**CHAPTER-I**

**INTRODUCTION**

Tropical, agro-based Bangladesh has 47.51 million livestock of which 22.87 million are cattle (BBS, 2008).Livestock, the backbone of Bangladesh’s agricultural economy, is at risk of decline in production due to number of ecto- and endo-parasites. Bangladesh is usually hot and humid except in winter and the climatic condition of Bangladesh is very conducive to a wide variety of parasites as well as ticks (Razzak and Shaikh, 1969). Ectoparasitic infestation is one of the major veterinary problems affecting livestock industries in many parts of the world (Hourrigan, 1979). Ectoparasites including lice, ticks, mites etc. play an important role in the transmission of certain pathogens (Loomis, 1986). The ectoparasites are known to cause heavy economic losses to livestock industry due to their usual habit of blood sucking, which adversely affects the economic production (Branscheid and Schroer, 1997). Among ecto-parasites, ticks have been recognized as the notorious threat due to severe irritation, allergy and toxicosis (Niyonzema & Kiltz, 1986). In some cases, ticks have been reported to cause lowered productivity, mortality (Niyonzema and Kiltz, 1986) and transmit such diseases as babesiosis, theileriosis, anaplasmosis etc (Norval *et. al*., 1984). Ticks act not only as potential vectors but also as reservoirs of certain infectious agents e.g. *Pasteurella multocida*, *Brucella abortus* and *Salmonella typhimurium* in man and animals (Jongejan and Uilenberg, 2004). Besides ticks lice also cause harm in cattle health. Lice infested animals keep poor physical condition and develop an unthrifty, anemic appearance and discoloured greasy hair (Nelson, 1984). Louse free animals have been reported to be more profitable than infested animals due to increased rate of weight gain and more feed utilization (Kettle, 1974). In addition, lice infestation contributes to huge economic losses due to damage to skin and hide in the form of light flecks and spots followed by secondary bacterial infection or scratching behavior and inflammation of the skin (Nafstad and Gronstol, 2001b). The situation of ticks and tick-borne diseases in animals have been partially documented in Bangladesh by number of authors (Samad, 2000), but these studies are fragmented and not yet done in Gaibandha District.

**The objectives of the study were to:**

1 .Estimate the prevalence of ectoparasitic (tick and lice) infestation in crossbred and local cattle of Gaibandha district.

2. Determine the effect of different factors such as, age, sex, breed, season and managemental factors (stall feeding/grazing) in the occurrence of tick and lice infestation.

**CHAPTER-II**

**REVIEW OF LITERATURE**

Pertinent literatures on occurrence of ecto-parasitic infestation in cattle were reviewed in this chapter. The main purpose of this chapter is to provide up to date information concerning the research works in relation to the respective subject. Important information related to the present study was represented below:

**Kabir *et al*. (2011)** revealed that 36.31% cattle are infested with tick of which *Boophilus microplus* (25%), *Rhipicephalus sanguineus* (13.68%) and *Haemaphysalis bispinosa* (12.63%) were most common in Chittagong district. In this survey, in young cattle (≤1.5 year) the prevalence was highest (46.28%) followed by adults (>1.5 year) (27.80%). The prevalence of tick was higher in local cattle (43.82%) than in cross-bred (24.13%). Besides this, the prevalence was estimated higher in female (59.37%) than in male (35.83%) cattle in Chittagong.

**Islam et al.(2009)** carried out an Experiment in Sirajgonj district during December, 2007 to May, 2008 to investigate the prevalence and population density of ectoparasitic infestation in randomly selected 245 cattle. The result revealed that overall 160 (65.4%) cattle were infested with one or more species of ectoparasites. Five species of ectoparasites were identified. Among them, Three species were Arachnids, namely *Boophilus microplus* (35.5%) *Rhipicephalus sanguineus* (10.6%) and *maphysalis bispinosa* (7.8%) and two species were insects, *Linognathus vituli* (10.2%) and *Haematopinus eurysternus* (7.4%). The overall parasitic burden was 2.5±1.5 per inch of infested area. The parasitic burden was highest in case of *H. eurysterunus* (3.9±2.2) followed by *L. vituli* (3.0±2.4), *B. microphus* (2.3±1.3), *H. bispinosa* (1.6±1.1) and *R. sanguineus* (1.3±0.5). Higher prevalence of ectoparasites was recorded in summer season (51.4%) than winter (33.3%). In summer season cattle were 2.1 times more susceptible to ectoparasitic infestation than winter season. The prevalence of ectoparasitic infestation was higher in old cattle (61.5%) followed by calves (56%) and adult (38.5%). The calves were 2.0 times more susceptible to ectoparasitic infestation than the adults. But the calves and the old animals were almost equally susceptible (odd ratio=1.26) to ectoparasitic infestation.

**Sajid et al.(2008)** determined the diversity and intensity of tick population infesting domestic ruminants in Districts Layyah and Muzaffargarh of lower Punjab (Pakistan). A total of 1050 cattle, 700 buffaloes, 1400 each of sheep and goats and 250 camels were randomly selected and examined for the prevalence of tick infestation. The highest (P=0.00) prevalence of tick infestation was found in cattle (n=789/1050; 75.1%) followed in order by goat (n=723/1400; 51.6%) and buffaloes (n=281/700; 40.08%). None of the examined camels and sheep was found infested with ticks. *Hyalomma anatolicum* was the most abundant followed by *Rhipicephalus sanguineus*. Appropriate control measures for ticks need to be employed in the study area for economical animal production.

**Bazarusanga *et al*.(2007)** carried out a study in both the dry and the wet season to determine the abundance and the dynamics of the tick populations infesting cattle in Rwanda. Six Ixodid tick species where identified namely *Rhipicephalus appendiculatus* (91.8%) followed by *Boophilus decoloratus* (6.1%)and *Amblyomma variegatum* (1.2%).

**Manan et al.(2007)** studied to investigate hard tick (Ixodid) infestation and genera identification in 30 different herds in randomly selected 15 villages of Frontier Region Peshawar was carried out during August 2003 through February 2004. Ticks were identified for their genera, in Parasitology Laboratory, Veterinary Research Institute, Peshawar. The effect of month, age, status of body condition, post treatment effect of acaricides, housing and grazing systems on tick infestation was recorded. Out of 1279 farm animals studied, 255 cattle, 97 buffalo, 273 sheep, 544 goat and 110 donkeys were studied for tick infestation. About 13.37 % of the total observed farm animals were found tick infested with highest infestation in cattle (20.4%) followed by sheep (12.8%), goat (12.1%), buffalo (11.3%) and donkey (6.4%). The most commonly prevalent ticks were belonging to genus Boophilus (46.1%) followed by Hyalomma (31.25%), Rhipicephalus (17.93%) and Amblyomma (4.61%). Tick infestation was higher in late summer and lower in winter. The effect of age, status of body condition and post treatment effect of acaricides was found non-significant.

**Omer *et al.* (2007)** surveyed on hard ticks affecting cattle, sheep, and goats from March 2005 until February 2006 in three areas (Dohuk surrounding area, Barwary Balla near Turkish border, and Eqre). They reported *Hyalomma anatolicum anatolicum* and *Hyalomma anatolicum marginatum* from cattle while the species collected from sheep and goats were *Rhipicephalus bursa, Rhipicephalus turanicus, Haemaphysalis parva,* and *Hyalomma* spp*.*

**Rahbari *et al*. (2007)** carried out a tick survey in four different geographical areas of Iran. They showed that the occurrence of ticks on cattle, sheep and goats were 62, 55 and 57%, respectively, with no differences between the zones. The mean number of ticks on each animal was low (10-20 ticks per animal).

**Razmi *et al*. (2007)** investigated the prevalence of hard tick species (Acari: Ixodidae) on cattle in Mazandaran province, Iran, during 2004-2005. Nine species were identified: *Boophilus annulatus* (51.3%), *Rhipicephalus bursa* (16.8%), *Haemaphysalis punctata* (6.3%), *Ixodes ricinus (*6.8%), *Hyalomma marginatum* (12.5%), *Hyalomma anatolicum excavatum* (5.2%), *Hyalomma asiaticum* (0.6%), *Hyalomma detritum* (0.2%),and *Dermacentor spp.* (0.1%).Results showed that *Boophilus annulatus, Rhipicephalus bursa,* and *Hyalomma* species are dominant tick species in the surveyed area.

**Sanjay *et al*.(2007)** examined the seasonal prevalence of tick infestation of Birsa state in India, significantly more during the rainy (24.33% of cattle and 18.08% of buffaloes) and summer seasons (21.58% of cattle and 10.72% of buffaloes) as compared to the winter season (4.03% of cattle and 2.35% of buffaloes).

**Sarkar et al.(2007)** studied the epidemiology and pathology of ectoparasitic infestations in Black Bengal goats in different areas of Mymensingh and Gaibandha districts, Bangladesh from December, 2006 to November, 2007. A total of 125 Black Bengal goats were examined. Among them 91 (72.8%) were infested with one or more species of ectoparasites. Six species of ectoparasites were identified, of which four species were arachnids, namely *Heamaphysalis bispinosa* (34.4%), *Boophilus* *microplus* (27.2%), *Rhipicephalus sanguineus* (7.2%), and *Psoroptes cuniculi* (5.6%) and two species belonged to the class Insecta namely *Damalinia caprae* (20.8%) and *Linognathus stenopsis* (18.4%). Overall mean parasitic burden was 2.36±1.49 per square inch of affected area. The highest parasitic burden was recorded in case of *L. stenopsis* (3.93±2.219), followed by *D. caprae* (3.00±2.424), *H. bispinosa* (2.32±1.278), *P. cuniculi* (2.00±1.414), *B. microplus* (1.59±1.098), and *R. sanguinus* (1.33±0.516). Significantly (p<0.01) higher prevalence of ectoparasites was recorded in the rainy season (90%), followed by

winter (82.61%), and summer (53.06%). The ectoparasitic infestation was higher in case of kids (82%) and older goats (79.55%) than that of young (51.61%) goats. The female goats (77.63%) were more susceptible than male (65.31%) to ectoparasitic infestation. The prevalence of ectoparasites was higher in Mymensingh (87.5%) than that of Gaibandha region (57.38%). In the present study, pathological lesions produced by ectoparasites were also studied. In *P. cuniculi* infestation, alopecia, rough, dry and leathery skin was found. Microscopically, it was characterized by hyperkeratinization, ulceration, acanthosis and eosinophilic infiltration. In tick infestation, rough, reddened skin and loss of hair were observed. In lice infestation, the skin was red and slightly elevated. The ectoparasites produced pathological lesions on the skin which reduces the value and quality of skin.

**Singh *et al*.(2007)** carried out a study in four valley districts of Manipur during January­ December 2004. The cattle tick *Boophilus microplus [Rhipicephalus microplus]* (Canestrini, 1888) was recorded infesting cattle throughout the year. The percentage of infestation of tick was recorded more in third quarter of the year (i.e. July-September) and maximum tick population was recorded in Bishenpur district.

**Stuti *et al*.**(**2007)** reported 35.78% tick-infested animals (37.32% cattle and 33.04% buffaloes) Uttarkhand state in India. The animals were infested with ticks throughout the year, with maximum infestation during the rainy season (53.01%), then during summer (43.25%), and the least during winter (7.15%). Five species of ticks belonging to 3 genera were recorded. *Boophilus microplus* was the most common and predominant tick (96.44%), followed by *Rhipicephalus sanguineus* (1.98%) and *R*. *haemaphysaloides* (1.96%), while *Hyalomma anatolicum anatolicum* (0.002%) and *H*. *marginatum isaaci* (0.001 %)were rarely encountered.

**Aydin *et al*. (2006) i**dentified tick infestation in cattle and sheep from three districts of Southeastern Bulgaria (Stara Zagora, Haskova and Kurdzhaly) from March to June 1997 and 2003. A total of 901 ticks were collected from 150 cattle and 200 sheep. 57.93% of the ticks were from cattle and 42.07% were from sheep. Nine tick species were identified: *Ixodes ricinus* (0.78%), *Dermacentor marginatus* (0.34%), *Rhipicephalus bursa* (7.54%), *R. turanicus* (19.50%), *R.* *sanguineus* (4.43%), *Hyalomma anatolicum anatolicum* (1.88%), *H*. *anatolicum excavatum* (1.23%), *H. detritum* (4.10%), *H. marginatum* (0.23%) and developmental stages (29.97%). The seasonal distributions of these tick species are also presented.

**Islam *et at.* (2006)** recorded *Boophilus microplus* on cattle (42.4%), buffaloes (31.5%), and on pigs (8.2%); *Haemaphysalis bispinosa* on goats (31.5%), cattle (12.0%), buffaloes (10.8%); *Rhipicephalus sanguineus* on dog (27.4%), cattle (10.8%), and on goat (6.8%); *Hyalomma anatolicum anatolicum* on cattle (19.2%) and *Amblyoma testudinarium* on cattle (4.4%) and pigs (2.3%) in three distinct topographic zones, viz. flood plains, hills and steppe "Barind" in Bangladesh. They reported that the prevalence were highest in summer (56.8%) followed by monsoon season (32.4%) and winter (8.5%).

**Mamak *et al*. (2006)** stated 29.6%, 24.0% and 19.9% prevalence of tick infestation in cattle, sheep and goats, respectively in the Zara-Sivas region of Turkey. They reported *Haemaphysalis parva* (33.8%), *Dermacentor marginatus* (2.8%), *Rhipicephalus annulatus* (21.1%), *Haemaphysalis concinna* (15.5%), *Hyalomma marginatum* (19.7%), and *Rhipicephalus bursa* (7%) in cattle only.

**Rabbi et al.(2006)** studied the parasitism in goats in relation to different feeding systems, 1110 goats from different areas of Jaypurhat, Tangail, Netrakona and Mymensingh districts were examined. By fecal sample examination, 76.5% goats were found to be infected with one or more species of endoparasites. In this study, 9 types of helminths’ ova were identified such as *Fasciola gigantica* (14.8%), *Paramphistomum* sp. (28.5%), *Schistosoma indicum* (3.2%), strongyles (35%), *Strongyloides* sp. (17.4%), *Toxocara* spp. (1.5%), *Trichuris* sp. (4.6%), *Capillaria* sp. (1.2%) and *Moniezia* sp. (3.7%). Two types of protozoa were also detected, namely, *Eimeria* sp. (7.1%) and *Balantidium coli* (5.5%). Along with these, five species of ectoparasites were found: two species were lice such as *Damilinia caprae* (13.9 %) and *Linognathus vitulli* (4.2%), and two species were ticks namely, *Haemophysalis bispinosa* (21.2%), *Rhipicaphalus (Boophilus) microplus* (3.6%) and one species was mite, namely, *Demodex* sp. (2.9%). Mean parasitic burden of *Paramphistomum* sp. (259.81 ± 3.35) was the highest followed by *Eimeria* sp. (224.1 ± 16.9) and *Moniezia* sp. (204.9 ± 19.7). Prevalence of helminths and protozoa was significantly (P<0.01) highest in extensive system (86.1%) followed by semi-intensive (76.3%) and intensive system (57.5%). Ova of *Schistosoma indicum* was absent in the fecal sample of goats of intensive system. Goats of extensive and semi-intensive systems were 4.6 and 2.4 times more susceptible to helminth infection than those of intensive system. Ectoparasitic infestation was the highest in semi-intensive system (59.7%) followed by extensive system (33.5%) and intensive system (8.2%). In conclusion, the present study suggests that feeding system has a great impact on the prevalence of parasites in Black Bengal goats. Further study can be carried out to determine the effect of parasitism in the production performance of Black Bengal goats.

**Torina *et al*. (2006)** examined ticks infesting livestock on farms in Western Sicily, Italy, A total of 6208 specimens was collected belonging to 9 species: *Rhipicephalus bursa* (32.4%), *Rhipicephalus turanicus* (22.7%), *Rhipicephalus sanguineus* (19.3%), *Hyalomma lusitanicum* (12.0%), *Haemaphysalis punctata* (7.8%), *Hyalomma marginatum* (3.5%), *Dermacentor marginatus* (1.4%), *Ixodes ricinus* (0.8%) and *Ixodes hexagonus* (0.1%).They showed that the species belonging to the genus *Rhipicephalus* were present on all hosts and habitats monitored, *R.* *bursa* was found to be abundant on cattle (46.3%).

**Estrada and Santos (2005)** conducted the first country wide faunistic study of the tick parasites of ruminants in Portugal. The aim of this study was to map accurately the distribution of the ticks *Dermacentor marginatus, Rhipicephalus annulatus, R. bursa, Hyalomma marginatum, H. lusitanicum* and *Ixodes ricinus* in Portugal. Four species (*R*. *annulatus, R. bursa, D. marginatus* and *H*. *marginatum)* were mostly restricted to south-eastern parts of the country, under hot and dry climatic conditions of Mediterranean type.

**Sanyal (2005)** described the morphology and geographical distribution of *Boophilus microplus [Rhipicephalus microplus], Haemaphysalis bispinosa, Hyalomma anatolicum and Rhipicephalus haemaphysaloides* obtained from cattle and goats in Maheshkhali Island, Chittagong, Bangladesh, in December 2003. These species were recorded for the first time from the area.

**Swai *et al*.(2005)** showed that the tick infestation rate was 85.6% in Tanzania and overall mean tick density was 20.7±2.2 ticks/ animal. *Rhipicephalus appendiculutus* and *R*. *evertsi* were the species mostly frequently encountered on the cattle and the degree of tick infestation varied significantly between sub-counties. Mature animals had higher odds of carrying ticks of either species. [odds ratio] (OR =12.3, P=0.018) than young stock.

**Sanjay *et al*. (2004)** examined a total of 1186 cattle and 857 buffaloes in Jharkhand, India during the summer (March­-June), rainy (July-October) and winter (November-February) seasons from November 2001 to October 2002. The seasonal prevalence of tick infestation was significantly more during the rainy (24.3% of cattle and 18.1% of buffaloes) and summer seasons (21.6% of cattle and 10.7% of buffaloes) as compared to the winter season (4% of cattle and 2.4% of buffaloes).

**Yakhchali and Hasanzadehzarza (2004)** stated that hard tick infestation on groin and mammary glands was most prevalent in cattle (52.2%), buffaloes (52.6%) and sheep (55.2%). Ixodid tick infestation of minor importance on head, ear and neck was 1.7%, 1.3% and 1.2% in cattle, buffaloes and sheep, respectively and the Ixodid tick distributions per animal were 5, 4-5, 2-3 and 1-2 in cattle, calves, buffaloes, female buffaloes and sheep, respectively. They also showed the heavy infestation was observed in adult cows (60.8%), female buffalo calves and ewes, whereas light infestation was observed in bulls and bull calves (20%) and male buffalo calves (16.7%).

**Alvarez *et al*. (2003)** showed the relative abundancy of *Boophilus microplus* collected from ten farms distributed in eight ecological zones (EZ) and two rainfall systems of Costa Rica. It was reported that there were no difference between ecological zones but there were differences between rainfall system and the rain seasonality showed larger tick infestation (P<0.03).

**Bahadori (2003)** examined 6259 ticks from 5491 animals including 3992 sheep, 695 goats, 426 cattle, 329 camels and 48 stray dogs and collected from the three zones of the body including ear, head and below the tail and perianal region and around of mammary glands in females and scrotum in males. 3 genus and 9 species namely: *R. sanguineus, Hyalomma anatolicum excavatum, H. anatolicum anatolicum, H. dromedarii, H. schulzei, H. detritum, H. asiaticum asiaticum* and *Ornithodoros lahorensis* were found. *H. anatolicum excavatum* in cattle and *H. dromedarii* in camels. The average number of ticks on the animals in Garmsar was found to be <10.

**Bekele (2002)** examined the seasonal distribution of ticks of Ogaden cattle from May 1997 to April 1998. A total of 2790 ticks were examined belonging to 4 genera; the dominant tick species identified were *Amblyomma cohaerens* (52.2%), *Rhipicephalus pravus* (19.3%) and *A*. *variegatum* (14.6%). *A. cohaerens* occurred throughout the sampling period and showed a peak during March. Their number declined significantly (P<0.01) from August to December. *R. pravus* occurred from July to December only and peaking in September (P<0.01). *A. variegatum* occurred in low numbers throughout the study period with a marked seasonal variation (P<0.01); abundant numbers of ticks were observed from May to July. The other tick species identified were *Boophilus decoloratus, R. bergeoni* and *R*. *evertsi .* Individual variation in tick infestation level was observed among the animals (P<0.05). Since all the animals were of the same breed, age group and were managed similarly, the selection of animals with low infestation level can be a component of tick control strategy.

**Das and Shrivastava (2002)** investigated the incidence of tick infestation in adult bovines in rural Chattisgarh, India. They showed that there was moderate to heavy infestation of bovine tick, *Boophilus microplus* among domestic cattle and these ticks preferred certain sites for attachment. Dewlap and udder were the preferred sites in females, whereas the area between the hind limb and dewlap were the preferred sites in males.

**Kaushal *et al*.(2002)** investigatedthe prevalence of ectoparasitic ticks from different localities of Nilgiris district, Tamil Nadu, India from August to November 1996. A total of 1232 adult and immature ticks were collected from domestic animals in the study area and these were identified as *Boophilus microplus, Haemaphysalis bispinosa, Rhipicephalus haemaphysaloides and Rhipicephalus sanguineus.* Studies carried out in grasslands, meadows and areas adjoining tea plantations by flagging method revealed mainly immature stages and a few adults of *Rhipicephalus spp.* and *Haemaphysalis* spp.

**Knopf *et al.* (2002)** showed the burden and seasonal epidemiology of ticks in the Central Guinea savannah of Cote d'Ivoire, Five different tick species were identified; the four genera in order of frequency were: *Amblyomma* (96%), *Boophilus* (47%), *Hyalomma (*<1%*)* and *Rhipicephalus (*<1%*). Amblyomma variegatum* was the most-abundant tick on cattle in all seasons.

**Mbati *et al.* (2002)** reported *Boophilus decoloratus* (53.1%), *Rhipicephalus evertsi evertsi* (44.7%), *Rhipicephalus follis* (1.0%), *Rhipicephalus gertrudae* (0.7%) and *Rhipicephalus warburtoni* (0.4%) from cattle in South Africa.

**Yukar and Umur (2002)** identified the tick species infesting cattle, sheep, and goats and determined their seasonal activities in the Burdur area of Turkey in between 1 September 1999 and 31 August 2000. 3280 (adults: 3073 and nymphs: 207) ticks were collected from 756 cattle, 996 sheep, and 698 goats (863, 1846 and 571, respectively). In cattle, the collected ticks were identified as *Dermacentor marginatus, Haemaphysalis parva, Rhipicephalus turanicus, Boophilus annulatus,* and *Hyalomma marginatum.* The tick infestation rates were 21.8, 25.4, and 15.8% in cattle, sheep, and goats, respectively. The highest tick infestation rate was observed in April and May on sheep, whereas the lowest was during winter on cattle (*B*. *annulatus).*

**Mekonnen *et al.* (2001)** collected tick from domestic animals, mainly cattle, in 11 administrative zones covering 84 districts in central Ethiopia over a period of 2 years (July 1996 to June 1998). Nineteen tick species were identified; 4 belonged to the genus *Amblyomma,* one to *Boophilus,* 2 to *Haemaphysalis,* 3 to *Hyalomma* and 9 to *Rhipicephalus. Amblyomma variegatum* and *Rhipicephalus evertsi evertsi* were present in all 11 administrative zones. With the exception of Afar, *Boophilus decoloratus* was present in nearly every district where collections were made. These 3 species constituted more than 50% of all the ticks collected. *Amblyomma cohaerens* and *Rhipicephalus bergeoni* were more common in the west of the survey region, whereas *Rhipicephalus pulchellus* was more common in the east. Except for *B. decoloratus,* of which more females than males were collected, the numbers of male ticks recovered were equal to or exceeded those of females.

**Roy *et al*. (2001)** studied the ecology of ticks and tick-borne blood protozoa of cattle at Modhupur forest area, Tangail from July 1999 to June 2000. *Boophilus microplus* infestation in 28.3% cattle and *Haemaphysalis bispinosa* in 7.6% cattle were recorded. They found that 0.8% cattle were infected with *Anaplasma* sp*. H. bispinosa* infestation in cattle and goats was found to be positively associated with rainfall and evaporation rate and negatively associated with ambient temperature.

**Beyazt (2000)** investigated the species of Ixodidae found on Bursa region cattle and determined their seasonal activities from March 1993 and February 1995. During this 2-year period, 66 cattle were examined once a month for a total of 1584 times and ticks were found on 298 of them. Total 1427 ticks were collected from 13 tick species. Those that were determined were: *Ixodes ricinus* (45.55%), *Rhipicephalus* sp.(14.92%), *R. turanicus* (13.03%), *R. sanguineus* (0.21%), *Hyalomma detritum* (8.54%), *H. marginatum* (2.87%), *H. anatolicum* *excavatum* (0.07%), *Boophilus annulatus* (7.56%), *Dermacentor marginatus* (3.57%), *D*. *niveus* (0.07%), *Haemaphysalis parva* (0.56%), *H.* *punctata* (0.14%) *and H. inermis* (0.21%). Seasonally, *I. ricinus* was collected throughout the year*,* except June and July, and *B. annulatus* during June andOctober. *Hyalomma* and *Rhipicephalus* were observed in spring and summer months and *Haemaphysalis* species in autumn and winter months. *Dermacentor marginatus* was present in all months except June and August. *D. niveus* was observed only in October.

**Etter et al.(1999)** carried out a two-year study in a dairy goat flock in order to assess an eventual relationship between the periparturient relaxation in immunity and the nutritional status of periparturient females . On year 1, pregnant does were fed at 26 % below their energy (UR) requirements and 5 % above their protein (PDI) ones during the last 3 weeks before parturition (week 0) and an increase in nematode egg counts occurred from week -2 to week +4 with a predominance of Oesophagostornum larvae in coprocultures. In year 2, two groups of pregnant goats were fed at about 100 % their energy requirements and 28 and 44 % above the protein requirernents respectively during the same period. In this latter situation, no nematode egg count increase occurred in any of the two groups of animals, Teladorsagia and Trichostrongylus being the prevalent larval genera in coprocultures. As the study covered two consecutive years, the implication of several factors related to host physiology, parasite epidemiology and host nutrition are discussed.

**Biu and Nwosu (1998)** investigated a total of 3,055 cattle maintained either under open or restricted grazing management systems at Maiduguri in the semi-arid zone of Nigeria between October 1994 and March 1996. They reported 273 (8.9%) cattle were infested by one or more tick species. Ixodid ticks were dominant. Hyalomma species were the most common (6.3%), *Boophilus decoloratus* (5.5%), *Rhipicephalus sp.* (2.2%) *and Amblyomma variegatum* (0.1%).A total of 872 ticks made up of 846 Ixodid and 26 Argasid ticks were collected during the study. Among the Ixodid ticks recovered, Hyalomma species were the most numerous and constituted 191 (50.1%) of the total collection, followed by *Boophilus decoloratus* (32.0%), *Rhipicephalus* sp*.* (14.6%) and *Amblyomma variegatum* (0.3%).Although most of the ticks occurred in relatively low numbers throughout the year, they were generally most common from the second half of the rainy season through the dry season. The influence of management system, and the age, sex, breed and the colour of the animals in the distribution of the ticks are discussed.

**Kamal et al.(1996)** Studied on the prevalence of ixodid ticks during July 1991 to June 1992 in five thanas of Chittagong hilly area in Bangladesh revealed that 65.45% cattle and 44.4% goats were infested with *Boophilus microplus, Rhipicephalus appendiculatus* and *Haemaphysalis bispinosa*. Aside these only 4.62% cattle were found infested with *Amblyomma sp*. The tick infestation was highest in summer and declined gradually through rainy season to lowest in winter.

**L'Hostis *et al*.(1994)** examined 110 lactating dairy cows to describe the attachment sites of female *Ixodes ricinus* ticks. It was showed that seventy per cent of the cows were infested by *I. ricinus* and the average tick burden on the infested cows was 15, ranging from 1 to 136. Preferred attachment sites were the axilla, udder/groin, neck, dewlap and flank. Udder/groin and axilla carried 35.3% and 44.1 % of the total tick burden, respectively.

**CHAPTER-III**

**MATERIALS AND METHODS**

**A.Study area and period**

The present study was conducted in cattle of different areas at Gaibandha Sadar Upazilla in Gaibandha district.The investigation was carried out during the period from May 2013 to March 2014. The investigation was carried out in three visits on three seasons (Summer: March- June; Rainy: July-October and Winter: November-February). Total two hundred and six (206) cattle were selected randomly from different parts in Gaibandha district for the convenience of the study and availability of the cattle.

**B.Survey design and sampling**

Two steps cluster sampling was performed for this study. Ten villages from in and around Gaibandha Sadar selected randomly followed by ten house hold from each of the village selected, from which 1- 6 cattle were examined for ectoparasites. After that, a thorough epidemiological investigation was performed using a semi-structured questionnaire including the animal level variables such as age, sex, health status and rearing system. Age was determined by asking the owner and farm attendant and by visual inspection and also by dentition whenever possible. Animals were categorized based on age as young (**≤** 2 years), adult (> 2 years to 8 years), and old (**>** 8 years).

**C.Collection and preservation of samples**

The selected cattle were thoroughly investigated by close inspection, parting the hairs against their natural direction for the detection of ectoparasites. Ectoparasites were collected from the different parts of the body of the individual cattle by hand picking. When required, small hairbrush dipped in ethanol was used for the collection of ticks. The point of attachment was smeared with ethanol. Adequate precautions were taken to preserve the mouthparts and appendages of the ectoparasites during collection. Ectoparasites were preserved in 70% alcohol in clean, well-stopper glass vials which were labeled properly.

**D.Identification of ectoparasites**

Morphological study for identification of species of ectoparasites was conducted at the laboratory in the Department of Pathology and Parasitology, Chittagong Veterinary and Animal Sciences University, Chittagongwith the help of dissecting (4X) and compound (10X) microscope. Ectoparasites were identified according to the keys and descriptions given by Wall & Shearer (1997) and Soulsby (1982) by preparing permanent slides according to the procedures described by Cable (1967).

**E.Statistical analysis**

Statistical analyses were carried out by using Statistical Package for Social Sciences (SPSS) version 11.5 for Windows (2002) using F test through the Department of Agricultural Economics and Social Sciences, Chittagong Veterinary and Animal Sciences University, Chittagong. In addition to F test, Odds ratio was calculated according to the formula given by Schlesselman (1982).

|  |  |  |
| --- | --- | --- |
|  |  |  |
| Plate 1. Mouthpart of *Boophilus*  *microplus* | Plate 2. Posterior part of *B*.  *microplus* showing caudal process | Plate 7. Full view of *Linognathus*  *vituli* |
|  |  |  |
| Plate 3. Mouthpart of *Rhipicephalus sanguineus* | Plate 4. Posterior part of  *Rhipicephalus sanguineus* | Plate 8. Full view of *Damalinia*  *bovis* |
|  |  |  |
| Plate 5. Mouthpart of  *Haemaphysalis bispinosa* | Plate 6. Posterior part of  *Haemaphysalis bispinosa* | Plate 9. Full view of  *Haematopinus eurysternus* |

**CHAPTER-IV**

**RESULTS AND DISCUSSION**

**A.Overall prevalence**

Of 206 cattle examined, 132 (64.07%) were found infested with one or more species of ticks (Table 1). The findings of this study agree with the reports of Islam *et al.* (2009) in Sirajganj, Kamal *et al*. (1996) in Chittagong of Bangladesh, who recorded 65.5% and 65.4% prevalence of ectoparasites in cattle, respectively. The findings of this study differ with the previous findings of some other scientists. Higher prevalence (75.1%) in cattle was reported by Sajid *et al*. (2008) in Pakistan. Roy *et al*. (2001) reported 36.31% prevalence of tick infestation in cattle at Madhupur in Bangladesh.

Table 1. Overall prevalence of ectoparasites in cattle (N=206)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species of ectoparasite involved | No of animal  affected | Prevalence  (%) | Parasitic burden | |
| Range | Mean±SE |
| *Boophilus microplus* | 94 | 45.63 | 1-7 | 2.64±0.12 |
| *Haemaphysalis bispinosa* | 34 | 16.50 | 1-2 | 1.09±0.04 |
| *Rhipicephalus sanguineus* | 76 | 36.89 | 1-4 | 1.68±0.09 |
| *Linognathus vituli* | 48 | 23.30 | 1-3 | 1.38±0.09 |
| *Haematopinus eurysternus* | 37 | 17.96 | 1-2 | 1.05±0.03 |
| *Damalinia bovis* | 17 | 8.25 | 1-2 | 1.12±0.08 |
| Total | 132 | 64.07 | 1-7 | 1.49±0.80 |

\*Total number of animals affected is less than the summation of individual infestation because same animal was infested by more than one type of ectoparasites. N = Total animal examined.

Three species of arachnids namely, *Boophilus microplus* (45.63%), *Rhipicephalus sanguineus* (16.50%) and *Haemaphysalis bispinosa* (16.50%) and 3 species of lice namely, *Linognathus vituli* (23.30%), *Haematopinus* *eurysternus* (17.96%) and *Damalinia bovis* (8.25%) were identified. This is similar to the findings of Islam *et al.* (2006) who reported *B. microplus* (42.4%) *H. bispinosa* (12.0%) and *R. sanguineus* (10.8%) in cattle in Bangladesh. Razzak and Shaikh (1969) recorded 33.4% cattle infested with ticks such as *Boophilus* mic*r*oplus, *Haemaphysalis bispinosa* and *Hyalomma* sp. The differences between the results of present and earlier study might be due to variation in the geographical locations, climatic conditions of the experimental area, methods of study, selection of sampling animal and breed of animal studied.

**B.Age-wise prevalence**

It was observed that, prevalence of ectoparasites was significantly (*p*<0.05) higher in older animals aged > 8 year (71.11%) followed by in adult aged > 2 years- 8 years (65.45%) and lowest in young aged < 2 year (47.05%) (Table 2). The mean tick burden was higher in case of adult (1.87±0.154) followed by in old (1.54±0.124) and in young (1.40±0.234). The results of present study agree with Islam *et al.* (2009) who found that prevalence of ectoparasitic infestation was higher in old cattle (61.5%) followed by calves (56%) and adult (38.5%) and calves had 2.0 times and 1.26 times more susceptibility to ectoparasitic infestation than the adults and older animals. On the other hand, Stuti *et al.* (2007) reported that, calves (below one year) were the most susceptible (65.38%) followed by grownups (34.60%) and adults (14.91%) cattle. Manan *et al*. (2007) found that resistance in the animals was building up as the age advances and the animals became more adoptable than in younger state irrespective of the farm species. It is hypothesized that the strong innate immunity and age resistance of young cattle are responsible for their less vulnerability to tick infestation (Sarkar, 2007) and in such way, leads to less ectoparasitic burden.

**C.Seasonal prevalence**

Prevalence of ectoparasites was higher in summer season (78.46%) followed by winter (62.85%) and lowest in rainy season (33.3%). In summer, cattle were 3.35 and 2.15 times more susceptible to such parasitism than rainy and winter season, respectively (Table2).

Table 2. Prevalence of ectoparasites in Cattle of Gaibandha district based on age of animal and seasons of study conducted

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Species of  ectoparasites | Age of the cattle | | | Seasons | | |
| Young\*  No. (%) | Adult\*  No. (%) | Old\*  No. (%) | Summer\*  No. (%) | Rainy\*  No. (%) | Winter\*  No. (%) |
| *Boophilus*  *microplus* | 18(35.29) | 51(46.36%) | 25 (55.55%) | 39 (60.0%) | 23 (32.39%) | 32 (45.71%) |
| *Haemaphysalis*  *bispinosa* | 6(11.76) | 19 (17.27%) | 9 (20.0%) | 15 (23.07%) | 10 (14.08%) | 9 (12.85%) |
| *Rhipicephalus*  *sanguineus* | 12(23.52) | 45 (40.91%) | 19 (42.22%) | 28 (43.07%) | 17 (23.94%) | 31 (44.28%) |
| *Linognathus*  *vituli* | 11(21.57) | 29 (26.36%) | 8 (17.77%) | 18 (27.69%) | 8 (11.26%) | 22 (31.43%) |
| *Haematopinus*  *eurysternus* | 3(5.88) | 18 (16.36%) | 16 (35.56%) | 7 (10.77%) | 15 (21.13%) | 15 (21.43%) |
| *Damalinia*  *bovis* | 4(7.84) | 10 (9.09%) | 3 (6.67%) | 2 (3.07%) | 6 (8.45%) | 9 (12.86%) |
| Overall  Prevalence | 28(54.90) | 72 (65.45%) | 32 (71.11%) | 51 (78.46%) | 37 (52.11%) | 44 (62. 85%) |
| Odds  Ratio | Adult vs Young = 1.56 | | | Summer Vs Rainy= 3.35 | | |
| Old vs Adult =1.29 | | | Winter Vs Rainy = 1.55 | | |
| Old vs Young =2.02 | | | Summer Vs Winter = 2.15 | | |
| Level of  significance | **P value=0.028** | | | **P value =0.002** | | |

\*Summer: March- June; Rainy: July-October and Winter: November-February.

\* Young (**≤** 2 years); Adult (> 2 years to 8 years) and old (**>** 8 years).

In contrast, Salih *et al.* (2008) found the highest number of ticks occur during the rainy season. Sanjay *et al.* (2007) reported the seasonal prevalence of tick infestation significantly more during the rainy (24.33%) andsummer seasons (21.58%) as compared to the winter season (4.03%). He also reported lice infestationsignificantly higher in winter (25.89%) than in the rainy (2.48%) and summer seasons (8.93%). Biu and Nwosu(1998) found that although most of the ticks occurred in relatively low numbers throughout the year, they weregenerally most common from the second half of the rainy season through the dry season. On the contrary, Stuti *et al.* (2007) observed low activity of *B. microplus* in very dry and very cold temperatures at farm level.The rise of infestation in summer may be due to rise of temperature in late winter leading to gradual increase in the load as well as percentage of infestation in May and June (Roy *et al*. 2001). The contrast in between the present and earlier findings can be explained by the fact of variation of geographical location of experimental area, topography, the composition of soil type and humidity, lack of control group of population and most importantly, the changed climatic condition of the earth.

**D.Sex related prevalence**

It was observed that the prevalence of ectoparasitic infestation was significantly (*p*<0.05) higher in female (69.74%) than the male (41.17%) cattle (Table 3). The mean tick burden was higher in female (1.54±0.896) than in male (1.43±0.136). It was also observed that 74.78% of cattle with poor nutritional condition were affected with ectoparasitic infestation. This result agree with the report of Sarkar (2007) who reported the prevalence of ectoparasites were significantly (*p*<0.01) higher in female than male.

**E.Nutritional factor related prevalence**

Cattle under poor nutritional level were 2.88 times more vulnerable to ectoparasitic infestation than animals with normal health (51.57%) (Table 3). The mean tick burden was higher in exhausted cattle (1.52±0.10) than in cattle with normal health (1.48±0.14). The present study agrees with the earlier study of Lapage (1962) who found malnourished animals are more susceptible to any infection as they are immune compromised. Moreover, Etter et al. (1999) also found that in immune compromised animals, prevalence of tick is usually increased.

**F.Rearing system related prevalence**

The present study implied that 69.06% of cattle brought up under free-range system were affected with ectoparasitic infestation (Table 3). Such animals were 2.46 times more vulnerable to ectoparasitic infestation than cattle reared intensively (38.89%). It is similar to the finding of Rabbi (2006) who reported, the highest ectoparasitic infestation in semi-intensive system (59.7%) followed by extensive system (33.5%) and intensive system (8.27%). The impact of ticks and tick borne diseases on the individual and national economics warrants application of appropriate tick control strategies on priority basis (Bansal, 2005). Various studies have shown that acaricidetreated and/ or tick free animals produce better than tick infested animals (Sajid *et al.,* 2007).

Table 3. Prevalence of ectoparasites in Cattle of Gaibandha district based on sex, health status and rearing systems of animals studied

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Species of ectoparasites | Sex | | Health status | | Rearing systems | |
| Male  No. (%) | Female  No. (%) | Normal  No. (%) | Poor  No. (%) | Free-range  No. (%) | Semi-intensive  No. (%) |
| *Boophilus microplus* | 37 (42.52%) | 57 (47.89%) | 33 (34.79%) | 61 (54.95%) | 90 (49.72%) | 4 (22.22%) |
| *Haemaphysalis bispinosa* | 11 (12.64%) | 23 (19.32%) | 11 (11.57%) | 23 (20.72%) | 34 (18.78%) | 0 (0.0%) |
| *Rhipicephalus sanguineus* | 28 (32.18%) | 48 (40.34%) | 27 (28.42%) | 49 (44.14%) | 74 (40.88%) | 2 (11.11%) |
| *Linognathus*  *vituli* | 13 (14.94%) | 35 (29.41%) | 18 (18.94%) | 30 (27.02%) | 46 (25.41%) | 2 (11.11%) |
| *Haematopinus eurysternus* | 14 (16.09%) | 23 (19.32%) | 7 (7.36%) | 30 (27.02%) | 37 (20.44%) | 0 (0.0%) |
| *Damalinia*  *bovis* | 4 (4.59%) | 13 (10.92%) | 4 (4.21%) | 13 (11.71%) | 17 (9.39%) | 0 (0.0%) |
| Overall  Prevalence | 49 (41.17%) | 83 (69.74%) | 49 (51.57%) | 83 (74.78%) | 125 (69.06%) | 7 (38.89%) |
| Odds  Ratio | Female Vs Male= 1.78 | | Poor Vs Normal= 2.88 | | Free-range Vs Semi-intensive =  2.46 | |
| Level of significance | **P value = 0.014** | | **P value =0.007** | | **P value= 0.001** | |

**CHAPTER-V**

**CONCLUSION**

The prevalence of ectoparasitic infestation in cattle and identification of tick and lice in different areas of Gaibandha district was estimated. I observed a considerable level of prevalence of ectoparasitic infestation in the study area. I observed a significant relationship between tick burden and prevalence of haemoparasitic infections. Tick and lice infestation should be controlled in the farm to prevent the haemoparasitic diseases because these are the vector of Anaplasmosis and Babesiosis and hamper the production of animal and reduce the farmer’s benefit. In this study, three species of arachnids namely, *Boophilus microplus Rhipicephalus sanguineus* and *Haemaphysalis bispinosa* and 3 species of lice namely, *Linognathus vituli*, *Haematopinus* *eurysternus* and *Damalinia bovis* were identified but no mites was detected from cattle. The occurrence of other species of ticks and lice and ectoparasites such as mites may be found in Gaibandha district, so further study is recommended. I detected ticks and lice in cattle throughout the Gaibandha district and the prevalence is varied with seasons. So, routine acaricidal treatment of cattle is recommended with a view to reduce the tick infestations, hence to reduce haemorpotozoan infection. I also would like to recommend a regular veterinary inspection over all farms within the study area to identify the trend in prevalence of haemoparasitic diseases.

**REFERENCES**

Alvarez, V., Bonilla, R. and Chacon, I. 2003. Relative frequency of *Boophilus microplus* (Acari: Ixodidae) in bovines *(Bos taurus* and *B. indicus)* in 8 ecological zones of Costa Rica. *Rev. of Bio. Trop.,* 51(2): 427-434.

Aydin, L., Prelosov, P., Bakirei, S. and Senlik, B. 2006. Ixodid ticks on cattle and sheep in South Eastern Bulgaria. *Ind. Vet. J.,* 83 (7): 802.

Bahadori, S.R. 2003. Study of species diversity of animal ticks in Garmsar, University of Tehran*.* *J. of the Faculty of Vet. Med.,* 58(1): 11-14.

Bansal, G. C. (2005). Bovine theileriosis in India: an overview. *Proceedings of National Academy of Science, India,* 75:134–43.

Bazarusanga, T., Geysen, D., Vercruysse, J. and Madder, M. 2007. An update on the ecological distribution of Ixodid ticks infesting cattle in Rwanda: countrywide cross-sectional survey in the wet and the dry season. *Experimental Applied Acarology,* 43(4): 279-291.

BBS (Bangladesh Bureau of Statistics). 2008. *Statistical Pocketbook of Bangladesh,* Statistics Division, Ministry of Planning, Government of the People of Republic of Bangladesh, Dhaka, pp: 256.

Bekele, T. 2002. Studies on seasonal dynamics of ticks of Ogaden cattle and individual variation in resistance to ticks in Eastern Ethiopia. *J. of Vet. Med.,* 49(6): 285-288.

Beyazt, A. 2000. The prevalence of Ixodidae species on cattle in Bursa province, Turkey. *Veteriner Kontrol ve Arastrma Enstitusu,* 25(39): 17-23.

Biu AA and Nwosu CO 1998. Seasonal prevalence of cattle ticks in Maiduguri, Borno State. *Entomology in the Nigerian economy Research focus in the 21st century*, pp.133-139.

Branscheid. W and Schroer 1997. Damage to cattle hides, detection, frequency and economic importance. *Fleischwirtschaft*. 77: 333–37.

Cable RM 1967. *An Illustrated Laboratory Manual of Parasitology*, 4th edition, Burgress Publishing Co., Minneapolis, Minnesota, USA. p. 111-131.

Das, K. and Shrivastava, S. K. 2002. Bovine tick, *Boophilus microplus* Canestrini, infestation in rural Chattisgarh. *J. of Applied Zoo. Res.,* 13(2): 247-248.

Estrada, P.A. and Santos, S.M.M. 2005. The distribution of ticks (Acari: Ixodidae) of domestic livestock in Portugal. *Experimental Applied Acarology,* 36(3): 233­-246.

Etter E, Chartier C, Lefrileux Y and Borgid LP 1999. The influence of nutrition on the periparturient rise in fecal egg counts in dairy goats. *Revue de Medicine Veterinaire*, 150:975-980.

Hourrigan JL 1979. Spread and detection of Psoroptic scabies of cattle in the United States, *Journal of American Veterinary Association*. 175:1278-1280.

Islam MK, Alim MA, Tsuji N and Mondal MMH 2006. An investigation into the distribution, host-preference and population density of Ixodid ticks affecting domestic animals in Bangladesh. *Tropical Animal Health and Production,* 38: 485-490.

Islam MS, Rahman SA, Sarker P, Anisuzzaman and Mondal MMH 2009. Prevalence and population density of ectoparasitic infestation in cattle in Sirajgonj district, Bangladesh. *Bangladesh Research Publications Journal.* 2(1): 332-339.Jongejan F and Uilenberg G (2004). The global importance of ticks, *Parasitology.*129:S3-S14.

Kabir, M. H. B., Mondal, M. M. H., Eliyas, M., Mannan, M. A., Hashem, M. A., Debnath, N. C., Miazi, O. F., Mohiuddin. C., Kashem, M. A, Islam, M. R. and Elahi, M. F., 2011. An epidemiological survey on investigation of tick infestation in cattle at Chittagong District, Bangladesh, *Afri. J. of Micrbio. Res.* 5(4): 346-352.

Kamal AHM, Uddin KH, Islam MM and Mondal MMH 1996. Prevalence of economically important ticks in cattle and goat at Chittagong hilly areas of Bangladesh. *Asian-Australasian Journal of Animal Sciences.* Vol.9. No.5.

Kaushal, K., Balakrishanan, N, Rakesh-Katyal and Gill, K.S. 2002. Prevalence of Ixodid ticks in Nilgiri district of Tamil Nadu State (India). *Ind. Vet. J.,* 21(4): 177-179.

Kettle PR 1974.The influence of cattle lice, *Damalinia bovis* and *Linognathus vituli* on weight gain in beef animals. *New Zealand Vet. J.,* 22: 10–11.

Knopf, L., Komoin, O.C., Betschart, B., Jongejan, F., Gottstein, B. and Zinsstag, J. 2002. Seasonal epidemiology of ticks and aspects of cowdriosis in N'Dama village cattle in the Central Guinea savannah of Coste d'Ivoire. *Pre. Vet. Med.,* 53(1-2): 21-30.

Lapage G (1962). *Monig’s Veterinary Helminthology and Entomology*, 5th edi. Bailliere, Tindall and Cox Ltd. London, UK. pp:556-723.Loomis EC 1986. Ectoparasites of cattle. *Vet. Clin. North America*, 2: 299–321.

L'Hostis, M., Diarra, O. and Seegers, H. 1994. Sites of attachment and density assessment of female *Ixodes ricinus* (acari: ixodidae) on dairy cows*. Exp. App. Acarol.,* 18(11-12):681-689.

Mamak, N.; GenVer, L.; Ozkanlar, Y.E. and OzVelik, S. 2006. Determination of tick species and treatment of cows, sheep and goats in the Sivas-Zara region. *Turkiye Parazitol Derg, 30*(3): 209-212.

Manan A, Khan Z, Ahmad B and Abdullah 2007. Prevalence and identification of ixodid tick genera in frontier region Peshawar. *Journal of Agricultural and Biological Science*, 2(1): 21-25.

Mbati, P.A., Hlatshwayo, M., Mtshali, M.S., Mogaswane, K.R., Waal, T.D. and Dipeolu, 0.0. 2002. Ticks and tick-borne diseases of livestock belonging to resource-poor farmers in the eastern Free State of South Africa. *Experimental Applied Acarology,* 28: 217-224.

Mekonnen, S., Hussein, I and Bedane, B. 2001. The distribution of ixodid ticks (Acari: Ixodidae) in central Ethiopia. [*J. ­of Vet. Res.,*](http://Ian.Akad.Nauk.SW.No.6) 68 (4): 243-251.

Nafstad O and H Gronstol 2001b. Variation in the level of grain defect light flecks and spots on cattle hides. *Acta. Vet. Scand.,* 42: 91– 98.

Nelson WA 1984. Effects of nutrition on animals on their ectoparasites. *J. Med. Entomol.,* 21: 621–35.

Niyonzema A and Kiltz HH 1986. Control of ticks and tick-borne diseases in Burundi. *Australian Center for International Agricultural Research*. 17:16-17.

Norval RAI, Fivaz BH, Lawrence JA and Brown AF 1984. Epidemiology of tick-borne diseases of cattle in Zimbabwe, *Tropical Animal Health and Production,* 16:63-70.

Omer, L.T., Kadir, M.A., Seitzer, U. and Ahmed, J.S. 2007. A survey of ticks (Acari: Ixodidae) on cattle, sheep and goats in the Dohuk Governorate, Iraq. *Parasitol. Res., 2*: 179-181.

Rabbi AKMA 2006. Parasitism in Black Bengal Goats in relation to different feeding systems. M.S. thesis. Department of Parasitology, Bangladesh Agricultural University, Mymensingh.

Rahbari, S., Nabian, S. and Shayan, P. 2007. Primary report on distribution of tick fauna in Iran. *Parasitol. Res.,* 2: 175-177.

Razmi, G. R; Glinsharifodini, M. and Sarvi, S. 2007. Prevalence of ixodid ticks on cattle in Mazandaran province, Iran. Department of Pathobiology, School of Veterinary Medicine, University of Mashhad, Iran. *Korean­ J. of Para.,* 45 (4): 307-310.

Razzak A and Shaikh H 1969. A survey on the prevalence of ticks on cattle in East Pakistan. *Pakistan Journal of Veterinary Science*, 3:54-60.

Roy AK, Rahman MH, Majumder S and Sarker AS 2001. Ecology of ticks and tick-borne blood protozoa in Madhupur Forest Area, Tangail. *Bangladesh Veterinary Journal*, 17:90-97.

Sajid MS, Iqbal I, Khan MN and Muhammad G 2008. Point prevalence of hard ticks (Ixodids) infesting domestic ruminants of Lower Punjab, *Pakistan. International Journal of Agriculture and Biology.* 10(3): 349-351.

Salih DA, Julia II, Hassan SM, El-Hussain AM and Jongejan F 2008. Preliminary Survey of ticks ( Acari: Ixodidae) on Cattle in Central Equatoria State, Southern Sudan. *Onderstepoort Journal of Veterinary Research,* 75 (1): 47-53.

Samad MA 2000. An overview of livestock research reports published during the twentieth century in Bangladesh. *Bangladesh Vet* J 34: 53 -149.

Sanjay K, Prasad KD and Deb AR 2007. Seasonal prevalence of different ectoparasites infecting cattle and buffaloes. *Journal of Research,* 16(1): 159-163.

Sanjay, K., Prasad, K.D. and Deb, A.R. 2004. Seasonal prevalence of different ectoparasites infecting cattle and buffaloes. *J. of Res.,* 16(1): 159-163.

Sanyal, A. K. 2005. First record of ixodid tick (Acarina: Metastigmata) from Maheshkhali Island, Chittagong, Bangladesh. *Zoo. Sur. of Ind.,* 105(1/2): 157-159

Sarkar M 2007. Epidemiology and pathology of ectoparasitic infestation in Black Bengal Goats in Bangladesh. M.Sc. thesis. Department of Parasitology, Bangladesh Agricultural University, Mymensingh.Schlesselman JJ (1982). *Case Control Studies*. *Oxford University Press, New York, pp*: 174-177.

Singh, 0.G., Mohilal, N. and Gambhir, R .K. 2007. Incidence of cattle tick Boophilus microplus (Canestrini, 1888) in Manipur valley. Parasitology Laboratory, Department of Life Sciences, Manipur University, Canchipur, India. *J. of Zoo.,* 27(2): 263-265.

Soulsby EJI 1982. Helminths, Arthropod and Protozoa of Domesticated Animals, 7th edition. Bailliere, *Tindall and Cassell Ltd. pp*.136-346, 365-491 *and* 763-778.

Stuti V, Yadav CL, Kumar RR and Rajat G 2007. Seasonal Activity of *Boophilus microplus* on Large Ruminants at an Organised Livestock Farm. *Journal of Veterinary Parasitology*, 21(2): 125-128.

Swai, E.S., Mbise, A.N., Kessy, V., Kaaya, E., Sanka, P. and Loomu, P.M. 2005. Farm constraints, cattle disease perception and tick management practices in pastoral Maasai community-Ngorongoro, Tanzania. *Live. Res. for Ru. Deve.,* 17(2): 17-20.

Torina, A., Khoury, C., Caracappa, S. and Maroli, M. 2006. Ticks infesting livestock on farms in Western Sicily, Italy. *Exp. App. Acarol.,* 38(l): 75-86.

Wall, R. and Shearer, D. 1997. Veterinary Entomology, 1st edition, *Chapman and Hall. London, UK*. p.265 and 290

Yakhchali, M. and Hasanzadehzarza, H.S. 2004. Study on some ecological aspects and prevalence of different species of hard ticks (Acarina: Ixodidae) on cattle, buffalo and sheep in Oshnavieh suburb. *Pajouhesh-va-Sazandegi in Animal and Fisheries Sciences,* (63): 30-35.

Yakhchali, M. and Hasanzadehzarza, H.S. 2004. Study on some ecological aspects and prevalence of different species of hard ticks (Acarina: Ixodidae) on cattle, buffalo and sheep in Oshnavieh suburb. *Pajouhesh-va-Sazandegi in Animal and Fisheries Sciences,* (63): 30-35.

Yukar, B.A. and Umur, S. 2002. The prevalance of tick species (Ixodoidea) in cattle, sheep and goats in the Burdur Region, Turkey. *Turk Veterinerlik ve Hayvanclk Dergisi,* 26(6): 1263-1270.