (10x) Fig. 4. Egg of *Fasciola gigantica* (40x)

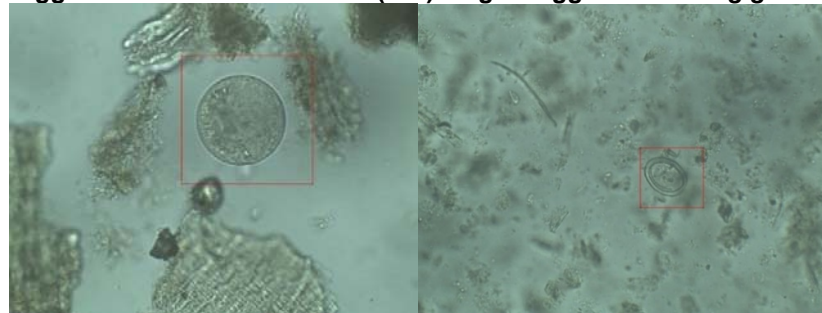


Fig. 5. Cyst of *Balantidium coli* (40x) Fig. 6. Cyst of *Giardia* sp (10x)



Fig. 7. Egg of *Trichuris* spp (10x)



Fig. 8. Egg of *Trichostrongylus axei* (10x)

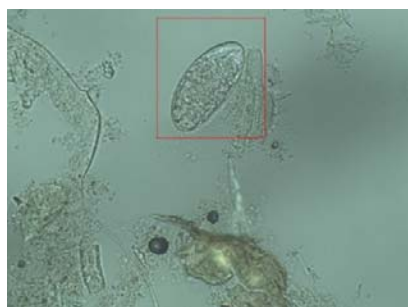


Fig. 9. Egg of *Strongyloides papillosus* (10x)

3.2 Age, Sex and Breed Factors

In this study, it was recorded that prevalence of parasitic infections in cattle was significantly higher in females (33.7%) than the male (19.4%) and also higher in cross breed (34.1%) than indigenous cattle breeds (18.4%). This finding is relatively similar with the findings of Roy [28] who recorded 39.68% and 36.36% prevalence of infection in female, male cattle respectively and infection in cross breed and local cattle breed was 40.57% and 37.57%, respectively in Bangladesh. But the result is in contrast to the earlier report of Ibrahim [29] who recorded no significant difference in infection rate between female (7.14%) and male (6.66%) cattle. The higher percentage of infection in the females cannot be explained exactly but it might be associated with hormonal influence as well as stress leading to immune-suppression, sample size, selection of samples and breed of cattle considered in this study. But this finding is in contrast to the earlier record of Gadre *et al.* [30] who studied the prevalence of infections in cross breed and local breed to be 63.98% and 61.45%, respectively. It appears that cross breed animals are more susceptible to the parasitic diseases, due to environmental variation, adaptation of the animal and poor management factor. In this research, it was observed that prevalence of gastrointestinal parasitic infections was relatively higher in adult cattle >1 years (28.5%) and lower in calves (≤ 1 year) (25.4%). This finding is similar to the earlier record of Afroze [23] who recorded that the age above 4 years had the highest (33.33%) prevalence of *Fasciola* sp in cattle of Netrakona district in Bangladesh. However, Rahman [31] recorded the highest infection with zoonotic gastrointestinal parasites in cattle of 1-2 years age group (14.5%) which is lower than the current findings. The cause of this variation in the prevalence of infection in different age groups in cattle might be due to the immunity of the young being poorly developed. This variation might also be due to the difference in the grazing area and management variation of cattle.

3.3 Management Related Factors

During this study, it was observed that the prevalence of parasitic infection was insignificantly ($p=0.60$) higher in cattle reared in free range system (40.00%) than that of cattle reared in semi-intensive (28.57%) and intensive (25.51%) rearing systems. Nutritional status of cattle might have an effect on the prevalence of zoonotic gastrointestinal parasitic infections. In this study, parasites were higher in poor

body conditioned cattle (36.3%) than that of medium (34%) and good (22.4%). This finding coincides with the findings of Roy [28] and Alam [27] who recorded the prevalence of infection in poor and good animal was 63.3% and 29.35%, respectively. It appears that malnutrition in animals increases their susceptibility to the parasitic infection. It may also happen that, the animals poor and weak due to any other causes are not able to resist the challenge of infection and subsequently become weaker and losses condition.

One of the new variable factor, stool consistency of cattle was investigated. In this study, prevalence of gastrointestinal parasitic infections in cattle was significantly higher in cattle with diarrhea (40.8%) than non-diarrhea animal (15.1%). Mostly diarrhea of cattle caused by any infections like bacterial, viral or parasitic. Another variable factor is previous history of de-worming animals with appropriate anthelmintic. Here, the prevalence of gastrointestinal parasitic infections was significantly ($P=0.02$) higher in cattle with no previous history of deworming (35.6%) than that of cattle with previous history of de-worming (19.4%).

3.4 Seasonal Factor

The present study revealed that the seasonal effect on prevalence of parasitic infections was higher in summer (36.5%) followed by winter (25.5%) and lowest in rainy season (15.7%). This result is much lower than the previous record of Gadre *et al.* [30] who recorded the infection rate of gastrointestinal parasitic infections was highest during post monsoon (78.80%) followed by winter (63.44%). But this finding is similar to the earlier record of Roy [28] who recorded higher prevalence of parasitic infection in summer (38.89%) than in winter (27.59%). This variation might be due to variation in the geographical location and climatic condition of the study area.

4. CONCLUSIONS AND RECOMMENDATIONS

Prevalence of gastrointestinal parasitic infections in cattle was significantly affected by sex, breed, diarrheic consistency and using anthelmintic. Although lack of control groups, lack of uniformity and selection criteria for cattle and lack of accurate measures of health, age etc may contravenes these results to some extent, incomplete sentences. In this study, only faecal sample was collected for identification of parasitic infections in cattle. Because of its effects on the production of cattle, economic loss per year in Bangladesh may be explained by further study which includes mortality, morbidity and treatment cost and it would be more beneficial for the farmers. So, further study should be carried out to determine the economic losses due to parasites of cattle and to find out effective control measures against gastrointestinal parasitic infections. However, particular emphasis should be given to proper management, regular deworming and improved hygiene, to prevent the parasitic infections in cattle.

CONSENT

It is not applicable.

ETHICAL APPROVAL

All samples were collected from randomly selected individual cattle of different households. Therefore, no endangered species were involved. Since faecal samples were collected directly from the rectum of the animals and also after natural defecation of the animals from the floor, no permission regarding laws on animal protection was required. We had received permission from the farm owners to collect the samples.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. N. M. A. Qadir. (1982). A preliminary study on the epidemiology of fascioliasis in

- goats. *Bangladesh Veterinary Journal*, 15: 13-17.
2. M. Jabber and D. A. G.Green. (1983). The status and potential of livestock within the context of agricultural development policy in Bangladesh. The University of Wales. Aberystwyth, United Kingdom, pp.113.
3. ADB (1984). ADB production year book. Volume-25.
4. Hossain, M.J., Amin, M., Mostofa, M., Sharif, M., Khalid, S.M.A. (2004). Efficacy of ivermectin against natural gastrointestinal nematodiasis and paramphistomiasis in sheep. *The Bangladesh Veterinary Journal*, 21 (2): 70-73.
5. Islam MK, Basak SC, Majumder S, Sarder SA (2003). Cystic echinococcosis in domestic ruminants in Cox's Bazar of Bangladesh. *Pakistan Journal of Scientific Industrial Research* 46: 251-254.
6. Samad MA (2008). Animal Husbandry and Veterinary Science. 1st Pub., LEP No. 11, BAU Campus, Mymensingh, Bangladesh.
7. Kabir MHB, Eliyas M, Hashem MA, Mohiuddin and Miazi OF (2010). Prevalence of zoonotic parasitic diseases of domestic animals in different abattoir of Comilla and Brahman Baria region in Bangladesh. *University Journal of Zoology*, Rajshahi University 28: 21-25.
8. Rahman MM and Samad MA (2010). Prevalence of sub-clinical gastro-intestinal parasitosis and their effects on milk production with therapeutic management in Red Chittagong cattle. *Bangladesh Journal of Veterinary Medicine* 8: 11-16.
9. Islam KS and Awal MA (1991). Schistosome dermatitis in Bangladesh. *Indian Journal of Parasitology* 15: 165-169.
10. Bob (2011). Dr. Bob's all creatures site. www.Petdoc.ws, Zoonotic Diseases. file:///F:/zoonotic diseases1.htm, pp 1-169.
11. Alam MGS, Rahman A and Sen MM (1979). Blantidiasis in cattle. *Bangladesh Veterinary Journal* 13:39-42.
12. Islam MR, Huque AKMF, Khan MAHNA and Talukder MRI (2000). Balantidiosis in water buffaloes: Incidence and therapeutic trial. *Bangladesh Journal of Agricultural Science* 27: 143-146.
13. Belal SM SH, Mahmud M AA and Ferdous M J (2014). Prevalence of Anaplasmosis in Cattle in Sirajganj District of Bangladesh.
14. MAFF (1986). Ministry of Agriculture, Fisheries and Food (MAFF). Manual of Parasitological Laboratory Techniques. Reference Book Number 418, 3rd edition ADAS, HMSO, London, UK.
15. Soulsby, E.J.L. (1982). Helminths Arthropods and Protozoa of Domesticated Animal. 7th Edition, Bailliere Tindal and Cassell Ltd. London.
16. Saifuzzaman ABM (1996). Incidence and seasonal variation of helminth parasites of cattle at Chandinathana in Comilla District. M. Sc. Thesis Submitted to Department of Parasitology, Bangladesh Agricultural University.
17. TC Nath, MJUBhuiyan, MS Alam (2013). Prevalence of gastro-intestinal parasites of calves in Mirsarai Upazilla of Chittagong district of Bangladesh. *Bang. J. Anim. Sci.* 42 (2): 139- 142
18. Youn H (2009). Review of zoonotic parasites in medical and veterinary fields in the republic of Korea. *Korean Journal of Parasitology* 47: 133-141.
19. Okiluddin SM (1996). Studies on Fascioliasis of cattle in Kishoregonj district. M. Sc. Thesis, Department of Parasitology, Bangladesh Agricultural University, Mymensingh.
20. Singh A, Srivastava S, Shekhar C and Singh J (2009). Prevalence of trematodes in bovines and snails. *Indian Veterinary Journal*, 86(2): 206-207.
21. Mondal MH, Islam K, Hur J (2000). Examination of Gastrointestinal helminths in livestock grazing in grass land of Bangladesh. *The Korean Journal of Parasitology*, 38: 187-190.
22. Gupta SC and Singh BP (2002). Fasciolosis in cattle and buffaloes in India. *Journal of Veterinary Parasitology*, 16(2): 139-145.
23. Afroze S (2009). Epidemiological study of fascioliasis in cattle at Netrokona district. M. S. thesis, Department of Parasitology, Bangladesh Agricultural University, Mymensingh.
24. Ntonifor H. N., Shei S. J., Ndaleh N. W. and Mbunkur G. N. (2013) Epidemiological studies of gastrointestinal parasitic infections in ruminants in Jakiri, Bui Division, North West Region of Cameroon. *J. Vet. Med. Anim. Health*. Vol.5(12), pp.344-352.
25. Anwar LM (2008). Prevalence of helminth parasites in cattle of chars of the Jamuna river. M.S. thesis submitted to Department of Parasitology, Bangladesh Agricultural University, Mymensingh.

26. Akter Y, Uddin MM, Khatun MA (2011). Prevalence of gastro-intestinal parasitism in dairy cattle in Muktagachaupazila of Mymensingh district. *Bangladesh Research Publication Journal*, 5: 376-380.
 27. Alam, M. M and Samad, M.A. (1997). Comparative efficacy of some fasciolicides against bovine fascioliasis. *Bangladesh Veterinary Journal* 31: 47-49.
 28. Roy, B.C. (2010). *Balantidium coli* infection (Balantidiasis) in ruminants: an epidemiological survey. MS Thesis, Dept Parasitology, Bangladesh Agricultural University, Mymensingh, Bangladesh.
 29. Ibrahim, M.A. (2004). Epidemiological studies on fascioliasis in the Beni-Suef Governorate. *Veterinary Medical Journal Giza*, 52(4): 507-515.
 30. Gadre, A.S., Maske, D.K., Panchbhai, C.G., Gawande, T.R., Kolte, S.W. and Sirothia, A.R. (2007). Seasonal population dynamics of gastrointestinal helminthes in dairy animals of central zone of Vidarbharegion. *North East Veterinarian*, 7(1): 16-17.
 31. Rahman, K.M. (2009). Studies on identification of schistosomiasis egg from tissue of infected ruminant in Mymensingh district. M. S. Thesis submitted to Department of Parasitology, Bangladesh Agricultural University, Mymensingh.
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