Research Article

Epidemiological Studies of Fascioliosis (*Fasciola gigantica* Infection) in Cattle

Kazi Mehetazul Islam[1*], Md. Siddiqul Islam[2], Gitaindro Nath Adhikary[3], Khandoker Mohammad Mozaffor Hossain[4], Shah Md. Abdur Rauf[4], Moizur Rahman[4]

[1]Department of Parasitology; [2]Department of Pharmacology and Toxicology; [3]Department of Anatomy and Histology, Faculty of Veterinary and Animal Science, Sylhet Agricultural University, Sylhet-3100; [4]Department of Animal Husbandry and Veterinary Science, Faculty of Agriculture, University of Rajshahi-6205, Bangladesh.

Abstract | To investigate the epidemiology of fascioliosis in cattle of different ages, sexes, seasons and different district in Sylhet division of Bangladesh. Epidemiological studies on fascioliosis of cattle were under taken in such localities under different climatic conditions existing in Sylhet division of different district. Cattle were divided into young and adult groups. Rectal fecal samples from household live and livers from slaughterhouse cattle were collected randomly and examined by direct/and sedimentation techniques and grossly from July 2014 to June 2015. A total of 920 liver samples from slaughter house and 920 rectal fecal samples from household live cattle were examined of which 139 (15.11%) slaughter house and 204 (22.17%) household live cattle were found positive for *Fasciola gigantica*. The overall prevalence was 18.64%. It was noticed that prevalence of slaughterhousewere 1.5 times less susceptible than household live cattle. The prevalence of fascioliosis was significantly ($p<0.001$) higher in rainy season followed by winter and summer season. Significantly ($p<0.001$) the highest prevalence of fascioliosis was recorded in young's. When considered the relationship with sex, the prevalence of fascioliosis in female's cattle was significantly ($p<0.001$) more than males. Fascioliosis is highly prevalent in both slaughterhouse and household live cattle in Sylhet division of Bangladesh. Effective control measures to proper management, improved hygiene and the strategic use of regular deworming is need for the treatment of intensive fascioliosis in cattle.

Keywords | Epidemiology, *Fasciola gigantica*, Cattle, Sylhet division, Bangladesh

Editor | Muhammad Imran Rashid, Department of Parasitology, University of Veterinary and Animal Sciences, Lahore, Pakistan.
Received | December 01, 2015; **Revised** | January 31, 2016; **Accepted** | February 01, 2016; **Published** | March 02, 2016
***Correspondence** | Kazi Mehetazul Islam, Associate Professor and Chairman, Department of Parasitology, Faculty of Veterinary and Animal Science, Sylhet Agricultural University, Sylhet-3100, Bangladesh; **E-mail:** kmi.swu2010@gmail.com
Citation | Islam KM, Islam MS, Adhikary GN, Hossain KMM, Rauf SMA, Rahman M (2016). Epidemiological studies of fascioliosis (Fasciola gigantica infection) in cattle. J. Adv. Parasitol. 3(1): 10-15.
DOI | http://dx.doi.org/10.14737/journal.jap/2016/3.1.10.15
ISSN | 2311-4096

INTRODUCTION

The livestock population in Bangladesh is currently estimated to comprise 26.828 million cattle, 0.78 million buffalo, 30.242 million goat and 1.221 million sheep (BBS, 2010) which plays an important role in the rural economy (Kamaruddin, 2003). Livestock sub-sector contributed approximately 6.5% to the GDP and 13% to the foreign currency earning (Alam, 1993). More than 20% of the rural populations of our country were engaged in this sector (Samad, 1996). The diseases are major setback to livestock industry. Parasitic diseases causes enormous economic losses of the livestock population all over the world and these losses are due to lowered fertility, reduced work capacity, involuntary culling, a reduction in food intake and lower weight gains, lower milk production and meat production, treatment costs and mortality in heavily parasitized animals (Nansen, 1991; Kusiluka et al., 1994; Lebbie et al., 1994; Faizal, 1999). Fascioliosis is a serious parasitic disease caused by three trematodes all over the world which one is known as *Fasciola gigantica* of the most prevalent parasite infections of ruminants (cattle, sheep and goat) in countries with tropical climates (Harrison et al., 1996; Roberts and Suhardono, 1996; Tantrawatpan et

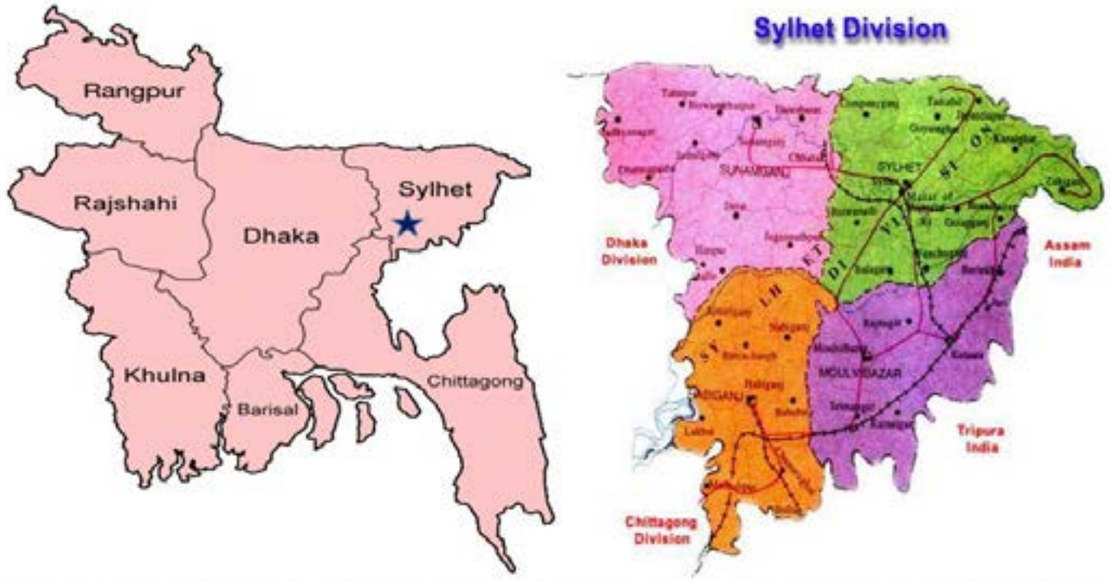

Figure 1: Map of Bangladesh indicating the location of study area (star mark) and map of Sylhet division indicating sampling sites and different districts

al., 2003).

Egg count from fecal sample is a usual tool to investigate prevalence/incidence/diagnosis of fascioliosis. Similarly information regarding epidemiology of fascioliosis on the basis of liver pathology is almost nil though the liver damage is a key factor of health status, productive and reproductive performance, body immunity and mortality of the animal (Boray, 1982). In Sylhet division of Bangladesh, domestic ruminants chronically infected are responsible for the spread of the disease by contaminating the pastures with liver fluke eggs; this is especially seen in areas that have favorable climatic conditions and suitable intermediate hosts. There was several research work carried out on different aspects of fascioliosis in buffaloes (Alim et al., 2000), cattle (Chowdhury et al., 1994), goats (Howlader et al. 1991) and sheep (Alam et al., 1994) in different areas of Bangladesh but there is no study on the Sylhet division. The present study has undertaken to investigate thoroughly the overall prevalence of *F. gigantica* infection in cattle on the basis of livers from slaughter house and rectal fecal samples from household live cattle to detect eggs, liver damage and gross pathology in the liver and also their relationship with ages, sexes, seasons and different district in Sylhet division of Bangladesh.

MATERIALS AND METHODS

Study Area

This study was conducted in Sylhet division of Bangladesh (Figure 1). Sylhet division is located in North-East part of Bangladesh and between 24°30' North latitude and 91°40' East longitudes. The division has an area of 3490.40 square kilometers. It was formed to four districts such as Habiganj, Moulvibazar, Sunamganj and Sylhet (Figure 1). More than three quarter of the division consists of mostly teagarden, hilly, water logged and low lying areas. The average maximum and minimum temperatures are 23°C and 7°C, respectively. The annual average rainfall is 3334 mm and humidity is 80%. The study was carried out in the Laboratory under the Department of Parasitology, Faculty of Veterinary and Animal Science, Sylhet Agricultural University (SAU) from July 2014 to June 2015.

Experimental Animal

The cattle of various local breeds, sexes and age groups were selected randomly from butchers and small holder farmers. The age of the cattle were determined by dentition. The cattle were divided into two age groups such as young (<3 years) and adult (≥3 years) age. The sexes of the cattle were recorded by examining presence of penis, testis, vulva, udder or uterus.

Collection of Liver Samples

During the study year, a number of 920 cattle at slaughterhouses were examined to record the prevalence of the disease in a systematic survey of various slaughterhouses in different district of Sylhet division. Post-mortem examinations of slaughtered cattle were carried out and livers were checked out for the presence of flukes. The livers with gall bladders in the Laboratory were subjected to thorough investigation and collection of parasites as well as for gross pathology. *F. gigantica* was identified on the basis of morphology (Soulsby, 1986).

Table 1: Prevalence of fascioliosis in both cattle and relation with their different districts

District	Slaughterhouse cattle			Household live cattle			Overall (%)
	No. examined	No. positive	Prevalence (%)	No. examined	No. positive	Prevalence (%)	
Habiganj	230	33	14.35	230	47	20.44	17.39
Moulvibazar	230	36	15.65	230	55	23.91	19.78
Sunamganj	230	39	16.96	230	61	26.52	21.74
Sylhet	230	31	13.48	230	41	17.83	15.65
Average	920	139	15.11±0.76	920	204	22.17±1.91	18.64±1.64

Mean in row with letters shown significantly (P<0.05)

Collection of Fecal Samples

During the study year, 920 of household cattle rectal fecal samples were collected from different district of Sylhet division and examined by direct smear/and sedimentation techniques for the presence of *Fasciola* eggs in the Laboratory of Parasitology, Faculty of Veterinary and Animal Science, Sylhet Agricultural University, Sylhet-3100, Bangladesh. Identification was done on the basis of morphology (Soulsby, 1986).

Collection of Liver Flukes

During collection of parasite, the affected cattle liver with gall bladders in the laboratory were subjected to thorough investigation and collection of parasites as well as for gross pathology following the procedure of Ross (1967) and those showing evidence of the infection were marked.

Statistical Analysis

Among the male and female cattle, variations in the prevalence of fascioliosis on the basis of different age groups, season, sex and their location and prevalence were analyzed by logistic regression using statistical software SPSS (Version 15.2) and Microsoft Excel 2007. Values of $p<0.001$ were considered as significant at 99.99% confidence interval. The relationship of different variables with the infection was observed by this regression analysis.

RESULTS AND DISCUSSION

A total of 920 livers from slaughter house and 920 rectal fecal samples from household live cattle in different district of Sylhet division were examined of which 139 (15.11%) livers and 204 (22.17%) fecal samples were found for *F. gigantica* positive. The overall prevalence was 18.64%. The prevalence of fascioliosis in slaughterhouse and household live cattle are presented in Table 1.Theprevalenceand overall prevalence of fascioliosis observed in present study was in accordance to similarities of the earlier reports. The prevalence of fascioliosis are recorded as 3.7-63.4% in cattle of different parts of Bangladesh (Rahman and Ahmed, 1991; Chowdhury et al., 1993; Khandaker et al., 1999). The geo-climatic conditions together with the water logged and low lying areas in Sylhet region of Bangladesh and most of the animals graze on the low land where are highly favorable for the development and multiplication of *Fasciola* species and their intermediate hosts (snails).

In this study, the overall prevalence of young (<3 years) age group of cattle were infected significantly ($p<0.001$) higher than adult (≥3 years). Age wise prevalence of fascioliosis in cattle are presented in the Table 2. Similar observation was reported by Kiyyu et al. (2003), Nganga et al. (2004), Akter et al. (2011) and Fatima et al. (2012). The young age groups

Table 2: Age-wise prevalence of fascioliosis in slaughterhouse and household live cattle

District	Young age (<3 years)				Overall Prevalence	Adult age (≥3 years)				Overall prevalence
	Slaughterhouse cattle		Household live cattle			Slaughterhouse cattle		Household live cattle		
	No. examined (positive)	Prevalence (%)	No. examined (positive)	Prevalence (%)		No. examined (positive)	Prevalence (%)	No. examined (positive)	Prevalence (%)	
Habiganj	115 (21)	18.26	115 (30)	26.09	23.37 ± 1.93***	115 (12)	10.44	115 (17)	14.78	13.91 ±1.37***
Moulvibazar	115 (22)	19.13	115 (34)	29.57		115 (14)	12.17	115 (21)	18.26	
Sunamganj	115 (24)	20.87	115 (37)	32.17		115 (15)	13.04	115 (24)	20.87	
Sylhet	115 (20)	17.39	115 (27)	23.48		115 (11)	9.57	115 (14)	12.17	
Average	460 (87)	18.91 ± 0.74**	460 (128)	27.83 ±1.91**		460 (52)	11.30 ±0.79**	460 (76)	16.52 ±1.91**	

***Significant differences between age groups $p<0.001$; **young age groups $p<0.005$ and **adult age groups $p<0.05$

Table 3: Sex-wise prevalence of fascioliosis in slaughterhouse and household live cattle

District	Female				Overall Prevalence	Male				Overall prevalence
	Slaughterhouse cattle		Household live cattle			Slaughterhouse cattle		Household live cattle		
	No. examined (positive)	Prevalence (%)	No. examined (positive)	Prevalence (%)		No. examined (positive)	Prevalence (%)	No. examined (positive)	Prevalence (%)	
Habiganj	115 (25)	21.74	115 (34)	29.57	26.85 ±1.93***	115 (08)	6.96	115 (13)	11.30	10.44 ±1.37***
Moulvibazar	115 (26)	22.61	115 (38)	33.04		115 (10)	8.70	115 (17)	14.78	
Sunamganj	115 (28)	24.35	115 (41)	35.65		115 (11)	9.57	115 (20)	17.39	
Sylhet	115 (24)	20.87	115 (31)	26.96		115 (07)	6.09	115 (10)	8.70	
Average	460 (103)	22.39 ±0.74**	460 (144)	31.31 ±1.91**		460 (36)	7.83 ±0.79**	460 (60)	13.04 ±1.91**	

***Significant differences between sex's groups p<0.001; **female p<0.005 and **male p<0.05

Table 4a: Season-wise prevalence of fascioliosis in slaughterhouse and household live cattle in summer and winter season

District	Summer season				Overall prevalence (%)	Winter season				Overall prevalence (%)
	Slaughterhouse cattle		Household live cattle			Slaughterhouse cattle		Household live cattle		
	No. examined (positive)	Prevalence (%)	No. examined (positive)	Prevalence (%)		No. examined (positive)	Prevalence (%)	No. examined (positive)	Prevalence (%)	
Habiganj	76 (5)	6.58	77 (9)	11.69	10.44 ±1.14***	77 (11)	14.29	77 (14)	18.18	16.99 ±0.93***
Moulvibazar	76 (7)	9.21	77 (11)	14.29		77 (10)	12.99	77 (16)	20.78	
Sunamganj	76 (6)	7.89	77 (12)	15.58		77 (12)	15.58	77 (19)	24.68	
Sylhet	76 (6)	7.89	77 (8)	10.39		77 (10)	12.99	77 (12)	15.58	
Average	7.90±1.14**		12.99±1.14**			13.96±0.93**		19.81±0.93**		

Table 4b: Season-wise prevalence of fascioliosis in slaughterhouse and household live cattle in rainy season

District	Rainy season				Overall prevalence (%)
	Slaughterhouse cattle		Household live cattle		
	No. examined (positive)	Prevalence (%)	No. examined (positive)	Prevalence (%)	
Habiganj	77 (17)	22.08	76 (24)	31.58	28.63 ±1.62***
Moulvibazar	77 (19)	24.68	76 (28)	36.84	
Sunamganj	77 (21)	27.27	76 (30)	39.47	
Sylhet	77 (15)	19.74	76 (21)	27.63	
Average	23.38±1.62**		33.88±1.62**		

**Significant differences in different season's p<0.001 and groups p<0.05

of cattle found to be infected more with helminthes is an important factor in the onset of infection because immunity plays a great role in the establishment of parasites in the host body and/or undernourishments and generally poor husbandry. In adult animals, the prevalence of helminthes is low due to the development of significant immunity. Winkler (1982) reported that host may recover from parasitic infection with increasing age and hence become resistant. On the other hand, young age groups of cattle were more infected than adults may be due to decrease of immunity. Similar observation was reported by Kiyyu et al. (2003), Nganga et al. (2004), Akter et al. (2011) and Fatima et al. (2012).

During the present study, the overall prevalence of both slaughterhouse and household live cattle in different district of fascioliosis were observed that female cattle were more infected significantly (p <0.001) than their male (Table 3). These findings are in agreement with others who have reported of Saifuzzaman (1996), Affroze et al. (2013) and Rashid et al. (2015) reported higher prevalence of fascioliosis in females than in the male cattle. On the other hand, the results of the present study are in agreement with the findings of Molina et al. (2005) and Bhutto et al. (2012) who observed higher prevalence in females as compared to male buffaloes. Physiological peculiarities of female animals which usually constitute stress factors like calving and lactation reduced their immunity to infections. Females are usually weak and malnourished and consequently are more susceptible to infections besides some other reasons (Blood and Radostits, 2000).

The study also shows seasonal relation of infections indicated that the highest infection was significantly (p <0.001) observed in rainy season followed by in winter and in summer (Table 4). The proportions of most of the fascioliosis were higher in rainy season than other seasons, which was in close agreement with earlier reports (Alim et al., 2012; Sardar et al., 2006; Aktaruzzaman et al., 2013; Akanda et al., 2014). Climatic conditions, particularly rainfall, were frequently associated with differences in the prevalence of fascioliosis because this was suitable for intermediate hosts like snails to reproduce and to survive longer under moist conditions (Ahmed et al., 2007). Moreover, Bangladesh has a rainy season for four months, which facilitates parasitic survival in such an environment. The prevalence of *F. gigantica* was found to be significantly higher during the wet season than that of dry season. The proportion of animals passing fluke eggs increased gradually from the early dry season and peaked at the end of the dry season and the early part of the rainy season (Keyyu et al., 2005).

CONCLUSIONS

Fascioliosis devastates the large ruminants and continually drains the economic gains from the animals in case of Sylhet region of Bangladesh. These observations will help to adopt control strategies against fascioliosis in cattle as well as meat inspection and treatment protocol like choice of anthelmintic, liver tonic etc. of infected animals. The effective methods are required to control fascioliosis in cattle. The effective methods such as the strategic use of anthelmintic, reduction of intermediate host and proper husbandry practices may be suggested to overcome economic loss due to fascioliosis in cattle.

ACKNOWLEDGEMENT

Authors are highly thankful to the staff of Department of Parasitology, Faculty of Veterinary and Animal Science, Sylhet Agricultural University, Sylhet-3100, Bangladesh and especially thanks to the staff of District Veterinary Hospital, farmers and Butcher's in different District at Sylhet division of Bangladesh for providing materials and laboratory facilities during the period of study.

CONFLICT OF INTEREST

The authors declare no conflict of interests.

AUTHOR'S CONTRIBUTION

Kazi Mehetazul Islam has examined the feces from household live and liver from slaughterhouse cattle, written the whole article. Shah Md. Abdur Rauf and Moizur Rahman for his kind, scholastic guidance and valuable advice throughout the research activities preparation of the manuscript.Md. Siddiqul Islam, Gitaindro Nath Adhikary and Khandoker Mohammad Mozzafor Hossain helped in laboratory examination of the collected samples.

REFERENCES

- Affroze S, Begum N, Islam MS, Rony SA, Islam MA, Mondal MMH (2013). Risk factors and gross pathology of bovine liver fluke infection at Netrokona district, Bangladesh. J. Anim. Sci. Adv. 3:83-90. http://dx.doi.org/10.5455/jasa.20130219031948
- Ahmed EF, Markvichtr K, Tumwasorn S, Koonawootrittriron S, Choothesa A, Jittapalapong S (2007). Prevalence of *Fasciola* spp. infections of sheep in the middle awash River Basin, Ethiopia. South-East Asian J. Trop. Med. Public Health. 38: 51-57.
- Akanda MR, Hasan MMI, Belal SA, Roy AC, Ahmad SU, Das R, Masud AA (2014). A survey on prevalence of gastrointestinal parasitic infection in cattle of Sylhet division in Bangladesh. Am. J. Phytomed.Clin. Therap. 2: 850-860.
- Aktaruzzaman M, Rony SA, Islam MA, Yasin MG, Rahman AKMA (2013). Concurrent infection and seasonal distribution of gastrointestinal parasites in cross-bred cattle of Sirajganj district in Bangladesh. Vet. World. 6:720-724. http://dx.doi.org/10.14202/vetworld.2013.720-724
- Akter Y, Uddin MM, Khatun MA (2011). Prevalence of gastrointestinal parasitism in dairy cattle in Muktagachaupazila of Mymensingh district, Bangladesh. Res. Public. J. 5:376-380.
- Alam MM, Samad MA, Chowdhury NS, Ahmed MU (1994). Haemato-biochemical changes and therapeutic management of clinical fascioliasis in sheep and goats. Bangladesh Vet. J. 28: 7-14.
- Alim MA, Das S, Roy K, Sikder S, Mohiuddin MM, Hossain MA (2012). Prevalence of gastrointestinal parasitism in cattle of Chittagong division, Bangladesh. Wayamba J. Anim. Sci. 4: 247-254.
- Alim MA, Mondal MMH, Islam MK, Khan MAHNA (2000). A note on the pathology in *Fasciola gigantica* and *Gigantocotyle explanatum* in the livers and gall bladder of buffaloes. Bangladesh Vet. 17: 124-125.
- Bangladesh Bureau of Statistics (2010). Report of the Household-based Livestock and Poultry Survey, 2009.
- Bangladesh Society for Veterinary Education and Research. BSVER Publications, 25:26-34.
- Bhutto B, Arijo A, Phullan MS, Rind R (2012). Prevalence of fascioliasis in buffaloes under different agro-climatic areas of Sindh Province of Pakistan. Int. J. Agri. Biol. 14: 241–245
- Blood DC, Radostits OM (2000). Veterinary Medicine 9th edition, Balliere Tindall, London, UK, Pp1378-1382.
- Boray JC (1982). Chemotherapy of Fasciolosis. New South Wales Vet. Proc. 8:42-47.
- Chowdhury SMZH, Moin MF, Debnath NC (1993). Prevalence of helminthic infections in Zebu cattle (Bosindicus) at Savar Bangladesh. Aust. J. Anim. Sci. 6: 427-431. http://dx.doi.

org/10.5713/ajas.1993.427
•Chowdhury SMZH, Mondal MMH, Huq S, Rahman MH (1994). Prevalence of *Fasciola* cercariae in Lymnaeid snails in Bangladesh. Am. J. Anim. Sci. 7: 343-346. http://dx.doi.org/10.5713/ajas.1994.401
•Faizal ACM (1999). Prevalence of *Eimeria* Spp. and gastrointestinal nematodes versus weight gains in treated goats raised in the dry areas of Sri Lanka, Small Ruminants Research 34:21-25. http://dx.doi.org/10.1016/S0921-4488(99)00037-1
•Fatima M, Ahmad F, Chishti MZ, Lone BA (2012). A survey on the bovine Amphistomiasis in Kashmir Valley, India. Int. J. Rec. Sci. Res. 3: 50-52.
•Harrison LJS, Hammond JA, Sewell MMH (1996). Studies on helminthosis at the Centre for Tropical Veterinary Medicine (CTVM). Trop. Anim. Health Prod. 28:23–39. http://dx.doi.org/10.1007/BF02250725
•Howlader MMR, Hoq MM, Chowdhury SMZH (1991). Correlation of *Fasciola gigantica* infestation with fecal egg counts in Black Bengal goats. Bangladesh Vet. 8: 1-3.
•Kamaruddin KM (2003). Goat farming as a means of poverty alleviation. In: Proceedings of BSVER symposium. Goats farming in Bangladesh; Problems and prospects. BAU. BSVER Publications. 25: 26-34.
•Keyyu JD, Monrad J, Kyvsgaard NC, Kassuku AA (2005). Epidemiology of *Fasciola gigantica* and Amphistomes in cattle on traditional, small-scale dairy and large-scale dairy farms in the southern highlands of Tanzania. Trop. Anim. Health Prod. 37: 303-314. http://dx.doi.org/10.1007/s11250-005-5688-7
•Khandaker MMU, Chanda PK, Rahman E (1999). Hepatic changes of cattle naturally infected with *Fasciola gigantica.* Bangladesh Vet. J. 3: 33-44.
•Kiyyu JD, Kassuku AA, Kyvsgaard NC, Willinggham AL (2003). Gastrointestinal parasites in indigenous zebu cattle under pastoral and nomadi management systems in the lower plain of Southern highlands of Tanzania. Vet. Res. Commun. 27: 371-380. http://dx.doi.org/10.1023/A:1024706120270
•Kusiluka LJM, Kambarage DM, Mathewman RW, Harrison LJS, Daborn CJ (1994). Epidemiology of gastrointestinal helminthes in goats under different systems of management in Morogoro District. Tanzania Vet. J. 14:3-4.
•Lebbie SHB, Rey B, Irungu EK (1994). Small ruminant research and development in Africa Proceedings of the Second Biennial Conference of the African Small Ruminant Research Network, ILCA. Pp.1-5.
•Molina EC, Gonzaga EA, Lumbao LA (2005). Prevalence of infection with *Fasciola gigantica* and its relationship to carcass and liver weights, and fluke and egg counts in slaughter cattle and buffaloes in Southern Mindanao, Philippines. Trop. Anim. Health Prod. 37: 215-221. http://dx.doi.org/10.1023/B:TROP.0000049294.87048.48
•Nansen P (1991). Research collaboration on gastrointestinal parasites. *In:* "Inaugural seminar on DANIDA funded ruminant gastrointestinal helminths research project" conducted at Sokoine University of Agriculture, Morogoro Tanzania. 13:1-2.
•Nganga CJ, Maingi N, Munyua WK, Kanyari PW (2004). Epidemiology of helminth infection in ruminants of semi-arid area of Kenya. Ondestepool J. Vet. Res. 71: 219-226.
•Rahman MF, Ahmed Z (1991). Final report of pilot project for the control of parasitic diseases of animals in Bangladesh. Bangladesh livestock Research Institute, Savar, Dhaka.
•Rashid MM, Hoque MA, Alim MA, Huque KS, Bhuiyan AKFH (2015). Prevalence of gastrointestinal parasites in Brahman crossbred cattle of Bangladesh. Livest. Res. Rural Develop. 27: 15-20
•Ratnaparkhi MR, Shastri UV, Rajurkar SR, Jamkhedkar PP (1993). Efficacy of Distodin (Pfizer) against fascioliasis in cattle, buffaloes and goats under field conditions. Indian Vet. J. 70:157-159.
•Roberts JA, Estuningsih E, Widjayanti S, Wiedosari E, Partoutomo S, Spithill TW (1997). Resistance of Indonesian thin tail sheep against *Fasciola gigantica* and *F. hepatica*. Vet. Parasitol. 68:69–78. http://dx.doi.org/10.1016/S0304-4017(96)01027-8
•Ross JG, Dow C, Todd JR (1967). The pathology of *Fasciola hepatica* infection in pigs: A comparison of the infection in pigs and other hosts. Brit. Vet. J. 123: 317-322.
•Saifuzzaman ABM (1996). Incidence and seasonal variation of helminth parasites of cattle at Chandinathana in Comilla district. M. Sc. Thesis, Department of Parasitology, Bangladesh Agricultural University, Mymensingh.
•Samad MA (1996). Poshupalon o chikissavidya [In Bengali], 1st edition, LE Publications, Dhaka, Bangladesh. Pp. 25-29.
•Sardar SA, Ehsan MA, Anower AKMM, Rahman MM, Islam MA (2006). Incidence of liver flukes and gastro-intestinal parasites in cattle. Bangladesh J. Vet. Med. 4: 39-42.
•Soulsby EJL (1986). Helminths, Arthropods and Protozoa of Domesticated Animals, 5th& 7thEdition. Lea & Febiger, Philadelphia. Pp. 186-190.
•Tanrawatpan C, Maleewong W, Wongkham C, Wongkham S, Intapan P M, Nakashima K (2003). Characterization of Fasciola gigantica adult 27-kDa excretory-secretory antigen in human fascioliasis. Parasitol. Res. 91:325-327.
•Winkler J (1982). Prevalence of helminths in sheep and goats. Aust. Vet. J. 12: 14-18.