PREVALENCE OF TICK INFESTATION IN CATTLE AT SADAR UPZILA OF DINAJPUR DISTRICT

A Thesis

By

DIPA ROZARIO
Student ID. 1605143
Session: 2016-2017
Semester: January-June, 2017

MASTER OF SCIENCE (MS)
IN
PARASITOLOGY

DEPARTMENT OF PATHOLOGY AND PARASITOLOGY
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR-5200, BANGLADESH

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Approved as to the style and contents by

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DEDICATED

TO MY

BELOVED PARENTS

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June, 2017 ***The Author***

ABSTRACT

The study was designed with an aim to determine the overall prevalence of tick infestation in relation to age, sex, breed, health status, season, management system and affected body parts of the cattle at Sadar upzilla of Dinajpur district during the period from January to June, 2017. The investigation was done by collecting ticks with fine forceps and identifying ticks by preparing temporary and permanent slides. A total of 140 cattle (male 45 and female 95) were examined. Among them, 62 (44.29%) were found to be infested with three species of ticks namely *Rhipicephalus sanguineus*, *Boophilus microplus* and *Hemaphysalis bispinosa*. The prevalence of tick was higher in case of *Rhipicephalus sanguineus* (27.14%) followed by *Boophilus microplus* (15.71%) and *Hemaphysalis bispinosa* (1.43%). The results revealed that the prevalence was significantly ($P<0.05$) higher in female cattle (52.63%) than in male (26.67%). Malnourished cattle were vulnerable (51.85%) to tick infestation than the cattle with normal body condition (33.90%). In age groups, highest infestation was found in calf (< 6 months) (58.33%) followed by adults (> 2 years) (47.05%) and the lowest in young (≤ 2 years) (33.33%). Tick infestation was more prevalent in local (46.24%) cattle than the cross-bred (40.43%) cattle. In case of cattle management system significantly ($p<0.005$) higher prevalence was observed in cattle reared under extensive system (65.38%) than the intensive (47.37%) and semi-intensive (34.21%) systems. Prevalence was significantly ($p<0.001$) higher in rainy (54.17%) season than summer (33.82%) season. Ticks were distributed in different parts of the host body such as ear, neck, dewlap, base of horn, eye, tail, perineum, udder and body surface. Among the body parts, ear (35.71%) was the most affected part and tail (3.71%) was the least. It is concluded that tick infestation is a threat to the cattle population at Sadar upzilla of Dinajpur irrespective of age, sex, breed, health status, seasons of the year, management system and affected body parts. This might hamper cattle production in this area. Hence attention in cattle management and appropriate control strategies are need to be initiated to control ticks in the study area.

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LIST OF ABBREVIATIONS AND SYMBOLS

R. sanguinus	:	*Rhipicephalus sanguinus*
B. microplus	:	*Boophilus microplus*
H. bispinosa	:	*Haemaphysalis bispinosa*
Fig.	:	Figure
etc.	:	Etcetera
et al.	:	And others / Associates
>	:	Greater than
<	:	Less than
≤	:	Less or equal
%	:	Percent
N	:	Total number of animal
n	:	Total number of animal in each group
No.	:	Number

CHAPTER 1

INTRODUCTION

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INTRODUCTION

Livestock represents one of the most promising fields of diversification of the national economy as well as socio-economic status of millions of rural households particularly in the developing world. Bangladesh is a tropical agro-based developing country where cattle are an integral component of the complex farming system performing multifarious roles. Among livestock cattle population is about 25.7 million (livestock, Banglapedia, 2015). Cattle are considered to be a multipurpose animal. It is the sustenance of landless people, livelihood options for the rural poor families particularly women is potentially important for poverty reduction; income generation, contribution to food nutrition security, source of animal protein (around 8% of total protein for human consumption), employment generation, land cultivation, post-harvest threshing, draft power for transportation, fuel for cooking, manure for crop vegetables, export earnings (ranked third in earnings after RMG shrimp), cultural religious uses etc. are some of the contribution of livestock. So, its importance is big enough. The livestock sub-sector provides full time employment for 20% of the total population and part-time employment for another 50%. Contribution of Livestock to National Economy in GDP growth (2015-16) provisionally-3.21%, Contribution to GDP (2015-16) provisionally-1.66%, Share of Livestock to Agricultural GDP-14.21%, Employment Generation (Direct)-20%, Employment Generation (Indirect)- 50%, GDP Volume (Million BDT)-329100 (BBS- 2015-16).

In Bangladesh, among many constrains, parasitism is thought to be a major cause that hindering the development of livestock population including cattle. Ticks are cosmopolitan in distribution, but occur principally in tropical subtropical regions (Soulsby, 1982). Hot and humid climatic condition of Bangladesh is very conducive to a wide variety of ticks (Razzak and Shaikh, 1969). Ticks are hematophagous arthropods belonging to phylum Arthropoda and class Arachnida (Soulsby, 1982) ranking second to mosquitoes as vector of infectious pathogens to humans and animals. All stages (egg, larvae, nymph adult) of ticks are exclusively parasitic (Hourrigan, 1979; Colebrook and Wall, 2004).

Ticks have been considered as a burning veterinary problem in many parts of the world (Hourrigan, 1979) as about 80% of the world cattle population is infested with ticks and they cause direct and indirect damage to animals. It has been studied that about 80% of the world cattle population is infested with ticks (Bowman *et al*., 1996). The direct damage are severe irritation, allergy toxicosis (Niyonzema and Kiltz, 1986), loss of blood on which the tick feeds, whereas indirect damage is physical damage (Razput *et al*., 2006) diseases transmitted through the tick bite (Bwangamoi, 1979, cited in Lazarus, 2002) .They also as potential vector of babesiosis, theileriosis, anaplasmosis, etc. (Lawrence *et al*., 1984; Norval *et al*., 1984) reservoirs of certain infectious agents e.g. *Pasteurella multocida*, *Brucella abortus* *Salmonella typhimurium* in man animals (Jongejan Uilenberg, 2004).

Breeds, age, geographical area month-wise prevalence of tick infestation are significant associated determinants. Predilection sites vary with host infesting tick specie. Perineum, udder external genitalia are the most tick infested sites followed by dewlap, inner thighs, neck back, tail, ears, around eyes, flanks, legs (Atif *et al*., 2012; Biswas, 2003). Ticks also irritate the animal body, resulting damages the hide skin leading to significant financial losses to livestock's farmer (Biswas, 2003). Tick infestation diminishes quality of skin/hide up to 20-30% causes severe anemia, loss of production, weakness and immunosuppression in the infected animals. Economically, ticks impact the availability of good quality hides skins to the leather industry, reduce milk production (Sajid *et al*., 2007), and increase mortality (Niyonzema and Kiltz, 1986). Food and Agricultural Organization of the United Nations estimated the global Losses of hard tick infestation to be US $ 7.0 billion annually (Harrow *et al*., 1991).

The ticks are voracious blood drinkers. Both male and female continuously suck host blood during their lengthy attachment period 3-5 days (Kettle, 1995) which may be extended depending on the tick species unique host association. Usually a tick or its instars suck 0.8 to 2.0 ml blood in a day. One female tick can suck more blood than thirty times of her weight during engorgement (Sangwan *et al*., 1995). Severely affected animals may die (Soulsby, 1982). These diseases are associated with various degrees of morbidity economic losses even death may occur especially in untreated cases.

The important boophilid ticks, formerly of the genus *Boophilus*, are now classified as a subgenus within the genus *Rhipicephalus*. These genera are known as hard ticks because their outer surfaces have hard plates. Within these 10 genera are, very approximately,

100 species of importance to domestic animals (Taylor *et al*., 2007).The economically most important ixodid ticks of livestock in tropical regions belong to the genera of *Hyalomma*, *Boophilus*, *Rhipicephalus* and *Amblyomma*. According to some local preliminary survey, domestic animals of Bangladesh are frequently affected by about 21 different species of ticks (Samad, 2000; Razzak and Shaikh, 1969; Qader and Haque, 1973; Rahman and Mondal, 1983). Three species of ticks namely *Boophilus microplus*, *Rhipicephalus sanguineus* and *Haemaphysalis bispinosa* infesting cattle were documented in Bangladesh (Kabir *et al*., 2011).

Epidemiological pattern of the ectoparasitic diseases in the different agro climatic zones of the country would provide a basis for evolving strategic tactical control of these diseases. The climatic condition geographical location of the areas might favor the growth multiplication of ticks. To often farmers tend to regard tick infestations as a problem of cattle but factually it is a serious problem.

Furthermore, change in the climate length of different seasons will affect directly the tick survival (Gray, 2008) affects the distribution prevalence of vector borne diseases (Wilson, 2006; Kirby *et al*., 2004). Tick dispersal in any area depends upon the environmental factors (Estrada-Pena, 2003) e.g. temperature of 27-39 °C relative humidity range of 60-80% render ticks more active (Rodriguez and Dominguez, 1998); however, ticks can also survive at temperatures down to -18.5℃ (Clark, 1995; Vandyk *et al*., 1996; Schulze *et al*., 2001).

Variations in the phenology of ticks occur from year to year at same location. The climatic condition of the Dinajpur is highly conducive for growth and development of ticks. Considering above the facts, it is assumed that tick is one of the major problem in Bangladesh as well as in Dinajpur. Different studies on prevalence of tick infestation have been conducted in home abroad but less attention had been paid in this area.

Duly considering the limitation of information on tick infestation in cattle at this area the importance of cattle wealth in the national economy the present study was undertaken with the aim to fulfill fallowing objectives –

- To investigate the overall prevalence of tick infestation in cattle at Sadar upzila of Dinajpur district.
- To study the prevalence of tick infestation in relation to age, sex, breed, health status, management system, season of the year and affected body parts of the host
- To know the intensity of tick infestation in cattle.

CHAPTER 2

REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

Scientists all over the world have studied different aspects on tick prevalence risk factors the literature in these areas are voluminous elsewhere rather than Bangladesh. The main purpose of this chapter is to provide up to date information concerning the study works in relation to the respective subject. Pertinent literatures on the prevalence of tick infestation in cattle have been reviewed in this chapter under the following subheadings.

2.1 Prevalence of tick in cattle in Bangladesh:

Hossain *et al.* (2016) revealed 60.00% cattle to be pervaded with several species of ticks and mites from April 2014 to March 2015 in milk shed areas of Baghabari of Shahjadpur Upazila of Sirajgonj district. The prevalence rate was *Rhipicephalus sanguinus* (20.00%) and *Boophilus microplus* (18.75%). The result communicated that the infestation rate was significantly (P<0.05) higher in female compare to male mature >5 years (64.17%) cattle were more vulnerable than that young calves <2 years (51.96%) less vulnerable adolescent dairy cattle ages 2-5 years (48.13%).The infestation was more common in weak animals than ordinary sound cattle. Seasonal prevalence showed significantly (P<0.05) higher prevalence in rainy season (74.55%) followed by summer (67.80%) and winter (42.44%). The Mean parasitic burdens were 2.12±0.13 per square inches of heavily infected area.

Happy *et al*. (2016) conducted a study From October, 2014 to May, 2015 in different villages at Sadar Upazila in Sylhet district where he observed the overall prevalence of skin diseases was 74.68% in cattle. The prevalence of tick infestation (73.71%) was highest among ectoparasites in study area. Among the age groups, the highest infestation was recorded in adult cattle of >2 to 7 years (90.04%) and the lowest in young of ≤2 years (56.90%). The prevalence was recorded significantly higher in females (80.83%) than in male (62.50%) where cattle with poor health were more vulnerable (93.28%) than the cattle with normal body condition (43.78%).

Nath *et al.* (2015) revealed that 71.09% cattle were to be pervaded with a few types of ectoparasites. Higher prevalence rate was present in case of *Rhipicephalus sanguineus* (16.80%) followed by *Boophilus microplus* (15.82%) and *Hemaphysalis bispinosa*

(14.84%). Results showed that, adolescent dairy cattle matured 1-3 years are more (80.78%) vulnerable than that of grown-ups matured >3 years (58.53%), young aged <1 years (61.91%). Higher prevalence occurred in summer season (80.74%) than in winter (80.01%) rainy season (60.73%).

Haque (2014) conducted a study from May, 2014 to October, 2014 in Godagari Gomastapur Upazila of Barind Tract of Bangladesh to investigate the prevalence of tick infestation in cattle. They found 35.7% cattle were infested with ticks involving *Rhipicephalus (Boophilus) microplus* (22.6%), *Haemaphysalis bispinosa* (15.2%) *Hyalomma anatolicum anatolicum* (7%).

Bilkis *et al.* (2013) revealed 56.8% cattle were infested with one or more species of ticks and lice. Among ticks, the prevalence rate was highest in case of *Haemaphysalis bispinosa* (31.2%) followed by *Rhipicephalus sanguineus* (29.2%) and *Boophilus microplus* (27.2%). The range of parasitic burden was 1 to 16 per four square inch of heavily infested area of affected cattle. Mean parasitic burden was high in case of *Rhipicephalus sanguineus* (4.56 ± 0.29), *Boophilus microplus* (4.25±0.15) and *Haemaphyalis bispinosa* (2.85 ± 0.17). The prevalence was significantly (P<0.01) higher in young cattle aged >1-3 years (68.0%) than calves aged ≤1 year age (46.15%) and adults aged >3 years (45.2%). Infestation was significantly higher (P<0.05) in female (64.63%) than the male (41.86%). Infestation was more prevalent in local (72.32%) breed than the crossbred (44.2%) cattle. Cattle with poor body conditioned cattle were significantly (P<0.01) more vulnerable than cattle having normal body condition.

Kabir *et al.* (2011) observed 36.31% cattle were infested with tick involving *Boophilus microplus*, *Rhipicephalus sanguineus* and *Haemaphysalis bispinosa*. Among them *B. microplus* is the main tick species identified threatening to the cattle population in Chittagong District. Infestation of tick was significantly higher (p<0.01) in female (59.37%) than the male (35.83%) cattle. Prevalence was significantly (p<0.01) higher in cattle of 1.5 years of age (46.28%) than in cattle of >1.5 years of age (27.80%). They also found tick infestation was more prevalent in local (43.82%) cattle than the cross-bred (24.13%) cattle and field grazing (41.96%) cattle were more susceptible (p<0.01) than the stall-feeding (24.8%) animals. There was significantly (p<0.01) higher infestation in summer (41.66%) season followed by winter (31.5%) season. Ticks were widely distributed in different parts of the host body of which groin (48.75%) was most

affected parts of animal body, face and neck (30%) was the least. There was significantly ($p<0.01$) higher infestation in hilly area (44.44%) followed by plain area (30.27%).

Mondal *et al*. (2010) found 64.07% cattle were infested with several species of ticks and lice in his investigation at Bhawal forest area, Gazipur. Among ticks the prevalence rate was highest in case of *Boophilus microplus* (45.63%) followed by *Rhipicephalus sanguineus* (36.89%) and *Hemaphysalis bispinosa* (16.50%). Results revealed that, older cattle aged > 8 years are more (71.11%) susceptible than that of adults aged > 2-8 years (67.74%), young aged ≤2 years (47.05%). In females, prevalence was observed significantly ($p< 0.005$) higher than that of male. Prevalence of ectoparasitic infestation was significantly ($p<0.005$) higher in animal reared under free range system than that of semi-intensive system cattle with malnourished poor health status were found to be significantly more vulnerable to such parasitic infestation than normal healthy cattle. Seasonal prevalence showed that, significantly ($p<0.001$) higher prevalence occurred in summer season (78.46%), followed by winter (62.85%) rainy season (52.11%). Mean parasitic burden were 1.49±0.80 per square inches of heavily infected area.

Islam *et al.* (2009) revealed that 65.4% cattle were infested with one or more species of ectoparasites in Sirajgong district. Among five species of ectoparasites identified three species were *Boophilus microplus* (35.5%), *Rhipicephalus sanguineus* (10.6%) and *Haemaphysalis bispinosa* (7.8%). Higher prevalence of ectoparasites was recorded in summer season (51.4%) than winter (33.3%). The prevalence was higher in old cattle (61.5%) followed by calves (56%) adult (38.5%).

Islam *et at.* (2006) recorded *Boophilus microplus* (42.4%), *Hyalomma anatolicum anatolicum* (19.2%) and *Amblyoma testudinarium* (4.4%) on cattle in three distinct topographic zones, viz. flood plains, hills 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%).

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

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

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

2.2 Prevalence of tick in cattle in abroad:

Torina *et al.* (2016) recorded Hyalomma as significantly (P<0.05) the most prevalent tick genus 62.03%, followed by Boophilus 28.57% mixed infection 9.4% in cattle buffaloes, respectively in the River Ravi Region, Lahore. Females were significantly (P<0.05) the most affected gender than males Calves were significantly (P<0.05) the most affected age group in both, followed by adult, young old, respectively in cattle. Udder, inner thighs, perineum, legs tail, neck, most affected part in cattle

Ali (2015) was performed a survey of Ixodidae ticks in domestic ruminants in Ilam County in August 2009. He revealed 43% cattle infesteted where *Hyalomma anatolicum anatolicum* (71.4%), *Hyalomma asiaticum asiaticum* (17.6%) and *Rhipicephalus bursa* (11%) was identified. In this survey the highest infestation was found in the udder tail (21%) in cattle lowest infestation was observed in the ear and shoulder (2%) in cattle.

Subalini *et al.* (2015) was conducted the study from November 2012 to May 2013 at Girar Jarso districts of Fitche Selale identified four generas seven species of ticks. Accordingly, genus Ambylomma (39.1%) was the most abundant tick followed by Rhipicephalus (25.0%) while Hyalomma (12.4%) and Boophilus (23.5%) were found to be the least prevalent tick genera. At that study, the prevalence of disease (tick infestation) significantly varies with the breed and body condition of the cattle. The significantly higher prevalence was seen in animals with medium (44.5%) than poor

body condition (29.4%) (p=0.01). The local breeds were highly infested (70.8%).The study indicated that there was high burden of ticks in the area.

Gebreselama *et al.* (2014) found 47.0% cattle were infested with one or more ectoparasites in a cross-sectional study from October, 2010 to May, 2011 in and around Bishoftu town, central Ethiopia. Prevalence of tick infestation was 35.2% in cattle. Among the risk factors assessed, female animals and production system were significantly associated with prevalence of tick infestation.

Musa *et al.* (2014) conducted a survey study from June to December 2009 found 63.4% tick infestation (*B. microplus, Amblyomma variegatum, Hyalomma* spp*., Rhipicephalus sanguineous and Ornithodorus* spp) among cattle of different breeds in Maiduguri, Northeastern Nigeria. Males had a non-significantly (P>0.05) higher infestation rate of 63.4% compared with the females 60.9%. Younger animals aged ≤ 3 years had a significantly (P<0.05) higher prevalence of 85.4% as compared with the adults aged > 3 –7 years 55.8% and older animals > 7 years 35.0%. Based on the predilection sites, the udder and external genitalia, inner thigh and under the tail/perineum were the most tick-infested sites with 84.3%, 79.0% and 69.8% respectively (P<0.05), while the less preferred sites eyes, neck/dewlap, ears all over the body each had prevalence of 26.3%, 14.6% , 12.2% 11.2% respectively. This study reveals high prevalence of tick infestation among indigenous cattle in Maiduguri.

Tadesse and Sultan (2014) recorded that *Ambylomma varigatum* was the most common and more abundant (32.2%) followed by *Boophilus decoloratus* (23.5%), *Rhipicephalus evertsi evertsi* (20.6%), *Rhipicephalus pulchellusn* (4.45%), *Amblomma lipidiumn* (6.88%), *Hyalomma marginatum rufipes* (7.41%) and *Hyalomma trancatum* (5.03%) in cattle at Girar Jarso districts of Fitche Selale from November 2012 to May 2013. The significantly higher prevalence was seen in animals with medium (44.5%) and poor body condition (29.4%) (p=0.01). The local breeds were highly infested by the ticks with the prevalence of (70.8%).

Geeta *et al.* (2013) conducted a study for epidemiological characterize of common ticks infesting Indian zebu cattle between July 2010-June 2011 period at various locations of Mathura region of India. The overall prevalence was 60.07% and two species of ticks were identified namely *Boophilus microplus, Hyalomma anatolicum anatolicum*. The highest prevalence was reported in September (75%) while the lowest was in January

(46.07%). The highest tick infestation was found in rainy season (69.46%), followed by summer (62.55%) while lowest in the winter (47.96%). The highest percentage of tick infestations was noticed in animals <1 year age (80.21%) followed by animals of age between 1-3 years (68.48%) lowest in animals of age>3 years (44.85%). The most common feeding sites for adult ticks were neck, axilla, belly, groin, udder, perineal and regions tail**.**

Simeon *et al*. (2013) conducted a study in cattle in Bench Maji Zone, Southwestern, Ethiopia, from October 2011 to April 2012. The study revealed that cattle were infested with single (24.5%) multiple (2.8%) ectoparasites with an overall prevalence of 27.3% among them tick was 16.0%. Among the species of ticks *Boophilus decoloratus* (8.0%), *Amblyoma variegatum* (4.7%) and *Amblyoma coherens* (4.2%) were the dominant ones in a decreasing order. There was no statistical deference (p>0.05) between the prevalence of infestation with regard to sex, age and body condition score.

Nigatu *et al*. (2012) carried out a study from November 2009 to June 2010 to determine ectoparasites infestations diversity in Awi zone, Amhara region. Among 783 cattle of different breeds, husbandry and sex 89.4% ticks were collected. Tick species identified were: *Amblyomma variegatum* (49.2%), *Boophilus decoloratus*, (21.2%), *Hyalomma marginatum* (9.8%), *Hyalomma truncatum* (6.2%), *Rhipicephalus evertsi evertsi* (6.6%) and *Rhipicephalus pulchellus* (5.3%). Seasonal infestation was higher in local cattle breed extensive husbandry than cross intensive one. The largest number of ticks collected from a single animal was 25.

Atif *et al.* (2012) conducted a survey to evaluate the current precipitation of cattle tick infestations in the livestock progressive districts of Punjab including Sargodha, Khushab and Rawalpindi. The overall prevalence was 54.76%. The highest prevalence (57.71%) was recorded in Sargodha district followed by Khushab (54.00%) and Rawalpindi (52.57%) districts respectively. Highest prevalence of tick infestation was recorded in the months of June-July in all study districts. Perineum, udder external genitalia (98%) were the most tick infested sites in cattle followed by dewlap (92%), inner thighs (90%), neck and hump, back (54%), tail (26%), ears (13%), around eyes (10%), flanks (4%) and legs (2%).

Tiki *et al*. (2011) 25.64% cattle were found to be infested by one or more tick species. The relative prevalence of each species was *Amblyomma variegatum* (45.49%),

Rhipicephalus evertsi evertsi (29.29%), *Boophilus decoloratus* (18.13%), *Amblyomma coherence* (5.02%) and *Hyalomma marginatum rufipes* (1.86%). The prevalence of tick infestation was found to be significantly different (P<0.05) among the three breeds with highest prevalence in Local breed (44.96%) than both Cross (15.83%) and Jersey (8.50%) breed. Similarly, tick infestation was significantly (P<0.05) higher in cattle kept under extensive production system (45.40%) than in those kept under semi-intensive (10.06%) farming system.

Abdullah *et al.* (2007) carried out a study in cattle in the Kayseri region in Turkey from June 2000–November 2001. 21.7% cattle were infested by ticks involving *Rhipicephalus turanicus* (2.27%), *R. bursa* (2.14%), *R. sanguineus* (0.94%), *Hyalomma marginatum* (17.16%), *H. anatolicum excavatum* (24.73%), *H. a. anatolicum* (19.62%), *Dermacentor niveus* (1%), *Boophilus annulatus* (16.71%), *Ornithodorus lahorensis* (0.25%), *Hyalomma* sp. nymphs (7.31%) and *Boophilus annulatus* nymphs (7.82%). Seasonal fluctuation of ticks was also recorded. *Rhipicephalus* species were generally found in spring, others like *Hyalomma* in late spring, summer and early autumn, *B. annulatus* in September, October, December, *D. niveus* in December, January and February, *O. lahorensis* in December. Immature forms (nymphs) of *Hyalomma* species were found in summer and autumn, while *B. annulatus* nymphs were observed in October, November and December.

Durrani *et al.* (2008) showed highest prevalence (67%) of ticks in district Lahore and highest prevalence (12%) of *Hyalomma* ticks and lowest prevalence (3.1%) of *Rhipicephalus* in cattle was recorded. The highest mean pre-oviposition period was during spring while it was lowest in autumn. No oviposition was recorded at the temperature 10^0C, 85% humidity. The maximum number of eggs was laid at 34^0C lowest egg production occurred at 15^0C. The maximum number of eggs hatched at 32^0C, 85% humidity.

Sajid *et al.* (2009) determined the diversity intensity of tick population infesting domestic ruminants in Districts Layyah Muzaffargarh of lower Punjab (Pakistan). They observed the highest (P=0.00) prevalence of tick infestation in cattle (n=789/1050; 75.1%) followed in order by goat (n=723/1400; 51.6%) and buffaloes (n=281/700; 40.08%). The most abundant tick was *Hyalomma anatolicum* followed by *Rhipicephalus sanguineus*.

Quetta *et al.* (2008) investigated the prevalence of endo and ecto-parasites in cows and buffaloes in Quetta city, Pakistan. Among 28.96% ecto-parasites 10.14% was ticks.

Singh *et al.* (2008) recorded the overall prevalence of ixodid ticks in bovines of different agro-climatic zones of Punjab state, India. *Rhipicephalus microplus* (*R. microplus*), *Hyalomma anatolicum anatolicum (H. a. anatolicum*) mixed infestation were found 58.06%, 50.16%, 11.34% and 3.45% respectively. Highest prevalence rate of *R. microplus* and *H. a. anatolicum* were recorded in hot and humid environment in sub mountain undulating region (79.36%) and arid and semi-arid conditions in western region (20.40%) respectively. The overall prevalence was significantly (P <0.01) highest in monsoon season (83.74%), followed by summer (69.01%) and least in winters (31.64%). The maximum tick infestation was significantly (P< 0.01) recorded in calves < 6 months of age (72.59%), followed by 6 months -1 year age group (61.74%) least in > 1 year age group (55.02%).

Bazarusanga *et al.* (2007) investigated tick infestion in cattle in both the dry and the wet season at Rwa identified six Ixodid tick species namely *Rhipicephalus appendiculatus* (91.8%) followed by *Boophilus decoloratus* (6.1%) *Amblyomma variegatum* (1.2%) other three species were *Rhipicephalus composites, Rhipicephalus evertsi evertsi* and *Ixodes cavipalpus.*

Manan *et al.* (2007) studied to investigate hard tick (Ixodid) infestation genera identification in 30 different herds in randomly selected 15 villages of Frontier Region Peshawar was carried out during August 2003 through February 2004. 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%) Amblyomma (4.61%). Tick infestation was higher in late summer and lower in winter.

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

Rahbari *et al*. (2007) in four different geographical areas of Iran carried out a tick survey. 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) reported the prevalence of hard tick species (Acari: Ixodidae) on cattle in Mazaran 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%), *Dermacentor* spp. (0.1%). Results showed that *Boophilus annulatus, Rhipicephalus bursa, Hyalomma* species are dominant tick species in the surveyed area.

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

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

Rahbari *et al.* (2007) carried out A tick survey was in four different geographical areas of Iran, where the occurrence of ticks on cattle, sheep and goats were 62, 55 and 57%, respectively, with no differences between the zones. The largest numbers of adult ixodid ticks were generally present from April to August. *Rhipicephalus, Haemaphysalis Dermacentor* ticks occurred in the mountainous area, whereas *Boophilus, Ixodes* ticks were only present in the Caspian region. *Hyalomma* were very abundant in each zone but especially in the mountainous area, whereas *Ixodes* ticks were the minor genus.

Yamane (2006) collected Ixodid tick species from cattle in 60 grazing fields throughout Japan where *Haemaphysalis longicornis* was mainly recovered in the western and southern regions, *Ixodes* species were collected mainly in the central to northern regions.

Other tick species such as *Amblyomma testudinarium, Boophilus microplus, H. flava* and *H. kitaokai* were identified from a few fields in the central and southern regions. *Haemaphysalis longicornis* were recovered in the fields with higher temperatures and annual rainfall, whereas *I. ovatus* and *I. persulcatus* were collected in fields with lower temperatures and annual rainfall. Some of these tick species are capable of transmitting pathogens harmful to cattle and humans, so proper control strategies are required.

Aydin *et al.* (2006) identified tick infestation in cattle and sheep from three districts of Southeastern Bulgaria (Stara Zagora, Haskova Kurdzhaly) from March to June 2003. 57.93% ticks from cattle and 42.07% from sheep were recorded. 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%) developmental stages (29.97%).

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.

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 *et al.* (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, and D. marginatus* and *H. marginatum)* were mostly restricted to south-eastern parts of the country, under hot and dry climatic conditions of Mediterranean type.

Swai *et al.* (2005) showed that the tick infestation rate was 85.6% in Tanzania overall mean tick density was 20.7±2.2 ticks/ animal. The species mostly frequently encountered on the cattle were *Rhipicephalus appendiculutus* and *R. evertsi* 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.

Alessra (2006) recorded 46.3% cattle infested with *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%) on Farms in Western Sicily, Italy.

Itsuro (2006) revealed *Amblyomma testudinarium, Boophilus microplus, H. flava* and *H. kitaokai* from a few fields in the central and southern regions in Japan.

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 *et al.* (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 the Ixodid tick distributions per animal were 5, 4-5, 2-3 and 1-2 in cattle, calves, buffaloes, female buffaloes and sheep respectively. The heavy infestation of tick 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%).

Tomassone (2004) recorded adult ticks (57.1%), *Am. variegatum* adults constituted 27.4%, while 12.4% were *Rhipicephalus* spp. 2.5% *Hyalomma* spp. *Rhipicephalus turanicus* and *Hyalomma nitidum* were recorded for the first time on N'Dama cattle in the Republic of Guinea between June 1994 May 1995.

Alvarez *et al.* (2003) showed the relative abundance 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 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 48 stray dogs collected from the three zones of the body including ear, head below the tail, perianal region and around of mammary glands in females 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.

Mattioli *et al.* (2003) revealed tick burdens in N'Dama; Zebu F1 N'Dama × Zebu crossbred cattle. N'Dama showed significantly fewer ticks than the Zebu F1 cattle ($P<0.001$). On all cattle breeds prevalence *rate of Amblyomma variegatum* was 84.8% of *Hyalomma* spp. was 15.2%. N'Dama cattle were less susceptible to tick attachment than Zebu cattle.

Bekele (2002) reported the seasonal distribution of ticks of Ogaden cattle from May 1997 to April 1998. 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 ($P<0.05$).

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) investigated the prevalence of ectoparasitic ticks from different localities of Nilgiri 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 these were identified as *Boophilus microplus, Haemaphysalis bispinosa, Rhipicephalus haemaphysaloides* and *Rhipicephalus sanguineus.* Studies carried out in grasslands, meadows areas adjoining tea plantations by flagging method revealed mainly immature stages and a few adults of *Rhipicephalus* spp. *Haemaphysalis* spp.

Knopf *et al.* (2002) showed the burden seasonal epidemiology of ticks in the Central Guinea savannah of Cote d'Ivoire, Five different tick species were: *Amblyomma* (96%), *Boophilus* (47%), *Hyalomma* (<1%) *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, goats 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, 698 goats (863, 1846 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 to 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. 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.

Subalini *et al.* (2001) conducted a study to investigate the prevalence of tick species on cattle under various farming systems at Batticaloa district, Srilanka. The results of the study showed that around 39% of the farms had tick infestation the prevalence was significantly high (P<0.05) in crossbred cattle of exotic breeds (65%) than in extensive system local crosses (61.7%) under intensive system. Cattle breed of temperate crosses (59.6%) had significantly high (P<0.05) tick infestation when compared with tropical crosses. Tick infestation was significantly high (P<0.05) in female animals (73.6%) than in male and it was significantly higher in adult animals (68%) of age more than 3 years. The infestation recorded was significantly high (P<0.05) in lactating animals (56.3%) and was low in calves of age more than 3 months (17%).

Beyazt (2000) investigated the species of Ixodidae found on Bursa region cattle determined their seasonal activities from March 1993-February 1995. During this 2-year period, 66 cattle were examined once a month for a total of 1584 times ticks was found on 298 of them. Total 13 tick species were collected where *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 to July, *B. annulatus* during June to October. *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 August. *D. niveus* was observed only in October.

Biu and Nwosu (1998) investigated cattle maintained either under open or restricted grazing management systems at Maiduguri in the semi-arid zone of Nigeria between October 1994 to March 1996. They reported 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%) *Amblyomma variegatum* (0.1%). Among the Ixodid ticks recovered, Hyalomma species were the most numerous

constituted 50.1% of the total collection, followed by *Boophilus decoloratus* (32.0%), *Rhipicephalus* sp. (14.6%) *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, age, sex, breed and the color of the animals in the distribution of the ticks are discussed.

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 3

MATERIALS AND METHODS

CHAPTER 3

MATERIALS AND METHODS

3.1 Study area

The present study was conducted by randomly sampling 7 different villages at Sadar upazila of Dinajpur. Dinajpur is a city of Rangpur Division situated in northern part of Bangladesh, 413km north-west of Dhaka in Bangladesh. It is situated in 25°37' N latitude and 88°39' E longitude on the eastern bank of the river Punarvhaba.

In these areas, animals are reared under a traditional management system (i.e. farmers followed practices of their forefathers deal with animals according to traditional beliefs knowledge) in which the livestock is entirely dependent upon grazing. Variation in temperature, rainfall, humidity levels of the study districts depends upon the differences in the landscape, climate elevation of these areas from sea level (Anonymous, 2011).

3.2 Survey design sampling

The investigation was carried out in several visits from January-June/2017. Total 140 cattle, of which 45 male and 95 female were selected randomly followed by ten house hold from each of the village. The cattle were examined for ticks with the convenience of the study and availability of the cattle.

3.3 Selection of animals

Age was determined by asking the owner and attendant by visual inspection and also by dentition whenever possible. Animals (male/female) were categorized based on age as follows: (1) calves (≤6 months); (2) young stock (≤ 2 years); (3) adult stock (> 2 years). Among indigenous and cross breeds study was conducted. The health condition of the cattle was observed by distant and close inspection.

3.4 Experimental survey

Data regarding species, age, sex, breed, health status, management system, season of the year and body affected part of the host were recorded on a pretested questionnaire.

3.5 Examination of cattle for tick collection

The selected cattle were thoroughly investigated by close inspection, parting the hairs against their natural direction for the detection of ticks.

3.6 Collection and preservation of samples

Ticks 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. Adequate precautions were taken to preserve the mouthparts appendages of the ticks during collection. Ticks were preserved in 70% alcohol and labeled properly the sample.

3.7 Identification of ticks

Morphological study for identification of species of ticks was conducted in the Department of Pathology and Parasitology, Hajee Mohammad Danesh Science and Technology University, Dinajpur with the help of compound microscope (4X and 10X objectives). Ticks were identified primarily by preparing permanent slides and also 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).

Permanent slide preparation:

- Ticks were placed in a Petridis containing 10% KOH at room temperature until all colors of the body and legs disappeared.
- KOH was removed by several changes in tap water an immersion of 12 hours in each change.
- Then the ticks were dehydrated by passing gradually through 30%, 40%, 50%, 60%, 70%, 80% and 90% ethyl alcohol for 15 minutes in each case.
- After dehydration completed, the ticks were placed in absolute alcohol for 1 hour.
- The ticks were removed kept in a Petridis containing aniline oil for cleaning until the specimen sunk to the bottom were perfectly transparent.
- The aniline oil was poured off the ticks were placed on the clean glass slides and mounted by DPX.

- Then the slides were left horizontally on the table until the mounting agent hardened.
- Excess mounting agent was cleaned and the slides were labeled properly.
- Finally identification was performed under compound microscope (4X and 10X objectives) on the basis of the morphology.

3.8 Statistical analysis

Statistical analysis of experimental data was carried out by using Statistical Package for Social Sciences (SPSS) version 16 for Windows (2007) using F test. Moreover, to compare the prevalence of ticks of cattle of both sexes, ages, breeds, rearing system, seasons and topography of the area, data were analyzed by using paired sample t test (Mostafa, 1989). Odds ratio was calculated according to the formula Schesselman (1982).

3.9 Experimental design

Selection of study area
↓
Survey design sampling
↓
Preparation of questionnaire
↓
Selection of animals
↓
Experimental survey
↓
Examination of cattle for tick collection
↓
Collection of ticks from infected animal's body
↓
Collected samples are labeled
↓
Preservation of samples
↓
Permanent slide preparation
↓
Identification of ticks
↓
Statistical analysis

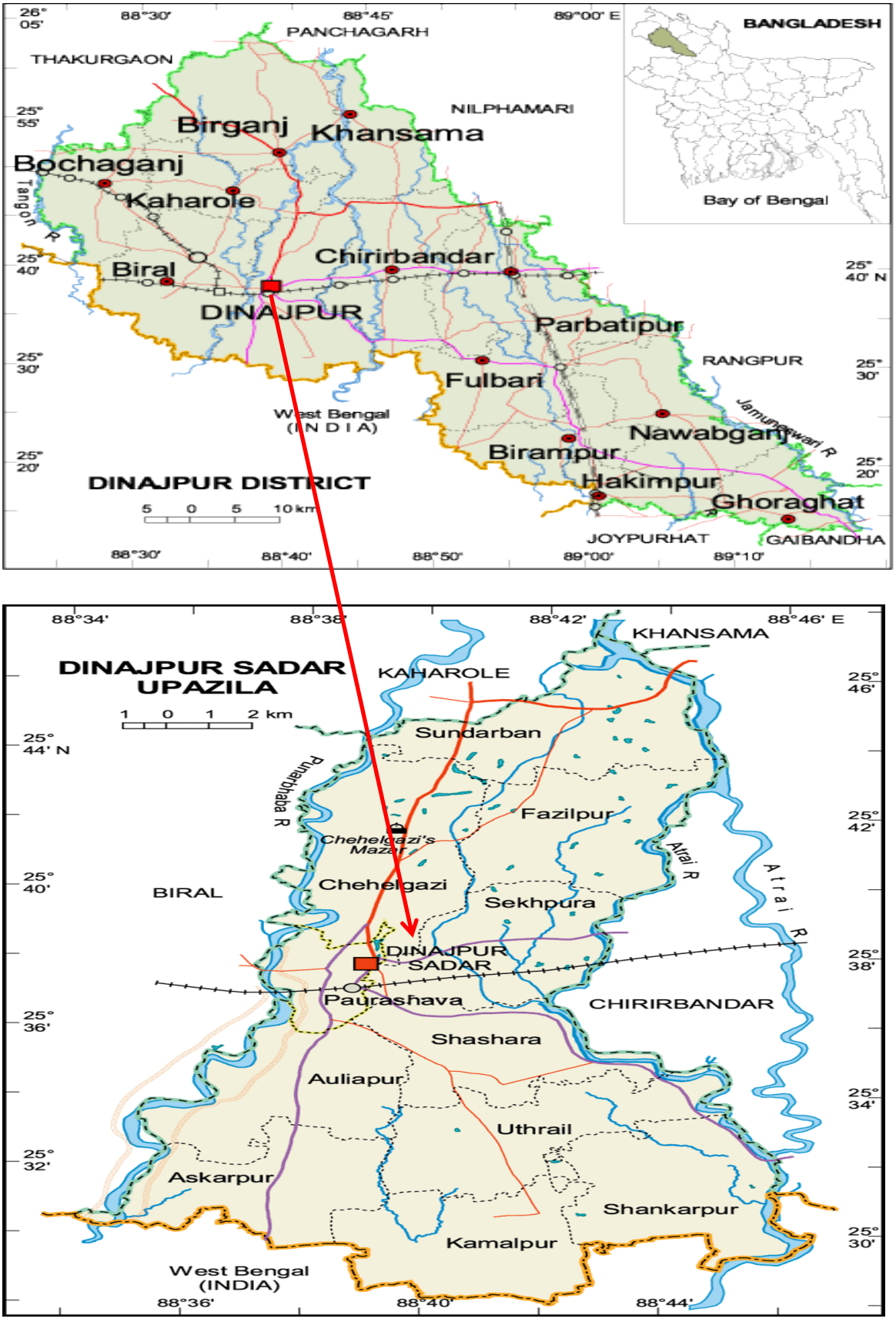


Fig. 1: Maps show the study area (Dinajpur sadar, Dinajpur, Bangladesh).

CHAPTER 4

RESULTS

CHAPTER 4

RESULTS

4.1 Prevalence of tick infestation

4.1.1 Overall prevalence of tick infestation in cattle

In the present study, a total number of 140 cattle examined of which 62 (44.29%) were found infested with one or more species of ticks (Table 1). Three species of tick were identified namely *R. sanguinus* (Fig.12, 13 and 14), *B. microplus* (Fig. 15, 16 and 17) and *H. bispinosa* (Fig. 18, 19 and 20) with their prevalence rate 27.14%, 15.71% and 1.43% respectively. 7.14% cattle were found infested with mixed species of ticks. Among the tick species highest prevalence was *R. sanguinus* (27.14%).

Table 1: Overall prevalence of tick in cattle (N= 140)

Name of the ticks	No. of cattle infested (%)	P value
R. sanguinus	38 (27.14%)	<0.001***
B. microplus	22 (15.71%)	
H. bispinosa	02 (1.43%)	
Mixed infection	10 (7.14%)	
Sub total	62 (44.29%)	

N= Total no. of animals examined.

<0.001*** = means statistically highly significant. The subtotal no. of animals affected is less than the summation of individual infestation because same animals were infested by more than one type of ticks.

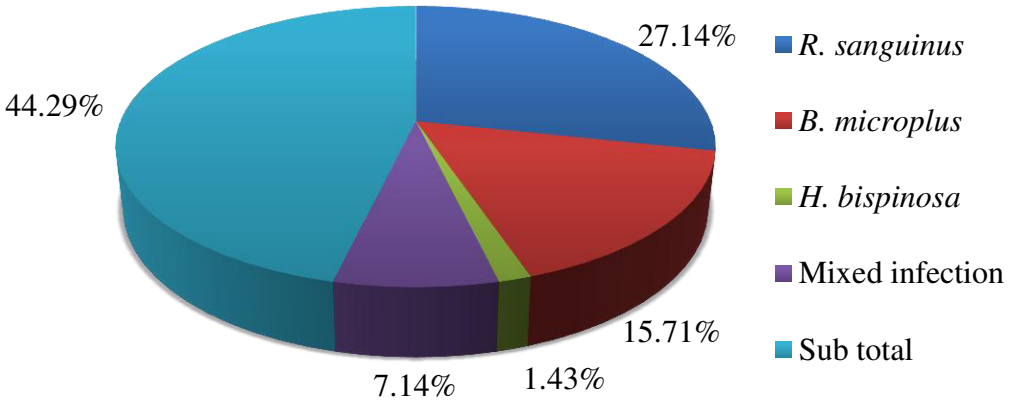


Fig. 2: Overall prevalence (%) of tick infestation

4.1.2 Area related prevalence of tick infestation in cattle

The present study revealed the prevalence of *R. sanguinus* was higher in Nashipur (45%) followed by Chadgonj (40%), Nayanpur (30%), Mirjapur (30%), Kornai (20%), Balubari (15%) and Uttar Sadipur (10%) (Table 2). The prevalence of *B. microplus* was higher in Uttar Sadipur (40%) followed by Nayanpur (20%), Nashipur (20%), Balubari (20%), Mirjapur (5%), Kornai (5%) and was absent in Chadgonj. The prevalence of *H. bispinosa* was only found in chadgonj (10%) and was absent in other areas. The prevalence of Mixed infection was higher in Nayanpur (15%) followed by Mirjapur (10%), Nashipur (10%), Kornai (5%) Chadgonj (5%), Balubari (5%) and was absent in Uttar Sadipur. But the overall prevalence of tick was higher in Nashipur (65%) followed by Nayanpur (50%), Uttar sadipur (50%), Chadgonj (50%), Mirjapur (35%), Balubari (35%) and Kornai (30%).

Table 2: Area related prevalence of tick infestation in Cattle

Species of ticks	Area (N=20)							χ^2 value	P value
	Nayanpur	**Mirjapur**	**Nashipur**	**Uttar Sadipur**	**Kornai**	**Chadgonj**	**Balubari**		
R. sanguinus	06(30%)	06 (30%)	09 (45%)	02 (10%)	04 (20%)	08(40%)	03 (15%)	13.649	0.030*
B. microplus	04 (20%)	01 (5%)	04 (20%)	08 (40%)	01 (5%)	00	04 (20%)	14.418	0.025*
H. bispinosa	00	00	00	00	00	02 (10%)	00	18.394	0.005**
Mixed infection	03 (15%)	02 (10%)	02 (10%)	00	01 (5%)	01(5%)	01 (5%)	4.308	0.635
Subtotal	10 (50%)	07 (35%)	13 (65%)	10 (50%)	05 (30%)	10 (50%)	07 (35%)	43.294	0.009**

N = Total animals examined. * = Means P<0.05. ** = Means P<0.01.

The subtotal no. of animals affected is less than the summation of individual infestation because same animals were infested by more than one type of ticks.

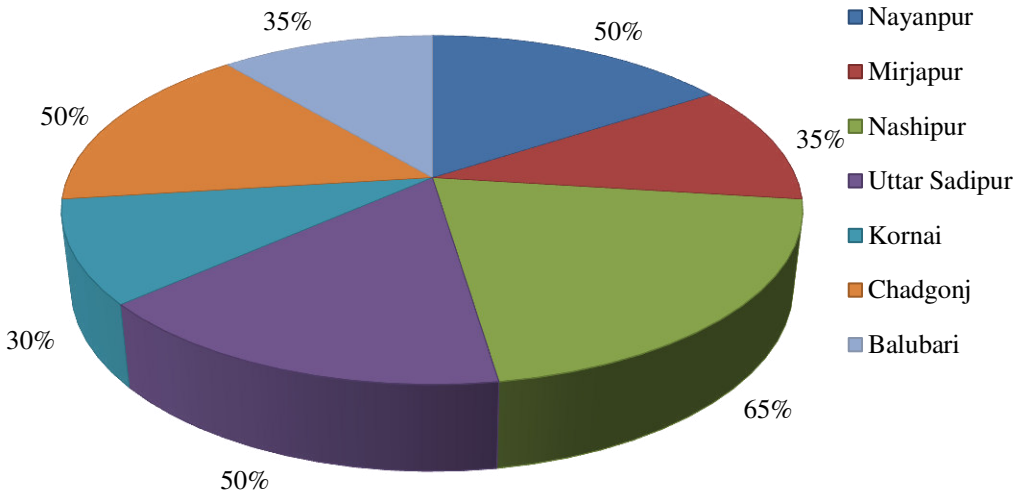


Fig. 3: Area related prevalence (%) of tick infestation

4.1.3 Age-related prevalence of tick infestation in cattle

In this investigation, the overall prevalence of tick infestation was significantly (p<0.05) higher in calf ≤ 6 months (58.33%) followed by adult cattle > 2 years (47.05%) and lowest in young aged ≤ 2 years (33.33%) (Table 3). Calves were 2.8 times more susceptible to tick infestation than young cattle and were 1.56 times more susceptible to tick infestation than adult cattle. On the other hand, Adults were 1.78 times more susceptible to tick infestation than young. In calf group prevalence of tick infestation was higher in case of *R. sanguinus* (33.33%) followed by *B. microplus* (25%) and *H. bispinosa* and mixed infection was absent. In adult age group prevalence of tick infestation was higher in case of *R. sanguinus* (32.35%) followed by *B. microplus* (13.23%), *H. bispinosa* (1.47%) and mixed infection (13.23%). In young age group prevalence of tick infestation was higher in case of *R. sanguinus* (16.67%) followed by *B. microplus* (14.58%) and both *H. bispinosa* and mixed infection (2.08%).

Table 3: Age related prevalence of tick infestation in Cattle

Species of ticks	Age of the cattle			χ^2 value	P value
	Calf (N = 24)	Young (N =48)	Adult (N =68)		
R. sanguinus	08 (33.33%)	08 (16.67%)	22 (32.35%)	9.007	0.011*
B. microplus	06 (25%)	07 (14.58%)	09 (13.23%)	1.271	0.530
H. bispinosa	00	01 (2.08%)	01 (1.47%)	0.733	0.693
Mixed infection	00	01 (2.08%)	09 (13.23%)	7.504	0.023*
Subtotal	14 (58.33%)	16(33.33%)	32(47.05%)	15.907	0.044*
Odds Ratio	Calf vs Young = 2.8				
	Adult vs young =1.78				
	Calf vs adult = 1.56				

* Calf (≤ 6 months); Young aged (≤ 2 years) Adult cattle (> 2 years). N = Total animals examined. * = Means P < 0.05.The subtotal no. of animals affected is less than the summation of individual infestation because same animals were infested by more than one type of ticks.

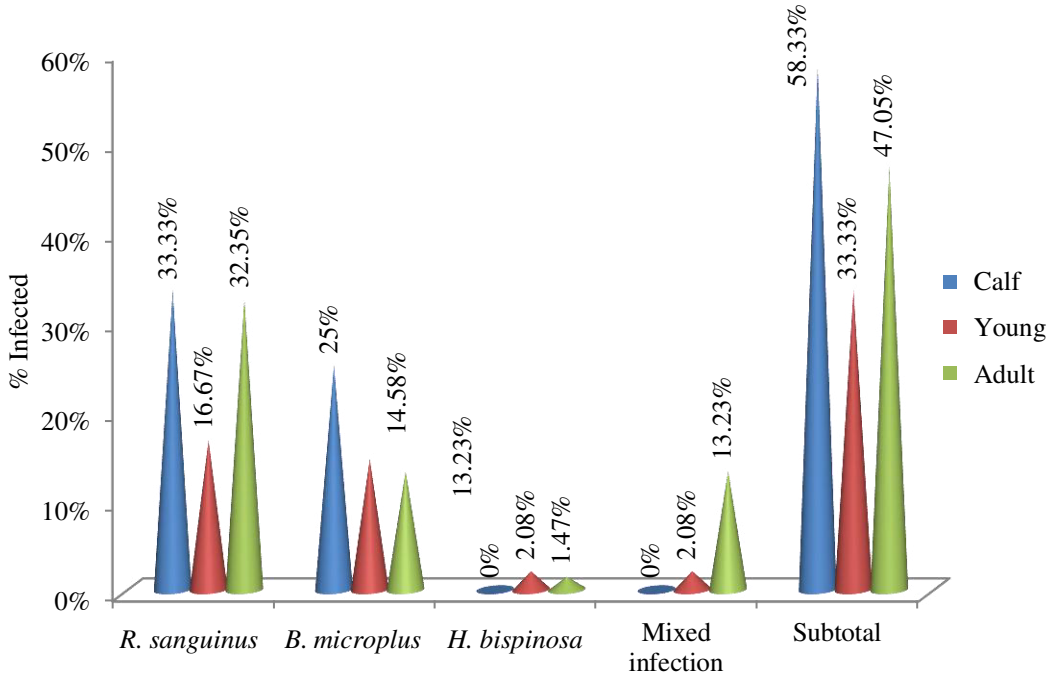


Fig. 4: Age related prevalence (%) of tick infestation

4.1.4 Sex related prevalence of tick infestation in cattle

It was found that in female the prevalence of *R. sanguinus, B. microplus*, *H. bispinosa was* 33.68%, 16.84% and 6.32% which was higher than male (in male *R. sanguinus* was 13.33%, *B. microplus* and *H. bispinosa* was absent) (Table 4). In case of mixed infection the prevalence was high in case of male (8.88%) than in case of female (6.32%). But the overall prevalence significantly higher (P<0.05) in female (52.63%) than in male (26.67%). Female cattle were 3.05 times more susceptible to tick infestation than male.

Table 4: Sex related prevalence of tick infestation in Cattle

Species of ticks	Sex of the cattle		χ^2 value	P-value
	Male (N =45)	Female (N =95)		
R. sanguinus	06 (13.33%)	32 (33.68%)	4.283	0.038
B. microplus	06 (13.33%)	16 (16.84%)	0.000	0.988
H. bispinosa	00	02 (2.11%)	1.452	0.228
Mixed infection	04 (8.88%)	06 (6.32%)	0.305	0.581
Subtotal	12(26.67%)	50 (52.63%)	9.569	0.048*
Odds Ratio	Female vs male =3.05			

N = Total animals examined. * = Means P < 0.05

The subtotal no. of animals affected is less than the summation of individual infestation because same animals were infested by more than one type of ticks.

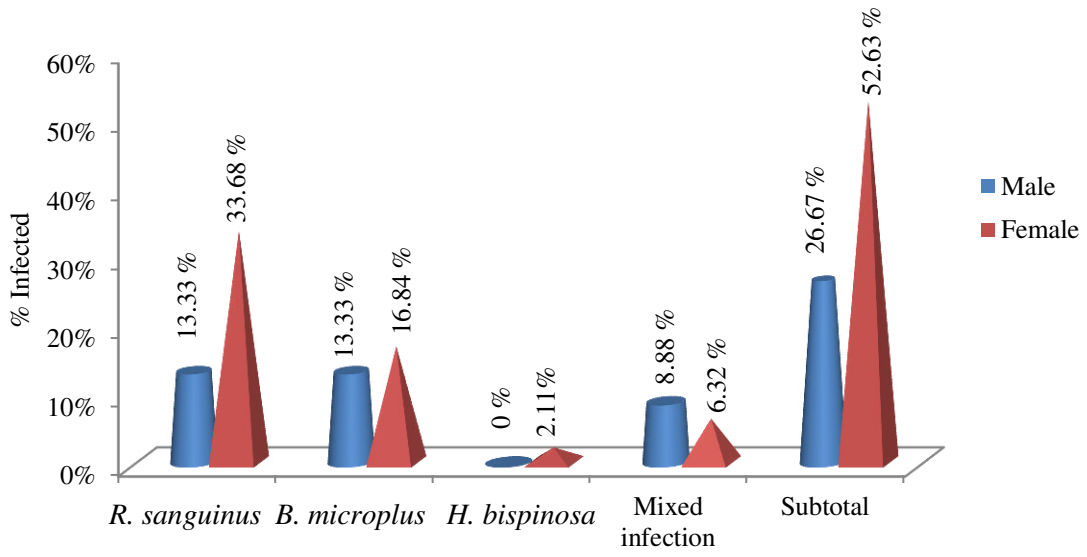


Fig. 5: Sex related prevalence (%) of tick infestation in cattle

4.1.5 Breed related prevalence of tick infestation in cattle

It was observed that in indigenous cattle the prevalence of *R. sanguinus* mixed infection was higher (31.18% and 7.53%) than cross breed (19.15% and 6.38%) whereas in cross breed the prevalence of *B. microplus* and *H. bispinosa* was higher (17.02% 4.26%) than indigenous cattle (15.05% and 0%) (Table 5). But the overall prevalence of tick infestation was higher in indigenous cattle 46.24% than cross breed cattle 40.43%. Indigenous cattle were 1.27 times more susceptible to tick infestation than cross breed.

Table 5: Breed related prevalence of tick infestation in Cattle

Species of ticks	Breed of the cattle		χ^2 value	P value
	Indigenous (N = 93)	Cross breed (N = 47)		
R. sanguinus	29 (31.18%)	09 (19.15%)	2.406	0.121
B. microplus	14 (15.05%)	08 (17.02%)	0.065	0.798
H. bispinosa	0	02 (4.26%)	1.506	0.220
Mixed infection	07 (7.53%)	03 (6.38%)	0.062	0.804
Subtotal	43 (46.24%)	19 (40.43%)	6.068	0.194
Odds Ratio	Indigenous vs cross = 1.27			

N = Total animals examined. The subtotal no. of animals affected is less than the summation of individual infestation because same animals were infested by more than one type of ticks.

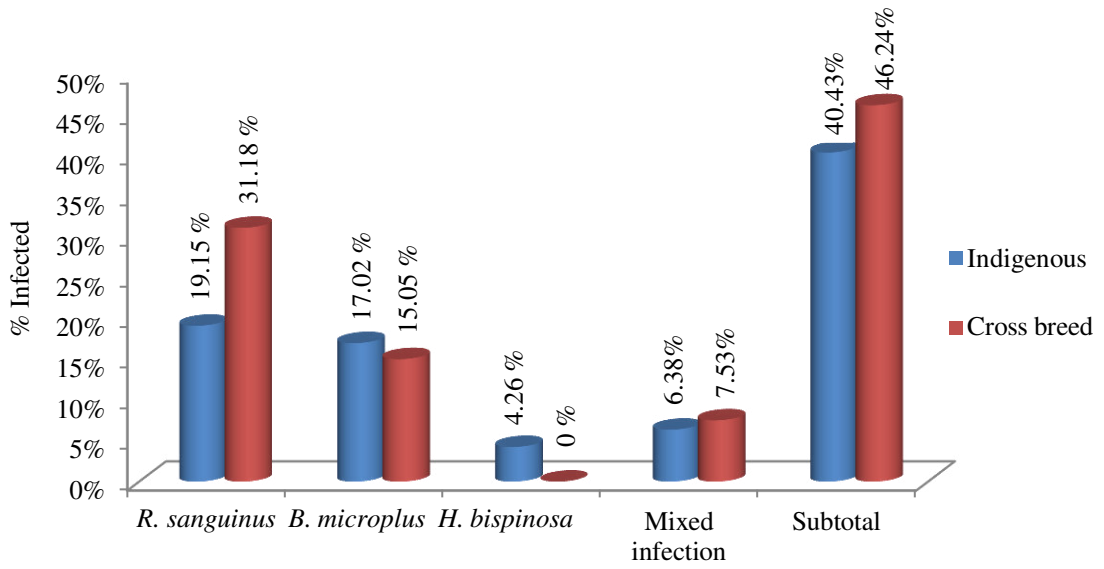


Fig. 6: Breed related prevalence (%) of tick infestation in cattle

4.1.6 Health status related prevalence of tick infestation in cattle

In this present study it was detected that malnourished cattle (51.85%) were more prone to tick infestation than normal healthy cattle (33.90%) (Table 6) and there is significant difference (P< 0.05). Malnourished cattle were 2.1 times susceptible to tick infestation than normal healthy cattle with normal body conditioned. In malnourished cattle the prevalence was higher in case of *R. sanguinus* (32.10%) followed by *B. microplus* (17.28%), mixed infection (9.88%) and *H. bispinosa* (2.47%). In normal healthy cattle the prevalence was higher in case of *R. sanguinus* (20.34%) followed by *B. microplus* (13.56%), mixed infection (3.39%) and *H. bispinosa* was absent.

Table 6: Health related prevalence of tick infestation in Cattle

Species of ticks	Health status of cattle		χ^2 value	P value
	Malnourished (N =81)	Normal Healthy (N =59)		
R. sanguinus	26 (32.10%)	12 (20.34%)	5.044	0.025*
B. microplus	14 (17.28%)	08 (13.56%)	1.596	0.207
H. bispinosa	02 (2.47%)	00	2.233	0.135
Mixed infection	08 (9.88%)	02 (3.39%)	2.166	0.141
Subtotal	42 (51.85%)	20 (33.90%)	9.706	0.046*
Odds Ratio	Malnourished vs normal healthy = 2.1			

N = Total animals examined. * = Means P < 0.05

The subtotal no. of animals affected is less than the summation of individual infestation because same animals were infested by more than one type of ticks.

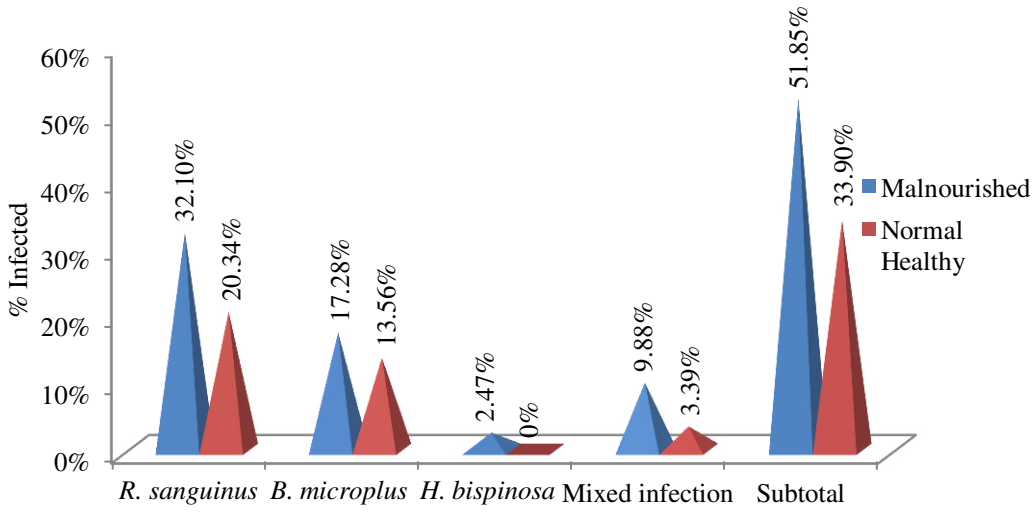


Fig. 7: Health status related prevalence (%) of tick infestation in cattle

4.1.7 Season related prevalence of tick infestation in cattle

The overall prevalence of tick was significantly (P<0.01) higher in rainy season (54.17%) followed by summer season (33.82%). In rainy, cattle were 2.31times more susceptible than summer season (Table 7). In rainy season prevalence was high in case of *R. sanguinus* (34.72%) followed by *B. microplus* (16.67%), mixed infection (12.5%) and *H. bispinosa* (2.78%). In summer season prevalence was high in case of *R. sanguinus* (19.12%) followed by *B. microplus* (14.71%), mixed infection (1.47%) and *H. bispinosa* was absent.

Table 7: Seasons related prevalence of tick infestation in Cattle

Species of ticks	Seasons of the year		χ^2 value	P value
	Summer (N =68)	Rainy (N =72)		
R. sanguinus	13 (19.12%)	25 (34.72%)	11.011	0.001**
B. microplus	10 (14.71%)	12 (16.67%)	2.730	0.98
H. bispinosa	00	02 (2.78%)	2.895	0.89
Mixed infection	01 (1.47%)	09 (12.5%)	6.414	0.011*
Subtotal	23 (33.82%)	39 (54.17%)	18.154	0.001**
Odds Ratio	Rainy vs summer =2.31			

*Summer: March- May; Rainy: June-July. ** = Means P < 0.01

N = Total animals examined. The subtotal no. of animals affected is less than the summation of individual infestation because same animals were infested by more than one type of ticks.

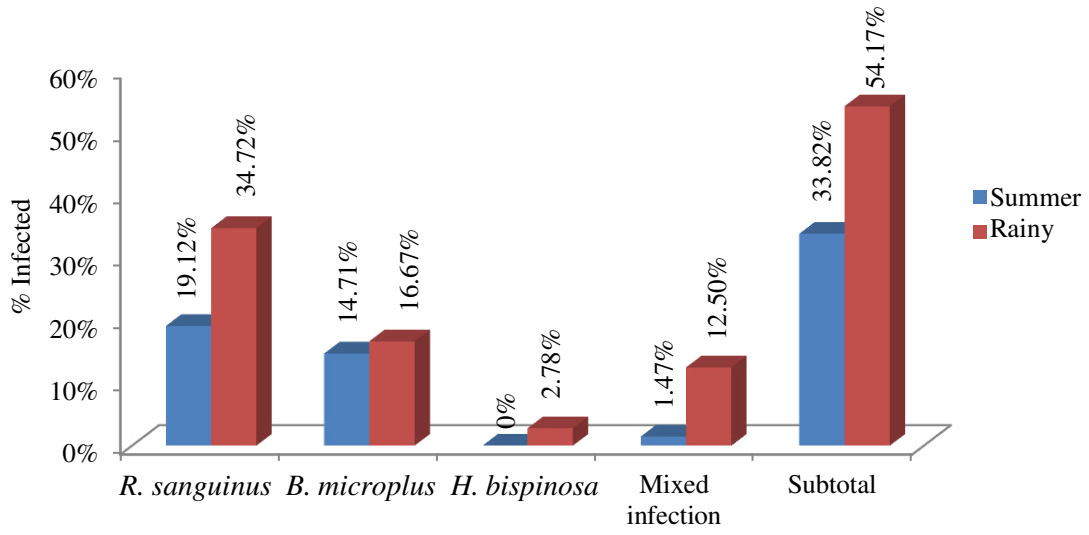


Fig. 8: Season related prevalence (%) of tick infestation in cattle

4.1.8 Management system related prevalence of tick infestation in cattle

The present study implied that in case of *R. sanguinus* the prevalence was higher in extensive system (38.46%) than in semi-intensive (18.42%) and intensive (27.53%). In case of *B. microplus* the prevalence was higher in intensive system (28.95%) than in extensive (26.92%) and semi-intensive (5.26%). In case of *H. bispinosa* the prevalence was higher in intensive system (2.63%) than in semi-intensive (1.32%) and was absent in extensive system. In case of mixed infection of tick the prevalence was higher in semi-intensive system (10.53%) than in extensive (7.70%) system and was absent in intensive system. But in case of overall prevalence cattle brought up under extensive system, intensive and semi intensive system were affected with tick infestation as 65.38%, 47.37% and 34.21% respectively (Table 8). Cattle reared in extensive system were 2.10 times more vulnerable tick infestation than cattle reared intensively and cattle reared in intensive system were 1.73 times more vulnerable tick infestation than cattle reared semi-intensively and cattle reared in extensive system were 3.63 times more vulnerable tick infestation than cattle reared semi-intensively and it differs significantly (P<0.01).

Table 8: Management related prevalence of tick infestation in Cattle

Species of ticks	**Management system of the cattle**			**χ^2 value**	**P value**
	Extensive (N=26)	**Intensive (N=38)**	**Semi-intensive (N=76)**		
R. sanguinus	10 (38.46%)	07 (18.42%)	21 (27.53%)	6.376	0.041
B. microplus	07 (26.92%)	11 (28.95%)	04 (5.26%)	5.960	0.051
H. bispinosa	00	01 (2.63%)	01 (1.32%)	0.699	0.705
Mixed infection	02 (7.70%)	00	08 (10.53%)	4.247	0.120
Subtotal	17 (65.38%)	18 (47.37%)	26 (34.21%)	21.826	0.005**
Odds Ratio	Extensive vs intensive = 2.1				
	Intensive vs semi-intensive = 1.73				
	Extensive vs semi-intensive = 3.63				

N = Total animals examined. **= Means P < 0.01

The subtotal no. of animals affected is less than the summation of individual infestation because same animals were infested by more than one type of ticks.

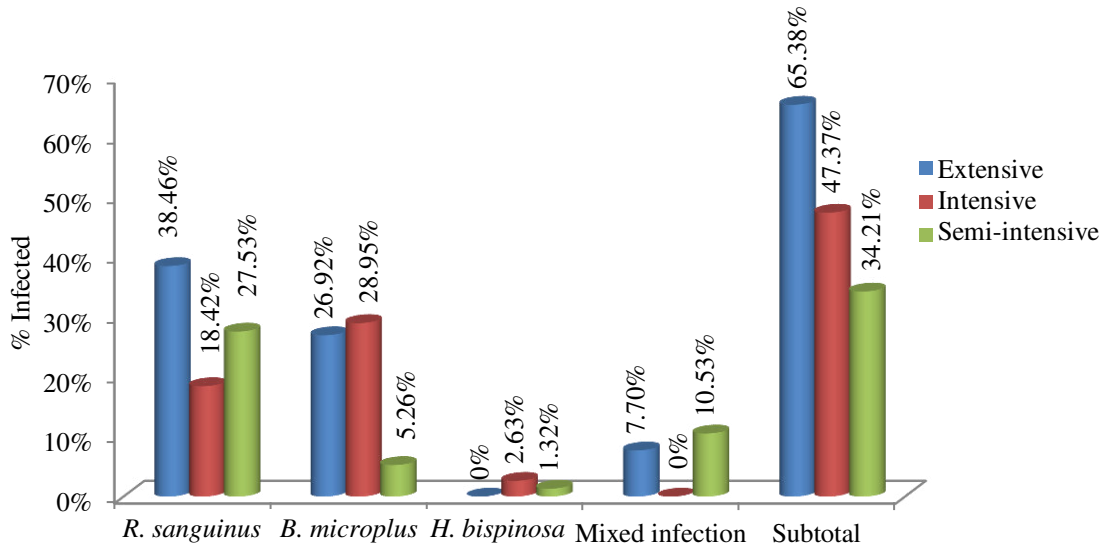


Fig. 9: Management related prevalence (%) of tick infestation in cattle

4.1.9 Body region related prevalence of tick infestation in cattle

In this present study it was detected that the overall prevalence of tick were higher in ear region (35.71%) followed by neck (32.14%), dewlap (29.29%), base of the horn (17.14%), eye (12.86%), udder body surface (5.71%), perineum (4.29%) and tail (3.71%) (Table 9). The prevalence of *R. sanguinus* was high in dewlap region (63.41%), *B. microplus* high in tail region (54.55%), *H. bispinosa* high in tail region (5.54%) and mixed infection high in perineum region (66.67%).

Table 9: Body affected parts prevalence of tick infestation in Cattle

Species of ticks	Body Parts								
	Ear (N=50)	**Neck (N=45)**	**Dewlap (N=41)**	**Base of horn (N=24)**	**Eye (N=18)**	**Tail (N=22)**	**Perineum (N=6)**	**Udder (N=8)**	**Body surface (N=8)**
R. sanguinus	27 (54%)	25 (55.55%)	26 (63.41%)	13 (54.17%)	08 (44.44%)	05 (22.72%)	01 (16.67%)	04 (50%)	03 (37.5%)
B. microplus	12 (24%)	11 (24.44%)	07 (17.07%)	03 (12.5%)	04 (22.22%)	12 (54.55%)	01 (16.67%)	01 (12.51%)	00
H. bispinosa	02 (4%)	02 (4.44%)	01 (2.44%)	00	00	01 (5.54%)	00	00	00
Mixed infection	09 (18%)	07 (15.56%)	07 (17.07%)	08 (33.33%)	06 (33.33%)	04 (18.18%)	04 (66.67%)	3 (37.51%)	05 (37.5%)
Sub total	50 (35.71%)	45 (32.14%)	41 (29.29%)	24 (17.14%)	18 (12.86%)	05 (3.71%)	06 (4.29%)	08 (5.71%)	08 (5.71%)
χ^2 value	78.280	65.943	64.752	50.283	32.999	44.139	34.486	16.878	42.313
P value	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	0.002**	0.000**

N = Total animals examined. **= Means P < 0.01

The subtotal no. of animals affected is less than the summation of individual infestation because same animals were infested by more than one type of ticks.

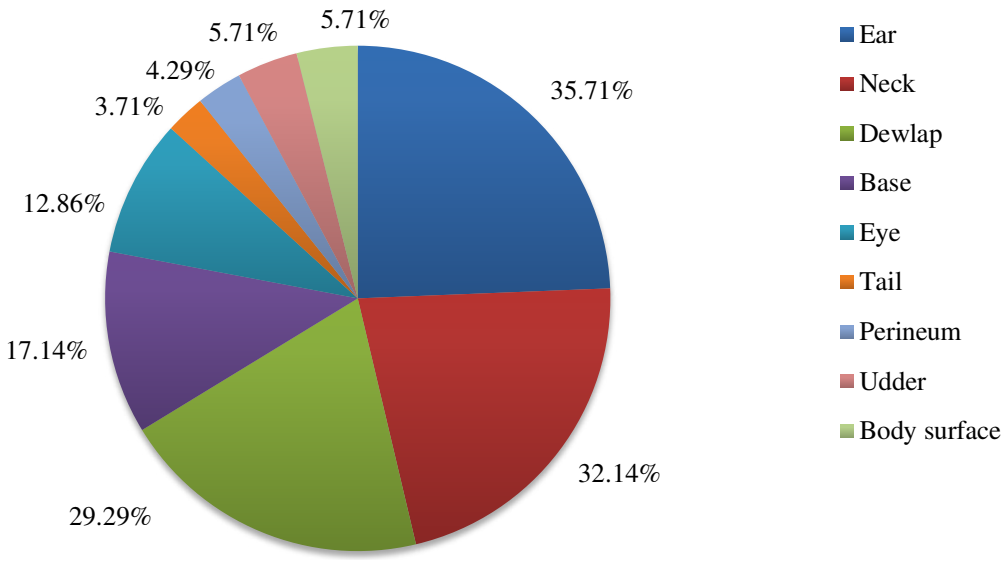


Fig. 10: Body affected area related prevalence (%) of tick infestation

4.2 Intensity of Tick infestation in cattle

4.2.1 Overall intensity of tick infestation in cattle

In this present study the intensity of tick infestation in cattle is presented at Table 10. The range of tick population was highest in case of mixed infection (3-9) followed by *H. bispinosa* (2-4), *R. sanguinus* (1-9) *B. microplus* (1-6). The mean intensity of tick burden was higher in case of mixed infection (4.40) followed by *H. bispinosa* (4.00), *R. sanguinus* (3.83) lowest in *B. microplus* (3.35).

Table 10: Overall intensity of tick infestation in Cattle

Name of the ticks	Tick burden		P value
	Range	Mean ± SE	
R. sanguinus	1-9	3.83±0.317	<0.001***
B. microplus	1-6	3.35±0.368	
H. bispinosa	2-4	4.00±1.155	
Mixed infection	3-9	4.40±0.733	
Subtotal	1-9	3.76±0.225	

<0.001*** = Means highly significant

4.2.2 Area related intensity of tick infestation in cattle

The present study revealed that mean intensity of tick infestation in cattle was significantly higher at Chadgonj (6.36) than other areas. The intensity of mean tick burden was significantly higher in case of *R. sanguinus* at chadgonj (6.56). But mean intensity of *B. microplus* mixed infection was non-significantly higher at Nayanpur (4.54) and Mirjapur (8.00) respectively (Table 11).

Table 11: Area related intensity of tick infestation in cattle

Species of ticks	Intensity	Area (N=20)							P value
		Nayanpur	Mirjapur	Nashipur	Uttar Sadipur	Kornai	Chadgonj	Balubari	
R. sanguinus	**Range**	1-7	1-6	1-7	1-4	2-5	2-9	3-7	0.002**
	Mean ± SE	3.0±0.62	3.62±0.53	3.36±0.56	2.5±1.5	3.0±0.55	6.56±0.73	4.75±0.85	
B. microplus	**Range**	2-7	2-3	1-5	2-5	3-4	-	1-5	0.169
	Mean ± SE	4.54± 0.75	2.67±3.3	2.67±0.67	2.8±0.35	3.5±0.50	-	2.80±0.68	
H. bispinosa	**Range**	-	-	-	-	-	2-5	-	
	Mean ± SE	-	-	-	-	-	3.67±0.882	-	
Mixed infection	**Range**	3-9	7-9	7-8	1-5	7	7	6	0.092
	Mean ± SE	6.0±1.7	8.00±1.0	7.50±0.5	2.8±0.36	7.00±0	7.00±0	6.00±0	
Subtotal	**Range**	2-9	1-9	1-9	2-5	2-7	2-9	1-7	0.008**
	Mean ± SE	4.54±0.62	4.11±0.81	3.53±0.54	3.0±0.55	3.67±0.80	6.36±0.64	4.00±0.73	

N = Total animals examined. ** = Means P<0.01

4.2.3 Age related intensity of tick infestation in cattle

The present study revealed mean intensity of tick infestation differs not significantly among calf, young and adult. The mean intensity was higher in adult (4.48) followed by young (4.18) and calf (3.93). The mean intensity of *R. sanguinus* was higher in young (4.44) followed by calf (4.25) and in adult (3.77). In case of B. *microplus* mean intensity was higher in calf (3.50) followed by young (3.38) and in adult (3.00). The mean intensity of *H. bispinosa* was higher in young (4.00) followed by adult (3.5) and was absent in calf. In case of mixed infection mean intensity was higher in young (7.00) than in adult (6.89) and was absent in calf (Table 12).

Table 12: Age related intensity of tick infestation in cattle

Species of ticks	Age of the cattle						P value
	Calf No. (N =24)		Young (N =48)		Adult (N =68)		
	Range	Mean ± SE	Range	Mean ± SE	Range	Mean ± SE	
R. sanguinus	2-7	4.25±0.701	1-7	4.44±0.709	1-9	3.77±0.406	0.674
B. microplus	2-6	3.50±0.563	2-5	3.38±0.420	1-7	3.00±0.437	0.753
H. bispinosa	-	-	4	4.00±00	2-5	3.5±1.5	0.879
Mixed infection	-	-	7	7.00±0	3-9	6.89±0.611	0.956
Subtotal	2-7	3.93±0.462	1-7	4.18±0.464	1-9	4.48±0.263	0.889

N = Total animals examined.

4.2.4 Sex related intensity of tick infestation in cattle

It was observed that the mean intensity was differs from sex to sex. The mean intensity of *R. sanguinus* was higher in female (4.13) followed by male (3.40). In case of B. *microplus* mean intensity was higher in male (3.20) than in female (3.19). The mean intensity of *H. bispinosa* was 3.33 in female was absent in male. In case of mixed infection mean intensity was higher in female (7.17) than in male (6.50). The mean intensity was higher in female (4.20) than in male (4.12) but there is no significance difference (Table 13).

Table 13: Sex related intensity of tick infestation in cattle

Species of ticks	Sex of the cattle				P value
	Male (N =45)		Female (N =95)		
	Range	Mean ± SE	Range	Mean ± SE	
R. sanguinus	1-6	3.40±0.562	1-9	4.13±0.366	0.348
B. microplus	2-6	3.20±0.442	1-7	3.19±0.363	0.988
H. bispinosa	-	-	1-7	3.33±1.856	-
Mixed infection	3-9	6.50±1.258	6-9	7.17±0.477	0.581
Subtotal	2-9	4.12±0.562	1-9	4.20±0.301	0.911

N = Total animals examined.

4.2.5 Breed related intensity of tick infestation in cattle

The present study showed that mean intensity of tick infestation between indigenous and cross breed was not significantly different. The mean intensity was higher in cross breed (4.36) than indigenous (4.10). The mean intensity of *R. sanguinus* was higher in cross breed (4.25) followed by indigenous (3.89). In case of B. *microplus* mean intensity was higher in cross breed (4.25) than in indigenous (3.89). The mean intensity of *H. bispinosa* was higher indigenous (5.00) followed by in cross breed (3.00). In case of mixed infection mean intensity was higher in cross breed (7.67) than in indigenous (6.57) (Table 14).

Table 14: Breed related intensity of tick infestation in cattle

Species of ticks	Breed of the cattle				P value
	Indigenous (N =93)		Cross breed (N =47)		
	Range	Mean ± SE	Range	Mean ± SE	
R. sanguinus	1-9	3.89±0.349	2-9	4.25±0.708	0.623
B. microplus	2-6	3.00±0.271	1-7	3.55±0.623	0.360
H. bispinosa	5	5.00±0	2-4	3.00±1.00	0.454
Mixed infection	3-9	6.57±0.685	6-9	7.67±0.882	0.390
Subtotal	1-9	4.10±0.307	1-9	4.36±0.516	0.360

N = Total animals examined.

4.2.6 Health status related intensity of tick infestation in cattle

The present study reported that mean intensity of tick infestation between malnourished and normal healthy cattle was different. The mean intensity of *R. sanguinus* was higher in malnourished (4.35) followed by normal healthy cattle (3.50). In case of *B. microplus* mean intensity was higher in normal healthy cattle (3.40) than in malnourished (3.10). The mean intensity of *H. bispinosa* was present only in normal healthy cattle (3.67). In case of mixed infection mean intensity was higher in malnourished (6.38) than in healthy (4.82). But the mean intensity was higher in normal healthy cattle (9.00) than in malnourished (4.48) (Table 15).

Table 15: Health related intensity of tick infestation in cattle

Species of ticks	Health status of cattle				P value
	Malnourished (N =81)		Normal Healthy (N =59)		
	Range	Mean ± SE	Range	Mean ± SE	
R. sanguinus	1-9	4.35±0.387	1-9	3.50±0.500	0.062
B. microplus	1-6	3.10±0.292	1-7	3.40±0.636	0.619
H. bispinosa	-	-	2-5	3.67±0.882	-
Mixed infection	3-8	6.38±0.532	3-9	4.82±0.711	0.046*
Subtotal	2-9	4.48±0.303	9	9.00±0	0.087

N = Total animals examined. * = Means P<0.05

4.2.7 Season related intensity of tick infestation in cattle

The study presented that mean intensity of tick infestation between summer and rainy season was different. The mean intensity was higher in summer (4.25) than in rainy season (4.15).The mean intensity of *R. sanguinus* was higher in summer (4.57) followed by rainy season (3.74). In case of *B. microplus* mean intensity was higher in summer (3.45) than in rainy season (3.05). *H. bispinosa* was present in rainy season (3.67) and was absent in summer season. In case of mixed infection mean intensity was higher in summer (7.00) than in rainy season (6.89) (Table 16).

Table 16: Season related intensity of tick infestation in cattle

Species of ticks	Seasons of the year				P value
	Summer (N =68)		Rainy (N =72)		
	Range	Mean ± SE	Range	Mean ± SE	
R. sanguinus	1-9	4.57±0.581	1-9	3.74±0.369	0.228
B. microplus	1-6	3.45±0.493	1-7	3.05±0.344	0.498
H. bispinosa	-	-	2-5	3.67±0.882	-
Mixed infection	7	7.0±.0	3-9	6.89±0.611	0.956
Subtotal	1-9	4.25±0.431	1-9	4.15±0.334	0.854

N = Total animals examined.

4.2.8 Management related intensity of tick infestation in cattle

In the present study it was found that the mean intensity of *R. sanguinus* was higher in intensive system (4.29) followed by extensive system (4.08) and in semi-intensive system (3.86). In case of *B. microplus* mean intensity was higher in semi-intensive system (3.82) followed by intensive system (3.00) and in extensive system (2.67). The mean intensity of *H. bispinosa* was higher in intensive system (4.00) followed by semi-intensive system (3.50) and was absent in extensive system. In case of mixed infection mean intensity was higher in extensive system (7.50) than in semi-intensive system (6.75) and was absent in intensive system. But the mean intensity was higher in semi-intensive system (4.74) followed by extensive system (3.84) and in intensive system (3.53) (Table 16)**.**

Table 17: Management related intensity of tick infestation in cattle

Species of ticks	Management system of the cattle						P value
	Extensive (N =26)		Intensive (N =38)		Semi-intensive (N =76)		
	Range	Mean ± SE	Range	Mean ± SE	Range	Mean ± SE	
R. sanguinus	1-9	4.08±0.679	1-8	4.29±0.918	1-9	3.86±0.390	0.125
B. microplus	1-5	2.67±0.500	1-6	3.00±0.426	2-7	3.82±0.501	0.886
H. bispinosa	-	-	4-6	4.00±00	2-5	3.50±1.50	0.233
Mixed infection	7-8	7.50±.50	-	-	3-9	6.75±.675	0.879
Subtotal	1-9	3.84±0.531	1-8	3.53±0.428	1-9	4.74±0.395	

N = Total animals examined.

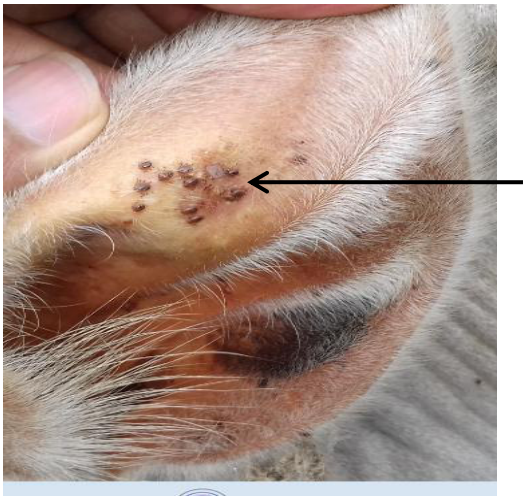
4.2.9 Body affected parts related intensity of tick infestation in cattle

In this present study it was observed that mean intensity of tick infestation differs among affected body parts of the host. The mean intensity was higher in udder (6.25) than other body parts. In udder the mean intensity of *R. sanguinus, B. microplus* mixed infection was 4.71, 4.25, 7.67 respectively which is higher than other body parts. The mean intensity of *H. bispinosa* was only present at tail that was 2.00 (Table 17).

Table 18: Body affected parts related intensity of tick infestation in cattle

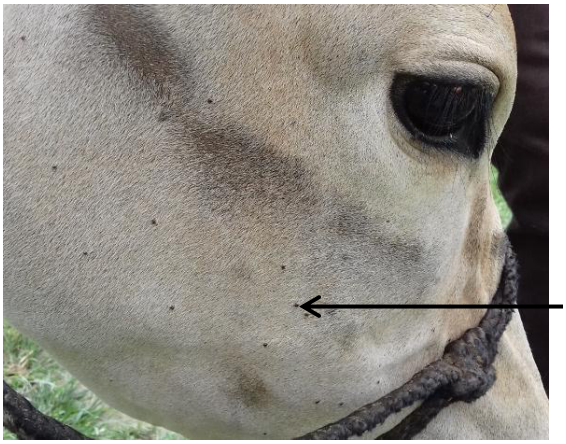
Species of ticks	Intensity	Body Parts								
		Ear (N=50)	**Neck (N=45)**	**Dewlap (N=41)**	**Base of horn (N=24)**	**Eye (N=18)**	**Tail (N=22)**	**Perineum (N=06)**	**Udder (N=08)**	**Body Surface (N=08)**
R. sanguinus	**Range**	1-9	1-9	1-9	1-7	1-9	1-7	1-7	2-7	1-7
	Mean ± SE	3.72 ± 0.33	4.34 ± 0.39	3.94 ± 0.39	3.62 ± 0.40	3.86 ± 0.73	3.00 ± 0.65	3.00 ± 2.0	4.71 ± 0.89	3.25 ± 0.84
B. microplus	**Range**	1-7	1-6	1-7	1-5	1-7	2-7	2-5	1-7	1-7
	Mean ± SE	3.55 ± 0.37	2.94 ± 0.40	1.702± 0.47	2.80 ± 0.36	4.00 ± 0.58	3.69 ± 0.42	3.33 ± 0.88	4.25 ± 1.25	4.0 ± 1.29
H. bispinosa	**Range**	-	-	-	-	-	2	-	-	5
	Mean ± SE	-	-	-	-	-	2.00±0	-	-	5.00 ± 0
Mixed infection	**Range**	3-9	3-9	3-9	3-9	6-9	3-9	4-5	6-9	7-9
	Mean ± SE	6.67 ± 0.55	6.71 ± 0.71	7.14 ± 0.77	6.62 ± 0.63	7.67 ± 0.49	6.50 ± 1.26	4.67 ± 0.33	7.67 ± 0.88	8.00 ± 0.45
Subtotal	**Range**	1-9	1-9	1-9	1-9	1-9	1-9	2-9	3-9	1-9
	Mean ± SE	4.32 ± 0.30	4.44 ± 0.34	4.44 ± 0.37	4.54 ± 0.44	5.22 ± 0.68	4.00 ± 0.46	6.17 ± 0.95	6.25 ± 0.68	5.88 ± 1.16

N = Total animals examined.



Tick infestation at ear

Tick infestation at eye



Tick infestation at face

Fig. 11: Tick infestation at different body parts of cattle

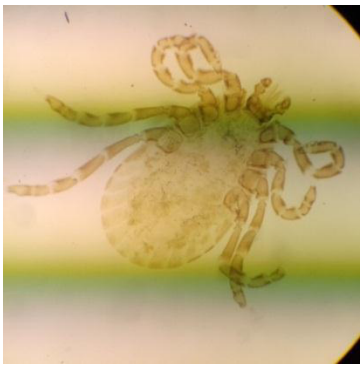


Fig. 12: Full view of *Rhipicephalus sanguineus*

Fig. 13: Mouth part of *Rhipicephalus sanguineus*

Fig. 14: Posterior part of *Rhipicephalus sanguineus*

Fig. 15: Full view of *Boophilus microplus*

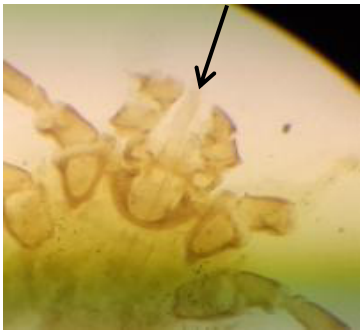


Fig. 16: Mouth part of *Boophilus microplus*

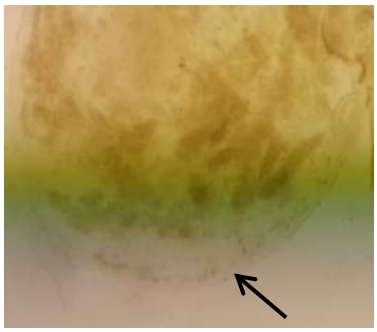


Fig. 17: Posterior part of *Boophilus microplus*

Fig. 18: Full view of *Hemaphysalis bispinosa*

Fig.19 : Mouth part of *Hemaphysalis bispinosa*

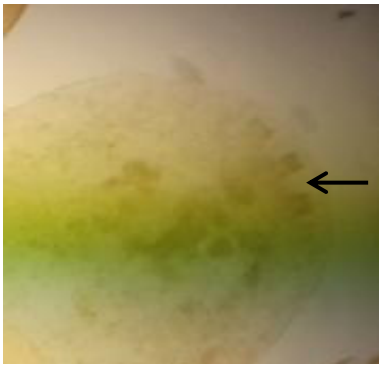


Fig. 20: Posterior part of *Hemaphysalis bispinosa*

CHAPTER 5

DISCUSSION

CHAPTER 5

DISCUSSION

5.1 Prevalence of tick infestation

5.1.1 Overall prevalence of tick infestation in cattle

In the present study, 44.29% cattle were found infested with one or more species of ticks. The prevalence rate in case of *R. sanguinus*, *B. microplus*, *H. bispinosa* and mixed infection was 27.14%, 15.71%, 1.43% and 7.14% respectively. This study has similarities and dissimilarities with other scientists report in home and abroad. Haque (*et. al* 2014) conducted a study in Barind Tract of Bangladesh where they found 35.7% cattle were infested with ticks which support the overall prevalence of tick infestation in cattle in this study but he found *R. (B.) microplus* (22.6%) and *H. bispinosa* (15.2%) which differs with present study. The prevalence of *R. sanguinus* in this study is similar with author Bilkis (2013) who revealed *R. sanguineus* (29.2%), *B. microplus* (27.2%) and *H. bispinosa* (31.2%). Nath *et al.* (2005) recorded *B. microplus* (15.82%) which supports this study. Islam *et al.* (2009) revealed *H. bispinosa* (7.8%) which is close to the present study. Yakhchali and Hasan zadehzarza (2004) reported 44.5% tick infested in cattle in West Azerbaijan. Mamak *et al*. (2006) reported 29.6% tick infestation in cattle in Turkey. Torina *et al*. (2006) recorded *R.* sanguineus (19.3%) in cattle in Italy. But Swai *et al.* (2005) who reported 85.6% tick infestation rate in cattle. Aydin *et al*. (2006) identified tick infestation in cattle from three Districts of Southeastern Bulgaria showed 7.93% of the ticks were collected from cattle of which *R*. sanguineus (4.43%). But 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.

5.1.2 Area related prevalence of tick infestation in cattle

But the overall prevalence of tick was higher in Nashipur (65%) followed by Nayanpur (50%), Uttar sadipur (50%), Chadgonj (50%), Mirjapur (35%), Balubari (35%) and Kornai (30%). The tick burden significantly ($P < 0.01$) differs from area to area. The prevalence of tick infestation varies from region to region. Host, management and environmental factors (agro-ecological and geo-climatic conditions) influence the

prevalence of ticks (Kivaria, 2006). But this result could not be compared and contrasted due to lack of relevant literature. However, some management system, feeding of cattle, use of acaricides may be associated with this variation.

5.1.3 Age related prevalence of tick infestation in cattle

In this investigation, the overall prevalence of tick infestation was significantly ($p<0.05$) higher in calf ≤ 6 months (58.33%) followed by adult cattle > 2 years (47.05%) and lowest in young aged ≤ 2 years (33.33%). Calves were 2.8 times more susceptible to tick infestation than young cattle were 1.56 times more susceptible to tick infestation than adult cattle. On the other hand, Adults were 1.78 times more susceptible to tick infestation than young. There are some similarities and dissimilarities of recent study in this area with others. Bilkis (2013) showed the prevalence was significantly (P<0.01) higher in young cattle aged >1-3 years (68.0%) than calves aged ≤1 year age (46.15%) and adults aged >3 years (45.2%). Kabir *et al.* (2009) observed prevalence was significantly (p<0.01) higher in cattle of 1.5 years of age (46.28%) than in cattle of >1.5 years of age (27.80%). Islam *et al.* (2009) revealed the prevalence was higher in old cattle (61.5%) followed by calves (56%) adult (38.5%). Nath *et al.* (2005) recorded adolescent dairy cattle matured 1-3 years are more (80.78%) vulnerable than that of grown-ups matured >3 years (58.53%), young aged <1 years (61.91%). Maluddin *et al.* (2004) revealed the mature >5 years (64.17%) cattle were more vulnerable than that young calves <2 years (51.96%) of adolescent dairy cattle ages 2-5 years (48.13%). The infestation was more common in weak animals than ordinary sound cattle. 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. But in this study in calves no mixed infection present so although adults are more affected with tick but due to absence of mixed infection in calf here and subtotal infection is higher in calf than adult. Manan *et al*. (2007) found that resistance in the animals was building up as the age advances the animals became more adoptable than in younger state irrespective of the farm species. It is hypothesized that the strong innate immunity age resistance of young cattle are responsible for their less vulnerability to tick infestation (Sarkar, 2007) in such way, leads to less ectoparasitic burden. So this variation in the rate of tick infestation between age groups in different records, this can be justified due to differences in nutrition, hormonal level of the host.

5.1.4 Sex related prevalence of tick infestation in cattle

It was observed that the overall prevalence significantly higher (P<0.05) in female (52.63%) than in male (26.67%). Female cattle were 3.05 times more susceptible to tick infestation than male.

This result agree with the reports of some authors such as Kabir *et al.* (2009) who observed Infestation of tick was significantly higher (p<0.01) in female (59.37%) than the male (35.83%) cattle, Bilkis (2013) revealed *tick* Infestation was significantly higher (P<0.05) in female (64.63%) than the male (41.86%) Torina *et al*. (2016) also recorded females were significantly (P<0.05) the most affected gender than males. The cause of more prone to tick infestation of female than of male is still unknown but it can be hypothesized that some hormonal influences stress factor like as pregnancy, lactation etc may be associated with this phenomenon by leading to immune suppression of the animal. Llyod (1983) reported that higher level of prolactin and progesterone hormones make the individual more susceptible to any infection.

5.1.5 Breed related prevalence of tick infestation in cattle

It was observed that the overall prevalence of tick infestation was higher in indigenous cattle 46.24% than cross breed cattle 40.43%. Indigenous cattle were 1.27 times more susceptible to tick infestation than cross breed. These results are more or less similar with the findings of some others. Bilkis (2013) revealed tick Infestation was more prevalent in local (72.32%) breed than the crossbred (44.2%) cattle, Kabir *et al.* (2009) found tick infestation was more prevalent in local (43.82%) cattle than the cross-bred (24.13%) cattle. Tadesse *et al*. (2014) recorded the local breeds were highly infested by the ticks with the prevalence of (70.8%). But Subalini *et al.* (2001) showed tick infestation was significantly high (P<0.05) in crossbred cattle of exotic breeds (65%) in extensive system and local crosses (61.7%) under intensive system at Batticaloa district, Srilanka. But in this study cross breeds was less prone to tick infestation than the indigenous cattle. Although the exact cause of higher prevalence of tick infestation in local cattle cannot be explained but this may due to most of the cross breeds are reared in intensive system where indigenous breeds are reared in extensive and semi-intensive system and farmer gives more attention takes more care to cross breed than indigenous cattle.

5.1.6 Health related prevalence of tick infestation in cattle

In this present study it was detected that malnourished cattle (51.85%) were more vulnerable/ prone to tick infestation than normal healthy cattle (33.90%) in statically 5% significant difference (P< 0.05). Malnourished cattle were 2.1 times susceptible to tick infestation than normal healthy cattle with normal body conditioned. The similar findings was reported by Haque (2014) in Barind Tract (53.9% in poor body conditioned and 29.0% in normal body conditioned) who reported poor body conditioned cattle are more vulnerable to tick infestation than normal body conditioned cattle. Tadesse *et al*. (2014) also recorded higher prevalence in animals with medium (44.5%) poor body condition (29.4%) than normal healthy animal. The present study also 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. It is hypothesized that, poor body conditioned animals may have been suffering from different gastrointestinal parasitic infections or any other diseases that weakens the cattle makes immune suppressive. Thus they are more prone to tick infestation.

5.1.7 Season related prevalence of tick infestation in cattle

The overall prevalence of tick was significantly (P<0.01) higher in rainy season (54.17%) followed by summer season (33.82%). In rainy, cattle were 2.31times more susceptible than summer season. It resembles with Salih *et al.* (2008) who 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%) and summer seasons (21.58%) as compared to the winter season (4.03%), Maluddin *et al.* (2004) revealed 60.00% cattle were pervaded Seasonal prevalence showed significantly (P<0.05) higher prevalence in rainy season (74.55%) followed by summer (67.80%).In contrast, Mondal *et al.* (2008) reported seasonal prevalence of ticks was highest in summer (97%) in comparison to rainy (95%) and winter (86%) season, Islam *et al.* (2006) revealed higher prenalence in summer (56.8%) followed by monsoon season (32.4%) and winter (8.5%), Nath *et al.* (2005) recorded higher prevalence occurred in summer season (80.74%), followed by winter (80.01%) and rainy season (60.73%). Islam *et al*. (2006) found that *B. microplus, R. sanguineus, H. bispinosa* infestation was higher during summer season in cattle in Bangladesh. Generally tick population remains

low during drought (Urquhart, 1996). Rainfall influences microclimate by affecting vegetation growth and soil moisture. High rainfall and relative humidity during summer season climate favorable for growth of ticks and their parasitic activity in livestock (Mooring *et al*., 1994). 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 humidity, lack of control group of population most importantly, the changed climatic condition of the earth.

5.1.8 Management system related prevalence of tick infestation in cattle

The present study implied that cattle brought up under extensive system, intensive and semi intensive system was affected with tick infestation as 65.38%, 47.37% and 34.21% respectively. Cattle reared in extensive system were 2.10 times more vulnerable tick infestation than cattle reared intensively and cattle reared in intensive system were 1.73 times more vulnerable to tick infestation than cattle reared semi-intensively and cattle reared in extensive system were 3.63 times more vulnerable tick infestation than cattle reared semi-intensively and it differs significantly ($P<0.01$). It is similar to the findings of Kabir *et al.* (2009) observed 36.31% cattle found tick infestation was more prevalent in field grazing (41.96%) cattle were more susceptible than the stall-feeding (24.8%) animals. Rony *et al.* (2001) who reported higher in animal reared under free range system than that of semi-intensive system. But contrasts with Rabbi (2006) who reported, the highest tick infestation in semi-intensive system (59.7%) followed by extensive system (33.5%) and intensive system (8.27%). Although exact cause is not known but it might be due to regular washing of barn animal, regular treatment with acaridae which may reduce the susceptibility of tick infestation in intensive animal whereas grazing cattle are move anywhere for grazing, so susceptibility of tick infestation is higher, Hussain and Kumar (1986).

5.1.9 Body affected part related prevalence of tick infestation in cattle

In this present study it was detected that the overall prevalence of tick were higher in ear region (35.71%) followed by neck (32.14.5), dewlap (29.29%), base of the horn (17.14%), eye (12.86%), udder and body surface (5.71%), perineum (4.29%) and tail (3.71%). This study has some similarities and dissimilarities with others work. Kabir *et al.* (2009) observed 36.31% cattle. Ticks were widely distributed in different parts of the host body of which groin (48.75%) was most affected parts of animal body face neck

(30%) was the least. Geeta *et al* (2013) find ticks in the most common feeding sites for adult ticks were neck, axilla, belly, groin, udder, perineal regions and tail. Atif *et al.* (2012) in his survey evaluate the Perineum, udder and external genitalia (98%) were the most tick infested sites in cattle followed by dewlap (92%), inner thighs (90%), neck and hamp; back (54%), tail (26%), ears (13%), around eyes (10%), flanks (4%) legs (2%) in the livestock progressive districts of Punjab including Sargodha, Khushab Rawalpindi. The exact cause of the variation in intensity at different body is not well known but this may be due to some area favors the growth, nutrition of the tick.

5.2 Intensity of tick infestation

In this present study, the range of tick burden was 1 to 9 per four square inch of heavily infested area. In case of *R. sanguinus, B. microplus, H. bispinosa* and mixed infection tick burden was 1-9, 1-6, 2-4 and 3-9. Mean tick burden was high in case of mixed infection (4.40±0.733) followed by *H. bispinosa (*4.00±1.155), *R. sanguinus* (3.83±0.317) and lowest in *B. microplus* (3.35±0.368). This result has dissimilarities with Bilkis *et al*. (2013) who found the range of parasitic burden 1 to 16 per four square inch of heavily infested area of affected cattle. Mean parasitic burden was high in case of *R. sanguineus* (4.56 ± 0.29), *B. microplus* (4.25±0.15) and *H. bispinosa* (2.85 ± 0.17). The mean intensity significantly differs from area to area. The mean intensity of tick infestation also in relation to age, sex, breed, health status, season, management system but there is no significance difference. These differences might be due to variation in the breed of animal studied and susceptibility of different body parts to the infestation.

CHAPTER 6

CONCLUSIONS

CHAPTER 6

CONCLUSIONS

Livestock are important in supporting the livelihoods of poor farmers, consumers, traders and laborers in developing countries like Bangladesh. The tropical climate of Dinajpur, poor and traditional husbandry methods provide suitable ecological conditions for rapid multiplication and dissemination of ticks. The prevalence of tick infestation in relation to age, sex, breed, body condition, season, management system and affected body parts were investigated and three tick species namely *Rhipicephalus sanguinus*, *Boophilus microplus* and *Haemaphysalis bispinosa* were identified. Significantly higher prevalence of tick infestation was recorded in female than in male and in malnourished cattle than cattle of normal healthy condition. The calf was more susceptible than the young adult. Prevalence was significantly higher in rainy season than summer. Ticks are considered to be the most important ectoparasites of animals on a global scale, primarily for their role as vectors of diseases of veterinary medicine importance for the reduction of the farmer's benefit. But our farmers are not so concern about these for that they do not take proper control strategies to avoid tick infestation in cattle. There is lack of work on prevalence of tick infestation as well as proper estimated data on direct indirect losses caused by tick infestation in this area. So further thorough extensive fruitful studies are essential on epidemiological prevalence of tick infestation with tick borne diseases, economic losses caused by them to promote effective strategic control approaches in tick infestation in cattle.

REFERENCES

REFERENCES

Abdullah I., Vatansever Z. and Karaer Z. (2007). Status of tick infestation of cattle in the Kayseri region of Turkey. Parasitology research; 101(2): 167-169.

Alessar N., Yamane I., Kobayashi S. and Zeniya Y. (2006). Cross-sectional survey of ixodid tick species on grazing cattle in Japan. Experimental Applied Acarology; 38(1): 67-74.

Ali L. M. (2015). Prevalence of ixodid ticks on cattle, sheep and goats in Ilam County, Ilam Province, Iran. Journal of Parasitic Diseases; 39 (1): 37–40.

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

Anonymous (2011). Pakistan Metrological Department, Lahore, Pakistan.

Atif F. A., Khan M. S., Iqbal H. J., Ali Z. and Ullah S. (2012). Prevalence of cattle tick infestation in three districts of the Punjab, Pakistan. Pakistan Journal of Science; 64(1):49-54.

Aydin L., Prelosov P., Bakirei S. and Senlik B. (2006). Ixodid ticks on cattle and sheep in South Eastern Bulgaria. Indian Veterinary Journal; 83(7): 802.

Bahadori S.R. (2003). Study of species diversity of animal ticks in Garmsar, University of Tehran. Journal of the Faculty of Veterinary Medicine; 58(1): 11-14.

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

BBS (Bangladesh Bureau of Statistics). (2015). 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 individual variation in resistance to ticks in Eastern Ethiopia. Journal of Veterinary Medicine; 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.

Bilkis M. D., Mondal M. M. H., Rony S., Islam M. A. and Begum N. (2013). Host determinant based prevalence of ticks lice in Cattle (*Bos Indicus*) at Bogra district of Bangladesh. Progressive Agriculture, 22(1-2): 65-73.

Biswas S. (2003). Role of veterinarian in the care and management during harvest of skin in livestock species. Proceedings of National Seminar Leather Industry in Today's perspective. Kolkata, India; 62-64.

Biu A. A. and Nwosu C. O. (1998). Seasonal prevalence of cattle ticks in Maiduguri, Borno State. Entomology in the Nigerian economy Research focus in the 21st century; 133-139.

Bowman P., Morel P. C., Aeschlimann A. (1996). Ticks of domestic animals in the Macedonia region of Greece. Veterinary Parasitology; 63: 25-40

Bwangamoi O., Mugera G. M. and Wera J. G. (1979). Diseases of cattle in tropical Africa.

Cable R. M. (1967). An Illustrated Laboratory Manual of Parasitology. 4th edition, Burgess Publishing Co. Minneapolis 15, Minnesota; pp. 111-132.

Clark D. D. (1995). Lower temperature limits for activity of several Ixodid ticks (Acari: Ixodidae): effects of body size rate of temperature change. Journal of Medical Entomology; 32: 449-52.

Colebrook E. and Wall R. (2004). Ectoparasites of livestock in Europe the Mediterranean region. Veterinary parasitology; 120(4): 251-274.

Das K. and Shrivastava S. K. 2002. Bovine tick, Boophilus microplus Canestrini, infestation in rural Chattisgarh. Journal of Applied Zoology Research; 13(2): 247-248.

Durrani A. Z., Shakoori A. R. and Kamal N. (2008). Bionomics of Hyalomma ticks in three districts of Punjab, Pakistan. Animal Poultry Science; 18: 121-124.

Estrada P. A. (2003). The relationships between habitat topology, critical scales of connectivity and tick abundance *Ixodes ricinus* in a heterogeneous lscape in northern Spain. Ecography; 26: 661-671.

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 L. P. (1999). The influence of nutrition on the periparturient rise in fecal egg counts in dairy goats. Revue de Medicine Veterinaire; 150: 975-980.

Gebreselama M., Fikre Z. and Gebremedhin R. (2014). Identification Prevalence of Ectoparasites in Cattle and Sheep in Around Bishoftu Town, Central Ethiopia. Animal Veterinary Sciences; 2(4): 124-129.

Geeta P., Shanker D., Jaiswal A. K., Sudan V., and Verma S. K. (2013). Prevalence of seasonal variation in ixodid ticks on cattle of Mathura district, Uttar Pradesh. Journal of Parasitic Diseases; 37(2): 173-176.

Mondal M. M. H., Rony S. A., Begum N., Islam M. A., and Affroze S. (2010). Epidemiology of ectoparasitic infestations in cattle at Bhawal Forest Area, Gazipur. Bangladesh Journal of Veterinary Medicine; 8(1): 27-33.

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

Kabir M. (2009). Tick and tick borne hemoparasitic diseases in crossbred cattle of selected farm in Chittagong city. Chittagong Veterinary and Animal Sciences University, Chittagong.

Gray J. S. (2008). Ixodes ricinus seasonal activity: implications of global warming indicated by revisiting tick and weather data. International Journal of Medical Microbiology; 298: 19-24.

Happy S. S., Sarker S., Hasan M. T., Jalaluddin A. B. M., Hossain M. M. and Islam M. R. (2016). Prevalence of Major Skin Diseases in Cattle at Sadar Upazila of Sylhet District. International Journal of Natural Sciences; 6(1): 21-26.

Haque (2014). Tick infestation in Indigenous Cattle (*Bos indicus*) in Barind Tract of Bangladesh. Bangladesh Veterinary Journal; 49: 1-4.

Harrow I. D., Gration K. A. F. and Evans N. (1991) .Neurobiology of arthropod parasites. Parasitologica; 102: 559–569.

Hossain M., Bhuiyan M. J. U. and Digonto M. T. H. (2016). Epidemiology of ecto-parasitic infestation of cattle in milk shed areas of Baghabari of Shahjadpur Upazila of Sirajgonj district, Bangladesh. The Journal of Advances in Parasitology; 3(2): 56-60.

Hourrigan J. L. (1979). Spread and detection of Psoroptic scabies of cattle in the United States, Journal of American Veterinary Association; 175: 1278-1280.

Hussain S. I., Kumar G. A. (1986). Observation on the topographical and environment conditions affecting the distribution of Boophilus microplus and its preference for herds in Sind. Experimental and Applied Acarology; 28: 225-228.

Subalini E., Thanujeah S. and Dasinaa S. (2001). Investigation on the prevalence of tick infestation in cattle at different farming systems in batticaloa district.

Islam M. K., Alim M. A., Tsuji N., and Mondal M. M. H. (2006). An investigation into the distribution, host-preference and population density of Ixodid ticks affecting domestic animals in Bangladesh. Tropical Animal Health Production; 38(6): 485-490.

Islam M. S., Rahman S. A., Sarker P. and Mondal M. M. H. (2009). Prevalence and population density of ectoparasitic infestation in cattle in Sirajgonj district, Bangladesh. Bangladesh Research Publications Journal; 2(1): 332- 339.

Itsuro Y. (2006). Cross-Sectional Survey of Ixodid Tick Species on Grazing Cattle in Japan. Experimental and Applied Acarology; 38(1): 67–74.

Jongejan F. and Uilenberg G. (2004). The global importance of ticks, Parasitology; 129: 3-14.

Kabir M. H. B., Mondal M. M. H., Eliyas M., Mannan M. A. and Elahi M. F. (2011). An epidemiological survey on investigation of tick infestation in cattle at Chittagong District, Bangladesh. African Journal of Microbiology Research; 5: 346-352.

Kakar M. N., Kakarsulemankhel J. K. (2008) Prevalence of endo (trematodes) and ectoparasites in cows and buffaloes of Quetta, Pakistan. Pakistan Veterinary Journal; 28: 34-36.

Kamal A. H. M., Uddin K. H., Islam M. M. and Mondal M. M. H. (1996). Prevalence of economically important ticks in cattle goat at Chittagong hilly areas of Bangladesh. Asian-Australasian Journal of Animal Sciences; 9: 5.

Kaushal K., Balakrishanan N., Rakesh K. and Gill K. S. (2002). Prevalence of Ixodid ticks in Nilgiri district of Tamil Nadu State (India). Indian Veterinary Journal; 21(4): 177-179.

Kettle P. R. (1974). The influence of cattle lice, *Damalinia bovis* and *Linognathus vituli* on weight gain in beef animals. The New Zealand Veterinary Journal; 22: 10–11.

Kirby A. D., Smith A. A., Benton T. G. and Hudson P. J. (2004). Rising burden of immature sheep ticks (*Ixodes ricinus*) on red grouse (*Lagopus lagopus scoticus*) chicks in the Scottish uplands. Medical Veterinary Entomology; 18: 67-70.

Kivaria F. M. (2006). Estimated direct economic costs associated with tick-borne diseases on cattle in Tanzania. Tropical Animal Health and Production; 38(4): 291–299.

Knopf L., Komoin O. C., Betschart B., Jongejan F., Gottstein B. And Zinsstag J. (2002). Seasonal epidemiology of ticks aspects of cowdriosis in N'Dama village cattle in the Central Guinea savannah of Coste d'Ivoire. Preventive Veterinary Medicine; 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.

Lawrence J. A., Norval R. A. I., Fivaz B. H. and Brown A. F. (1984). Epidemiology of tick-borne diseases of cattle in Zimbabwe, Tropical Animal Health and Production; 16: 63-70.

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

Livestock, Banglapedia (2015)

Lloyd D. H. (2004). Mites and ticks of domestic animals. An identification guide and information source. Veterinary Dermatology; 15(4): 266-266.

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. Turkish Journal of Parasitology; 30(3): 209-212.

Manan A., Khan Z. and Ahmed B. (2007). Prevalence identification of Ixodid tick genera in frontier region Peshawar. Journal of Agriculture Biological Science; 2: 19-61.

Mattioli R. C., Bah M., Faye J. and Kora S. (2003). A comparison of field tick infestation on N'Dama, Zebu and N'Dama×Zebu crossbred cattle. Veterinary Parasitology; 47: 139–148

Mbati P. A., Hlatshwayo M., Mtshali M. S., Mogaswane K. R. and Waal T. D. (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 Cenatral Ethiopia. Journal of Veterinary Research; 68 (4): 243-251

Mondal M. M. H., Rony S. A., Begum N., Islam M. A. and Affroze S. (2010). Epidemiology of ectoparasitic infestations in cattle at Bhawal Forest Area, Gazipur. Bangladesh Journal of Veterinary Medicine; 8(1): 27-33.

Mooring G., Haque M. M., Sarkar N. R., Rahman M. L. (1994). Seasonal incidence of Ixodid ticks grown in pasture of Bangladesh. Asian-Australasian Journal of Animal Sciences; 7:197-200.

Mostafa M. G. (1989). Methods of statistics. 4th edition, Karim Press Publications, Dhaka: 296-298.

Musa H. I., Jajere S. M. and Adamu N. B. (2014). Prevalence of tick infestation in different breeds of cattle in Maiduguri, Northeastern Nigeria. Bangladesh Journal of Veterinary Medicine; 12(2): 161-166

Nath, T. C., Nabila, I., Datta, R., Deb, L. C., Debnath, N., & Hossain, M. (2015). Ectoparasitic infestation of cattle in Brahmanpara Upazila of Comilla. Bangladesh. Journal of Biological and Chemical Research; 32(1): 215-221.

Nelson W. A. (1984). Effects of nutrition on animals on their ectoparasites. Journal of Medical Entomology; 21: 621–35.

Nigatu K. and Fetene T. (2012). Population dynamics of cattle ectoparasites in Western Amhara National Regional State, Ethiopia. Journal of Veterinary Medicine and Animal Health; 4(4): 22-26.

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

Norval R. A. I, Fivaz B. H., Lawrence J. A. and Brown A. F. (1984). Epidemiology of tick-borne diseases of cattle in Zimbabwe, Tropical Animal Health Production; 16: 63-70.

Omer L. T., Kadir M. A. A., Seitzer U., and Ahmed J. S. (2007). A survey of ticks (Acari: Ixodidae) on cattle, sheep goats in the Dohuk Governorate, Iraq. Parasitology Research; 101(2): 179-181.

Qader S.A. and Huq M.M. (1973). A survey on the prevalence of ticks of sheep and goats in Comilla kotwali police station, Bangladesh. MSc Thesis, Bangladesh Agricultural University, Mymensingh.

Rabbi A. K. M. A. (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. Parasitology research; 101(2): 175-177.

Rahman M. H. and Mondal M. M. H. (1983). Helminth parasites of cattle (*Bos indicus*) in Bangladesh. Indian Journal of Parasitology; 7(2): 173-174.

Rajput Z. I., Hu S. H., Chen W. J., Arijo A. G., and Xiao C. W. (2006). Importance of ticks their chemical immunological control in livestock. Journal of Zhejiang University-Science B; 7(11): 912-921.

Razmi G. R., Glinsharifodini M. and Sarvi S. (2007). Prevalence of ixodid ticks on cattle in Mazaran province, Iran. Korean Journal of Parasitology; 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(2): 54-60.

Rodríguez V. R. I. and Domínguez A. J. L. (1998). Grupos entomológicos de importancia veterinaria en Yucatán, México. Revista de Biomedicina; 9: 26-37.

Rony S. A., Mondal M. M. H., Begum N., Islam M. A. and Affroze S. (2001). Epidemiology of ectoparasitic infestations in cattle at Bhawal Forest Area, Gazipur. Bangladesh journal of veterinary medicine; 8(1): 27-33.

Roy A. K., Rahman M. H., Majumder S. and Sarker A. S. (2001). Ecology of ticks tick-borne blood protozoa in Madhupur Forest Area, Tangail. Bangladesh Veterinary Journal; 17: 90-97.

Sajid M. S., Iqbal Z., Khan M. N., Muhammad G. and Khan M. K. (2009). Prevalence associated risk factors for bovine tick infestation in two districts of lower Punjab, Pakistan. Preventive veterinary medicine; 92(4): 386-391.

Sajid M. S., Iqbal Z., Khan M. N., Muhammad G. and Iqbal M. U. (2007). Effect of Hyalomma ticks (Acari: Ixodidae) on milk production of dairy buffaloes (*Bos bubalus bubalis*) of Punjab Pakistan. Italian Journal Animal Science; 6: 939–941.

Salih D. A., Julia I. I., Hassan S. M., El-Hussain A. M. and Jongejan (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 M. A. (2000). An overview of livestock research reports published during the twentieth century in Bangladesh. Bangladesh Veterinary Journal; 34: 53 -149.

Sangwan A. K., Chhabra M. B. and Chaudbri S. S. (1995). Status report on ticks and mites affecting domestic livestock in Haryana. Agriculture Revenue Karnal; 16: 117-127.

Sanjay K., Prasad K. D. and Deb A. R. (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. Journal of Research; 16(1): 159-163.

Sanyal A. K. (2005). First record of ixodid tick (Acarina: Metastigmata) from Maheshkhali Island, Chittagong, Bangladesh. Zoological Survey of India; 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 J. J. (1982). Case Control Studies. Oxford University Press, New York, pp: 174-177.

Schulze T. L., Jordan R. A. and Dolan M. C. (2011). Experimental use of two standard tick collection methods to evaluate the relative effectiveness of several plant-derived and synthetic repellents against *Ixodes scapularis* and *Amblyomma americanum* (Acari: Ixodidae). Journal of Economic Entomology; 104(6): 2062-2067.

Simeon H. O., Tesfaheywet Z. and J. Shiferaw T. Z. (2013). Prevalence of ectoparasite infestations of cattle in Bench Maji zone, southwest Ethiopia. Advance Parasitology; 3(2): 56-60.

Singh N. K., Shitanshu S. R. and Guru A. D. (2008). To determine the epidemiology of ixodid ticks in bovines of different agro-climatic zones of Punjab state, India. Asian Pacific Journal of Tropical Medicine; 6(12): 947-951.

Soulsby E. J. I. (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 C. L., Kumar R. R. 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.

Subalini E., Thanujeah S. and Dasinaa S. (2015). Investigation on the prevalance of tick infestation in cattle at different farming systems in batticaloa district. 12nd International Conference on Agriculture Forestry; 2015.

Swai E. S., Mbise A. N., Kessy V., Kaaya E. and Sanka P. (2005). Farm constraints, cattle disease perception tick management practices in pastoral Maasai community-Ngorongoro, Tanzania. Livestock Research of Rural Development; 17(2): 17-20.

Tadesse B. and Sultan A. (2014). Prevalence distribution of tick infestation on cattle at Fitche Selale, North Shewa, Ethiopia. Livestock Research of Rural Development; 26(8).

Taylor C. (2007). A secular age. Harvard University Press.

Tiki B. and Mekonnen Ad. (2011). Distribution of Ixodid Ticks on Cattle in and around Holeta Town, Ethiopia, Belew. Global Veterinaria; 7(6): 527-531.

Tomassone L., Camicas J. L., Pagani P., Diallo O. T., Mannelli A. and Meneghi D. (2004). Monthly dynamics of ticks (Acari: Ixodida) infesting N'Dama cattle in the Republic of Guinea. Experimental and Applied Acarology; 32(3): 209-218.

Torina A., Khoury C., Caracappa S. and Maroli M. (2006). Ticks infesting livestock on farms in Western Sicily, Italy. Experimental Applied Acarology; 38(1): 75-86.

Torina A. (2016). Epidemiological Aspects of Bovine Tick Infestation in the River Ravi Region, Lahore. Pakistan Journal of Zoology; 48(2): 563-567,

Urquhart G. M. (1996). Veterinary Parasitology.Second edition. Backwell Science Ltd.

Vandyk J. K, Bartholomew D. M., Rowley W. A. and Platt K. B. (1996). Survival of Ixodes scapularis (Acari: Ixodidae) exposed to cold. Journal of Medical Entomology; 33: 6-10.

Wall R. and Shearer D. (1997). Veterinary Entomology, 1st edition, Chapman Hall. London, UK. pp. 265-290.

Wilson A. J., Rogers D. J., Hay S. I. and Graham A.J. (2006).The global distribution of yellow fever and dengue. Advances in Parasitology; 62: 181-220.

Yakhchali M. and Hasanzadehzarza H. S. (2004). Study on some ecological aspects prevalence of different species of hard ticks (Acarina: Ixodidae) on cattle, buffalo and sheep in Oshnavieh suburb. Pajouhesh-va-Sazegi in Animal 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. Turkish Journal of Veterinary and Animal - Academic Journals; 26(6): 1263-1270.

APPENDIX

APPENDIX

QUESTIONNAIRE

Serial No. ☐

1. **Particulars of the owner**

i. Name …….. ii. Village:……...……

iii. Upazila …… iv. District……

2. **Particulars of cattle**

I. Breed:

Indigenous ☐ Cross breed ☐

II. Sex:

Male ☐ Female ☐

III. Age:

Below 6 months ☐ 6 months - 2 years ☐ Over 2 years ☐

3. **Season**

Summer ☐ Rainy ☐

4. **Management practices**

Extensive ☐ Intensive ☐ Semi-intensive ☐

5. **Health status of host**

Malnourished ☐ Healthy ☐

6. **Affected body parts of the host:** ☐

…….....

Date : Signature of Investigator

Note: If necessary Bengali version of the questionnaire will be used while interviewing beneficiaries.