**CHAPTER I**

**INTRODUCTION**

The arthropod ectoparasites have a variety of direct and indirect effects on the goat production (Elsaid *et al.,* 2013; Wall and Shearer, 2001). Tick, mite, lice and ked are common and important parasites because of their disease transmission, blood feeding habit and skin damage in most of the live stock population (CSA, 2004). They are considered as annoying pests because of their movement over the skin (Sarkar *et al.,* 2010). Ectoparasites of small ruminants cause blood loss and very heavy infestations may result with severe anemia. Ectoparasites play an important role not only as pests but also as vectors of various diseases of humans, pets and wild animals. They are able to transmit different pathogens of medical and/or veterinary relevance like viruses, bacteria, protozoa, and helminthes (Ahmed *et al.,* 2007). Moreover, they are the most important vectors of protozoan, bacterial, viral and rickettsial diseases (Radostits *et al.,* 2007).

Ectoparasites of small ruminants cause mortality, decreased production and reproduction of small ruminants and also they cause serious skin defects that end up with down grading of quality and rejection of skin (Bayu, 2005; Sertse and Wossene, 2007a; Yebegashet *et al*., 2010). In addition, parasitic mites, lice and keds are considered as a potential threats and pose a serious economic problem to the development of sheep and goats production and the tanning industry in the country and need control intervention (Sertse and Wossene, 2007b; Yebegashet *et al*., 2010). As a result, feeding and digestion is hampered that may lead to retarded growth, loss of weight and reduced milk and meat production. The infested goats bite and rub the affected area leading to skin abrasion. Finally, myiasis and other secondary infections may occur which might lead to death of the animals (Soulsby, 1982).

Six species of ectoparasites were identified by Sarkar *et al* (2010) in Mymensingh and Gaibandha districts of Bangladesh, of which four species were arachnids, namely *Heamaphysalis bispinosa,* *Boophilus* *microplus*, *Rhipicephalus sanguineus*, and *Psoroptes cuniculi* and two species belonged to the class Insecta namely *Damalinia caprae* and *Linognathus stenopsis*.

Limited number of tick species infesting humans, cattle, dogs, goats, wild mammals, birds, and lizards have been identified by Rahman and Mondal (1985) and Ghosh *et al* (2007) in Bangladesh, namely *Boophilus micriplus, Haemaphysalis bispinosa, Hyalomma truncatum, Hyalomma canestrini, Hyalomma anatolicum, Amblyomma gervaisi, Haemaphysalis kinneari, Rhipicephalus sanguineus, Rhipicephalus evertsi evertsi, Amblyomma testudinarium, Amblyomma variegatum,* and *Argas persicus*. In India and other South Asian countries, more than 100 different tick species are known, and it is expected that more detailed investigations in Bangladesh will reveal a similar diversity (Ghosh *et al.,* 2007; Shemshad *et al.,* 2012).

The knowledge about the tick fauna in Bangladesh is particularly limited especially from clinical point of view. Only four hard tick species (*B. microplus, H. bispinosa, R. sanguineus,* and *A testudinarium*) have been documented from the Chittagong Hill Tracts in the remote southeastern Bangladesh (Islam *et al.,* 2006; Kabir *et al.,* 2011; Kamal *et al.,* 1996).

Therefore, the present study was aimed to determine the distribution of the common ectoparasites of goat with risk factors and to identify some species.

**CHAPTER II**

**REVIEW OF LITERATURE**

**2. 1. General study**

**2.1.1 Definition**

An ectoparastie is an organism or parasite that lives on the outer surface of its host and which does not contribute to the survival of the host. Ectoparasites are totally dependent on the host for sustenance, a fact that can seriously weaken the general health of the host over time (Smyth, 1994).

**2.1.2 Classification of (Veterinary important) Ectoparasites**

Phylum:

Class:

Order:

**2.1.3 Common ectoparasites**

**Flea:** Fleas are the insects forming the order Siphonaptera. They are dark brown, wingless with laterally compressed bodies which have glossy surface and mouthparts adapted for piercing skin and sucking blood. Fleas are living by hematophagy off the blood of mammals and birds. E.g. *Ctenocephalides canis* (dog flea), *C felis* (cat flea), *Pulex irritants* (human flea), *Xenopsylla cheopis* (rat flea) etc*. X. cheopis* has zoonotic significance (Loftis *et al.,* 2006).

**Lice:** Lice are the members of over 3,000 species of wingless insects of the order Phthiraptera. Like all the other insects lice have a head, a thorax which bears 3 pair of legs, an abdomen and flattened in appearance. They are highly host specific, permanent ectoparastie; cannot survive away from the host for more than one or two days. Goats can be host to two different kinds of lice.

Heavy louse infestations may cause pruritus, alopecia, excoriation and self-wounding. Severe infestation with sucking lice may cause anaemia. Lice can be divided into blood sucking (Anoplura) and biting (Mallophaga) lice (Radostits *et al.,* 2003).

* **Biting Lice**: They belong to an order called Mallophaga which contains over 3000 known species. *Damalinia caprae* is the species that parasitize goats. The heads of biting lice are large. They have mouth parts that are adapted to chewing structures that are part of their diet such as hair, feathers, skin debris, scabs, wool wax, and even their own eggs.
* **Sucking Lice:** Sucking lice belong to an order of insects called Anoplura. There are about 300 species and they are known to only parasitize mammals. *Linognathus stenopsis* is the species that are found on goats. The sucking lice have narrow heads with piercing mouth parts that are retracted into the head when not being used to suck blood and tissue fluid from the host. Unlike biting lice, a few species of sucking lice are known to transmit diseases.

**Tick:** Ticks are small arachnids in the order of Acarina along with mite (Klompen *et al.,* 1996). These ectoparasites are living by hematophagy on the blood of mammals, birds, and sometimes reptiles and amphibians. Ticks are vectors of a number of diseases, including Lyme disease, Q fever (Barker and Murrell, 2004), Colorado tick fever, Rocky Mountain spotted fever, African tick bite fever, tularemia, tick-borne relapsing fever, babesiosis, ehrlichiosis, Tick paralysis, and tick-borne meningoencephalitis, as well as bovine anaplasmosis (Drummond, 1983; Bram, 1983). A list of single and multiple host ticks is shown in Table 1 (Radostits *et al.,* 2003).

**Table-1: Different species of ticks.**

|  |  |
| --- | --- |
| One-host ticks | *Boophilus* spp. and *Otobius megnini* |
| Two-host ticks | *Rhipicephalus evertsi* and *Rhipicephalus bursa* |
| Three-host ticks | *Ixodes* spp., *Rhipicephalus* spp. (except *R. evertsi* and *R. bursa*) *Haemaphysalis* spp., *Amblyomma* spp., *Hyalomma* spp., *Ornithodorus* spp. and *Dermacentor* spp. |

**Mite:**

Mites are small (<0.3mm long) microscopic arachnids of the order Acarina, that often infest animals, plants, and stored foods and include important disease vectors. They cause dermatitis in all species. The mites cause intense itching and discomfort which is associated with decreased feed intake and production. Scratching and rubbing caused by mites result in extensive damage to hides and fleece (Gabaj *et al.,* 1992).

**Table-2: Important types of mange and the affected animal species** (Radostits *et al.,* 2003)**:**

|  |  |  |
| --- | --- | --- |
| **Mange** | **Etiology** | **Animals affected** |
| Sarcoptic mange | *Sarcoptes scabiei* | All species |
| Psoroptes mange | *Psoroptes* *ovis* | Sheep, Cattle and Horses |
| Chorioptic mange | *Chorioptes bovis* | Cattle, Horses, Goats and Sheep |
| Demodectic mange | *Demodex* *bovis, D.*  *ovis, D. caprae,* *D. equi and D. Phylloides* | Cattle, Sheep, Goats, Horses, and Pigs |

**2.1.4 Life cycle of common ectoparasites**

During the development of insect, young undergoes variable degree of changes in size, forms and structure. This series of changes is termed as metamorphosis. When the egg hatches the emerging insects normally follows one of two life cycles:

1. Simple metamorphosis: The immature insects and the adults are similar in appearance, and differ mostly in size but sexually undeveloped.

 Egg Nymphs Adult (e.g. Lice)

1. Complex metamorphosis: The immature insects and the adults have different forms, often live in different habitats, and may have very different behavior.

Egg Larva Pupa/Nymphs Adult (e.g. Fly, flea, tick and mite)

**2.1.5 Pathological conditions caused by ectoparasites**

Many ectoparasites are known to be vectors of pathogens, which the parasites typically transmit to hosts while feeding or occasionally defaecating. However, ectoparasites especially in large aggregations may also debilitate domestic animals in other ways, by causing the following disorders (Steelman, 1976):

* Entomophobia
* Blood loss, Detrimental immune reactions
* Irritability, Dermatitis, Skin necrosis
* Focal haemorrhages
* Low weight gains etc
* Secondary infection,
* Blockage of orifices (ears, etc.)
* Inoculation of toxins

**2.1.6 Prevention and control**

A number of different control methods are available to prevent and/or treat ectoparasites. These control methods can be broadly split into chemical (Ectoparasiticides) or cultural. Following chemical methods are commonly used in controlling the ectoparasites of the livestock.

* Organophosphorus compounds (OP) e.g. Diazinon
* Synthetic Pyrethroids (SP) e.g. Cypermethrin
* Amidines e.g. Amitraz and Macrocyclic Lactones e.g. Ivermectin and Doramectin

**2.1.7 Treatment**

Ivermectin is probably one of the most widely used antiparasitic drugs worldwide, and its efficacy is well established. Ivermectin was first marketed in 1981 by Merck Sharp and Dohme as an antiparasitic agent (Steel, 1993), and it remains the leading worldwide antiparasitic agent for livestock. It has exceptional potency against endo and ectoparasites (endectocide) at extremely low doses @ 200 µg/kg body wt. SC (Canga *et al.,* 2009), this account for its large margin of safety. It is neurotoxic to parasites by potentiating glutamate-gated chloride ion channels in parasites. Paralysis and death of the parasite is caused by increased permeability to chloride ions and hyperpolarization of nerve cells. It also potentiates other chloride channels, including ones gated by GABA.

Ivermectin is highly effective against many arthropod parasites of domestic animals such as ticks, biting flies, and parasitic dipteran larvae (Campbell and Benz, 1984; Campbell, 1989; McKellar and Benchaoui, 1996).

**2. 2. Review study:**

The factual cases of Ectoparasitic infestation in different goats and small ruminants were demonstrated by various researchers. Some of them which are mentioned below:

Amare *et al.,* (2014) find out that the prevalence of major ectoparasites of sheep and goats are associated with risk factors. Out of the 1230 clinically examined animals sheep (n=738) and goats (n=492), 331(44.9%) sheep and 214 (43.5%) goats were infested with one or more ectoparasites. Ectoparasites identified in sheep were *Damalinia ovis* (30.9%), *Mellophagus ovinus* (10.8%), ticks (3.9%), *Linognathus* species (3.1%) and flea (1.1%). Among goats, *Linognathus* species, ticks, flea and demodectic mange were identified with respective prevalence of 27%, 17.7%, 2.6% and 2.2%. Age and wool length of sheep were important predictors for the presences of *Mellophagus ovinus* on highland sheep. The prevalence of *Mellophagus* *ovinus* was significantly higher in young and long wool sheep than in adult and short wool sheep (P < 0.05). The observed overall prevalence is generally high which may result in enormous economic losses through decreased production and productivity, damages to the skin and deaths of the animal which requires an immediate attention and professional intervention.

Elsaid *et al.,* (2013) argue that goats are more susceptible to ectoparasitic infestations than sheep. Out of 1600 sheep and 520 goats, 322 (20.1%) of sheep and 182 (35%) of goats were infested by one or more ectoparasites. The high prevalence of sheep infested by ticks was (40.9%) during the summer season in Celline area, while in mites was (10.9%) during the summer season in Gahawat. While in goats was (9.3%) in Celline during the winter and spring season. Ticks were the most frequent ectoparasites on sheep (18.7%), while fleas were the highest prevalence ectoparasetes on goats (17.9%). The identification showed two different species of tick (*Hyalomma* *anatolicum anatolicum and Rhipicephalus turanicus),* one species of mites (*Sarcoptes scabiei*), one species of lice (*Linognathus africanus*) and two species of fleas (*Pulex irritans and Cctenocephalides canis*). The relationships among these ectoparasites are discussed in terms of flock size, seasonality and the ectoparasitic combinations on the host.

Shibeshi *et al.,* (2013) argue that the total examined of 228 sheep and 155 goats, 140 (61.40%) sheep and 90 (57.69%) goats were infested with various types of ectoparasites. The ectoparasites identified in both species of animals were ticks (24.74%), mange mites (15.36%), fleas (11.45%), lice (6.51%) and sheep ked (1.82%). Ticks were the most abundant ectoparasites recorded both in sheep and goats with a prevalence of 25.44%% and 23.72%, respectively. The genera of ticks observed in both sheep and goats were Amblyomma spp. Rhipicephalus spp. and Boophilus spp. in a decreasing order of prevalence. An overall prevalence of 15.87% mange mites was observed in both sheep and goats with 13.16% and 18.59%, respectively. The identified species of mange mites found in both species of animals were Sarcoptes scabei, Psoroptes spp. and Demodex spp. in a decreasing order of prevalence. Sheep were found to be infested with two species of lice (Linognathus spp. and Damalinia ovis) while goats only with Linognathus spp. The fleas, Ctenocephalides spp., were detected in both sheep (12.28%) and goats (10.25%).

Rabbi *et al.,* (2013) conduct a study on parasitism in goats in relation to different feeding systems, 1110 goats from different areas of Jaypurhat, Tangail, Netrakona and Mymensingh districts were examined. Along with endoparasites , five species of ectoparasites were found: two species were lice such as *Damilinia caprae* (13.9 %) and *Linognathus vitulli* (4.2%), and two species were ticks namely, *Haemophysalis bispinosa* (21.2%), *Rhipicaphalus (Boophilus) microplus* (3.6%) and one species was mite, namely, *Demodex* sp. (2.9%). Ectoparasitic infestation was the highest in semi-intensive system (59.7%) followed by extensive system (33.5%) and intensive system (8.2%).

Zangana *et al.,* (2013) state that in Duhok province North West region of Iraq, the prevalence of ectoparasitic infestation in goat is 753 (78.9%) out of 954. Five different types of ectoparasites, ticks (34.9%), lice (33.8%), mites (0.1%), fleas (7.75%) and ked (4.5%) were identified. Five species of hard ticks (Ixodidae) were identified in goats, namely *Hyalomma anatolicum anatolicun* (13.5%), *H. marginatum* (8.1%), *Rhipicephalus sanguineous* (39.93%), *R. turanicus* (49.54%) and *Haemaphysalis ssp*. (0.9%). Two species of lice were infested *D. caprae* (80.74%) and *L.stenopsis* (19.2%) on goats. Mite infestation was (0.1%) and infested with *S. scabiei*. Three species of fleas were found infested both sheep and goats. Out of 106 collected fleas (47.2%, 43.4%, and 9.4%) were *Ctenocephalides felis felis, Pulex irritans* and *Xenopsylla cheopis*, respectively. However, the only one species of Ked *Melophagus ovinus* were infested (4.5%) of goats.

Fentahun *et al.,* (2012) conducted a study from October, 2011 to March, 2012 in and around Gondar town to determine the prevalence and to identify ecto-parasites on small ruminants. A total of 384 small ruminants; sheep (n=273) and goats (n=111) were included in the study. The overall ectoparasite prevalence showed that 301 (78.38%) small ruminants were infested by single or mixed ectoparasites. The most common ectoparasites encountered in order of their predominance were lice (54.6%), flea (35.7), tick (20%), sheep ked (10.6%) and mite (7%). The infestation rate of ectoparasites was not statistically different between sex, body condition and age in the whole population of small ruminants. Nevertheless, the analysis showed as if there was statistically significant difference (P<0.05%) in the prevalence of tick with age of small ruminants while it was relatively higher in adult (28.3%) than young (20.4%).

Ibe *et al.,* (2012) performed a study for ascertaining the prevalence and geometric mean intensities of ectoparasites of Middle Belt goats sold at Nassarawa Market in Calabar, and comparing these with those of indigenous goats from Cross River State in Nigeria. Of 714 goats examined (338 from CRS, and 376 from MB), infestation prevalence of 77.9% (66.3% for CRS goats, and 88.0% for MB goats) was recorded. The overall GMI was 19 (9 for CRS goats; 23 for MB goats). GMI of infestation was significantly higher in the MB goats in all groups (t-test; p< 0.05). Ectoparasites observed were categorized into four major groups, namely, mites, lice, ticks and fleas. The ectoparasites species observed were, *Rhipicephalus evertsi, Amblyomma variegatum, Psoroptes communis, Lignognathus sp, Bovicola sp* and *Ctenocephalidis* felis. Multiple infestations were high in both groups (67.5% for CRS goats, and 80% for MB goats).

Radfar and Hajmohammadi (2012) conducted a study on 1964 goats from May 2007 to April 2008 in South-eastern part of Iran. Of that 1964 goats, 289 (14.71%) were infected with *Przhevalskiana silenus* larvae. The infection was observed from July 2007 to February 2008 and the prevalence rate varied from 6.8% in August to 41.8% in February. From infected goats, 151 and 138 were female and male respectively. The difference in the prevalence of the infection between males and females was not significant (*P*>0.05). The percentage of larvae in subcutaneous tissue of back and flanks was (71.25%) and (28.75%) respectively and this difference was significant (*P*<0.05).

Abebe *et al.,* (2011) in a study observed that, a total of examined 991 small ruminants (600 sheep and 391 goats) for presence of ectoparasites, among them 310 (51.7 %) sheep and 233 (59.6%) goats were found infested with one or more ectoparasites. The overall prevalence for both host species was 54.8% (n=543). The major identified ectoparasites in sheep were ticks (48%), sheep ked (6.7%) and lice (1.3%) and in goats were ticks (58.8%), lice (6.1%) and fleas (3.1%). Among the risk factors, agro-climatic zone, body condition score, flock size and flock type were found to be significantly associated with the prevalence of ectoparasites in the study area. The prevalence of ectoparasites infestation was significantly higher in small ruminants of the lowland and midland, small ruminants with poor body condition score, large flocks and mixed flocks than in their contemporaries within the same comparison category (*P* < 0.001).

Tadesse *et al.,* (2011) in a study argue that, ectoparasitic infestation causes the damages of live cattle, sheep and goat skins to assess their skin defect on processed wet-blue (pickled) skins at Kombolcha tannery. A total of 240 cattle, 175 sheep, 66 goats, were used to study the prevalence of ectoprasites on live animals as well as 344 fresh goat pelts and pickled (wet-blue) goat skins were used to assess skin defects. The result from goats demonstrates a high prevalence of *Sarcoptes* *scabiei* (30.3%) followed by *Linognathus stenopsis* (9.09%), *Amblyomma* (4.54%), *Ctenocephalides* spp (3.03%), *Bovicola caprea* (1.51%) and *Demodex* (1.51%) in that order. Result obtained from fresh goats pelts revealed an overall high prevalence of *Sacoptes scabie* (53.29%) followed by *Linognathus stenopsis* (9.88%), *Bovicola* *caprae* (2.08%) and *Demodex* (2.08%). Examination of pickled (wet-blue) skins from follow-up skins show a high prevalence of scratch (74.25%) followed by “Ekek” (Typical scatter type cockle) (68.56%), scar (67.06%), processing defect (28.44%).

Sarkar *et al.,* (2010) reported that in Black Bengal goats, 91 (72.8%) out of 125 were infested with one or more species of ectoparasites. Six species of ectoparasites were identified, of which four species were arachnids, namely *Heamaphysalis bispinosa* (34.4%), *Boophilus* *microplus* (27.2%), *Rhipicephalus sanguineus* (7.2%), and *Psoroptes cuniculi* (5.6%) and two species belonged to the class Insecta namely *Damalinia caprae* (20.8%) and *Linognathus stenopsis* (18.4%). Overall mean parasitic burden was 2.36±1.49 per square inch of affected area. The highest parasitic burden was recorded in case of *L. stenopsis* (3.93±2.219), followed by *D. caprae* (3.00±2.424), *H. bispinosa* (2.32±1.278), *P. cuniculi* (2.00±1.414), *B. microplus* (1.59±1.098), and *R. sanguinus* (1.33±0.516). Significantly (p<0.01) higher prevalence of ectoparasites was recorded in the rainy season (90%), followed by winter (82.61%), and summer (53.06%). The ectoparasitic infestation was higher in case of kids (82%) and older goats (79.55%) than that of young (51.61%) goats. The female goats (77.63%) were more susceptible than male (65.31%) to ectoparasitic infestation. The prevalence of ectoparasites was higher in Mymensingh (87.5%) than that of Gaibandha region (57.38%). Pathological lesions produced by ectoparasites were also studied in this study. In *P. cuniculi* infestation, alopecia, rough, dry and leathery skin was found. Microscopically, it was characterized by hyperkeratinization, ulceration, acanthosis and eosinophilic infiltration. In tick infestation, rough, reddened skin and loss of hair were observed. In lice infestation, the skin was red and slightly elevated. The ectoparasites produced pathological lesions on the skin which reduces the value and quality of skin.

Rony *et al.,* (2010) in a study comments that, among 165 Black Bengal goats 114 (69.09%) were found to be infested with several species of ticks, lice and flea. The prevalence rate was highest in *Boophilus* *microplus* (45.45%) followed by *Rhipicephalus sanguineus* (31.51%), *Linognathus vituli* (25.45%), *Heamaphysalis* *bispinosa* (20%), *Haematopinus eurysternus* (15.75%), *Damalinia caprae* (8.48%) and *Ctenocephalides canis* (4.84%). Young goats aged **≤** 6 months (75.86%) were more susceptible than adults aged > 6-24 months (65.51%) and older goats > 24 months (59.32%). In female, prevalence was recorded significantly (p < 0.05) higher than male. Animal with poor health was found to be significantly more vulnerable to such parasitic infestation than normal healthy animals. Prevalence of ectoparasites was significantly (p<0.05) higher in animals, reared under free-range system than that of semi-intensive system. Prevalence was highest (p<0.05) in the summer (81.35%) followed by winter (62.96%) and rainy season (59.26%).

Abunna *et al*., (2009) determine that the prevalence of tick infestation in sheep and goats of Miesso District, West Harergie Zone in Ethiopia is 89.9% and 87.5%, respectively. They identified ten species of ticks which grouped under four genera in their study. The most abundant species found in this study were *Boophilus decoloratus* (60%), *Rhipicephalus pulchellus* (25.1%), and *Amblyomma gemma* (11%). *Hyalomma dromedarii* was the minor species observed on goats.

Yacob *et al.,* (2008) argue that, the overall ectoparasite prevalence in goat was 28.43% (29 infested goats out of 102) in Southern Ethiopia. The main ectoparasites identified in this geographic area were ticks (*Rhipicephalus, Boophilus* and *Amblyomma*) and fleas (*Ctenocephales felis* and *canis* at a lesser extend). The tick infestation was significantly more frequently observed in goats (18.63%) and only one case of mange (*Demodex caprae*) was diagnosed in a Goat.

Vathsala *et al.,* (2008) in a study state that, *Hyalomma anatolicum anatolicum*, *Hyalomma marginatum isaaci*, *Rhipicephalus haemophysaloides* and *Haemophysalis bispinosa* were the most abundant ticks found at Tamil Nadu in India. The *H. a. anatolicum* was found in more numbers in the proximal portions of the ears, eyelids, lips, where as the adults were mostly found in the inguinal regions. *H. m. isaaci* was found in more numbers in the perianal region and the tip of the tail and were present during two seasons, one from February to March and another from June to November. Low temperature and humidity favored the attachment of this species onto their hosts. All stages of *Haemophysalis* spp. were found only in the ears of both sheep and the goats. The adults of *H. bispinosa* were found during winter, i.e. October to November, while their nymphs and larvae were found during the early summer, i.e. March to May. The distribution of tick parasites of grazing sheep and goats in the region of Tamil Nadu were 64.66% in sheep and 97.66% in goats.

Sertse *et al*., (2007) comments that, the different ectoparasites and different levels of infestation are responsible for defect the sheep and goats skin quality by producing the pickled or wet blue stage of processing in tanneries in Ethiopia. Pickled goat skins affected by Sarcoptic mange and *Linognathus* spp. were 100 and 0% positive for ‘ekek’ (cockle) lesion, respectively. There was a strong association (*p* < 0.05) between ‘ekek’ and infestation with sarcoptic mange in goats. Follow-up of randomly selected 1000 pickled sheep skins and 1000 wet blue goat skins revealed that 71% of pickled sheep and 42% of wet blue goat skins had ‘ekek’ lesions. As the proportion of ‘ekek’ increased, the quality of graded skins decreased both in sheep and goats. The annual economic losses in 2002/2003 due to ‘ekek’ at the two tanneries was estimated to be 1.6 million USD for pickled sheep and 0.6 million USD for wet blue goat skins.

Yakhchali & Hosseine (2006) observes that in an investigation into ectoparasites of sheep & goats in the northwest region of Iran, the prevalence of ectoparasites (ticks, mites, lice, and fleas) was 9.9% in goats, with an overall prevalence of 8.2%. All goats were infested with two species, including *R.* *bursa* (88.8%) and *R. sanguineus* (11.4%). An Ixodid tick distribution per goat was 4.3 and 71.4% goats were infested with three species of lice. These were *Damalina* *caprae* (71.4%), *Haematopinus species* (62.2%) and *Linognathus* *stenopsis*. However, the only one species of flea *Ctenocephalides felis felis* were infested (16.8%) of goats.

**CHAPTER III**

**MATERIALS AND METHODS**

**3.1 Profiles of the study areas**

The study was conducted in two geographically different southern districts of Bangladesh namely Comilla and Chittagong (Figure 1). Due to subtropical climate with almost all months above 180C and a dry period in the winter season, the regions provide suitable ecological conditions for the rapid multiplication and dissemination of arthropods. The animals examined under the study were mostly from two hospitals: Upazilla Veterinary Hospital **(**UVH**)**, Laksam, Comilla (Latitude 23°12'29.4"N and Longitude 91°9'30.6"E) and S.A. Quaderi Teaching Veterinary Hospital **(**SAQTVH**)**, Chittagong Veterinary and Animal Sciences University (CVASU), Chittagong (Latitude: 22.33°N and Longitude: 91.84° E).

**Figure 1: Map of Bangladesh showing the study areas (Comilla and Chittagong district).**

Comilla is a plane and low lying area where after monsoon; the soil contains moisture till autumn, which is a favorable condition for parasitic infestation. Conversely, Chittagong is hilly and costal area favoring the growth of tick, lice and flies.

**3.2 Study period and study population and survey design**

A total of five hundred thirty five (535) goats having age ranged from 7 days to 5 years were examined randomly for a period of four months staring from May’ 2013 to August’ 2013. Goat of different breeds such as Black Bengal, Jamunapari, Cross and Indigenous goats were examined under this study as target animals. At the same time data was collected from Chittagong Metropolitan Area (CMA) as well as from those goats which are brought in SAQ Teaching Veterinary Hospital, (CVASU) for treatment purposes.

**3.3 Questionnaire design and data collection**

A structured questionnaire was developed consisting close ended in majority having the basic questions with a view to extract information regarding management and preventive measures undertaken. Emphasis was given to the key consideration of different managemental sectors like owner’s address, animal ID, farm size, breed, age, sex, weight, body condition score, deworming history and some important clinical parameters (Onset, duration of illness, weakness, rectal temperature, secondary infection, general attitude etc). Important data were recorded by cross questioning to the animal owner, personal observation of patient and taking records from register books or case sheets.

**3.4 Examination of goats**

Following an extensive record of anamnesis, the goats were examined for the collection of ectoparasites and detection of clinical manifestations (dandruff, hypothricosis, alopecia, hyperkeratosis, abnormal pigmentation, desquamation and ulceration) relevant to ectoparasitic infestation, the selected goats were thoroughly investigated by close inspection, digital palpation and parting the hairs. The sites of infestation on the animal body also recorded.

**3.5 Collection and preservation of ectoparasites**

Ticks and lice were picked up manually by hand and tissue forceps from different parts of the body of the animals. A fine black comb was used when required for the collection of lice. To collect mites, skin scrapings samples from the affected areas were collected and examined under compound light microscope after adding 10% potassium hydroxide (10% KOH) (Hendrix and Robinson, 2006). Ticks and lice were preserved in 70% alcohol in clean, well-stopper plastic containers (Urqhart *et al*., 1996) for further gross and microscopic assessment. Temporary slides were prepared for species identification. Ectoparasites were identified according to the keys and descriptions given by Ferris (1951), Roberts (1952), Hoogstraal (1956) and Soulsby (1982).

**3.6 Identification of ectoparasites**

The adult ticks and lice used in the morphological study were examined by naked eye and with the help of compound light microscope (4X) and (10X) and each morphological character was measured and recorded. For microscopic examination tick and lice were digested by 10% KOH for 20 min (Bowman, 1999). The samples were processed in Parasitology Laboratory, CVASU.

**3.7 Statistical analysis**

Data found in this study was first stored in Microsoft excel (Microsoft Corporation). These data was then sort, cleaned and coded in Microsoft excel. Data was then exported to STATA 11.0 version (STATA Corporation, College Station, Texus, USA) for Windows (2007) using chi-square (χ2) test. Proportions and the Pearson’s chi-square test (χ2) were used to analyze the data collected and differences were considered as significant when *p*≤0.05. The variables mentioned in this study were quantitative and qualitative.

**CHAPTER- 4**

**RESULTS AND DISCUSSION**

**4.1 RESULTS**

**4.1.1 Overall prevalence of ectoparasites in goats**

A total 535 goats were examined (155 from Comilla, and 380 from Chittagong) and it was revealed that both Comilla and Chittagong 137 (25.61%) goats were infested with one or more species of ectoparasites. At Comilla and Chittagong the prevalence rates were lice (22.58, 3.16%), tick (8.39, 3.43%), flies (3.79, 7.89%), mite (1.95, 3.17%), flea (0, 0.79%) and multiple infections (12.31, 4.71%) respectively. Three different genuses of tick (*Haemophysalis, Rhipicephalus and Boophilus),* two species of lice(*Linognathus stenopsis and Damalina caprae*) and one species of flea (*Cctenocephalides canis*) were identified. Throughout the study period no mite was identified. Mange (mite infestation) was diagnosed tentatively based on anamesis and clinical signs. The main attachment sites of lice were neck, back, belly, tail, thigh and face while that of ticks were ear, head, face and neck.

**Table 3: Prevalence of ectoparasites of goats from Comilla and Chittagong**

|  |  |  |  |
| --- | --- | --- | --- |
| Common Ectoparasites | Comilla Goats (n=155) | Chittagong Goats (n=380) | Total (n=535) |
| Lice | 35 (22.58%) | 12 (3.16%) | 47 (8.79%) |
| Ticks | 13 (8.39%) | 13 (3.43 %) | 26 (4.85%) |
| Fly | 6 (3.79%) | 30 (7.89%) | 36 (6.72%) |
| Mites | 3 (1.95%) | 12 (3.17%) | 15 (2.80%) |
| Fleas | 0 (0.00%) | 2 (0.54%) | 2 (0.37%) |
| Multiple | 8 (5.16%) | 3 (0.79%) | 11 (2.06%) |
| **Total** | **41.90%** | **19.00%** | **25.61%** |

**4.1.2 Rearing system related prevalence of ectoparasites in goats**

The study showed that there was significant (p <0.05) variation on the tick and lice prevalence between Tethering and Free Range system for goats. It is predicted higher prevalence in animals under tethering condition (45.99%) than those of free range (26.28%) in goats.

**Table 4: Summary statistics of different variables with the presence of Ectoparasitic infestation in goats tested using Chi square test**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Category** | **Proportion ± SE** | **95% Conf. interval** | **P Value** |
| Breed | Local | 56.93±4.24 | 48.53-65.33 | **0.03** |
| Black bangle | 18.98±3.36 | 12.32-25.62 |
| Cross | 14.59±3.02 | 08.61-20.58 |
| Jamunapari | 9.48±2.53 | 04.51-14.45 |
| Sex | Male | 47.44±4.28 | 38.97-55.91 | 0.34 |
| Female | 52.55±4.28 | 44.08-61.02 |
| Age | < 6 Months | 13.86±2.96 | 08.00-19.72 | 0.09 |
| 6-12Months | 16.78±3.20 | 10.45-23.12 |
| 12-24Months | 42.33±4.23 | 33.95-50.71 |
| 24-36Months | 18.24±3.31 | 11.69-24.79 |
| >36Months | 08.02±2.33 | 03.42-12.63 |
| BCS | Cachectic | 1.46±1.02 | -0.52-3.50 | 0.07 |
| Poor | 24.82±3.70 | 17.49-32.14 |
|  Fair | 62.04±4.16 | 53.81-70.27 |
| Good | 11.67±2.75 | 6.23-17.13 |
| Hair coat | Rough & Stray | 48.90±4.28 | 40.42-57.38 | **0.001** |
| Shiny | 51.09±4.28 | 42.61-59.57 |
| District | Comilla  | 47.44±4.28 | 38.97-55.91 | **< 0.001** |
| Chittagong | 52.55±4.28 | 44.08-61.02 |

**4.1.3 Sex related prevalence of ectoparasites in goats**

From the study, it was found that there is no association between sex and ectoparasitic infestation. Ectoparasitic infestation was insignificantly (p>0.05) higher in female (52.55% in goats) than in male (47.45% in goats).

**4.1.4 Body condition scores (BCS) related prevalence of ectoparasites in goats**

The present study also revealed that the ectoparasitic load had a significant (p<0.05) effect on the animals with poor health conditions (62.04%) compared to that of normal healthy animals (11.68%).

**4.1.5 Age related prevalence of ectoparasites in goats**

From the study, it revealed that tick infestation in kids and young’s (72.99%) was more than adults (26.27%) and older animals (8.76%) though the relation is not significant (p>0.05).

**Figure 2: Prevalence of ectoparasites in accordance to breed, age, sex and BCS.**

****

**Figure (b): Part of collected samples**

**Figure (a): Lice infected goat**

****

Figure (c):*Linognathus stenopsis*

Figure (d)*: Damalinia caprae*

****

Figure (f): *Rhipicephalus sp*

Figure (e): *Haemaphysalis bispinosa*

**Figure 3: Parasites found (Lice-c &d, Ticks-e &f) in study.**

**4.2 DISCUSSION**

 The present study reported that prevalence of ectoparasitic infestation in goat is 25.61%, which is similar to Elsaid *et al.,* (2013) and less than Sarkar (2007) and Rahman and Mondal (1985) in goats of Bangladesh. Sarkar (2007) found 72.8% of Black Bengal goats are parasitized with ectoparasites. Rahman and Mondal (1985) reported the prevalence 74% in case of *H. bispinosa* and 1.7% in case of *B. microplus* infestation in goats. In contrast, comparatively lower prevalence has been reported by Roy *et al.,* (2000) who estimated 55.4% tick infestation in goats. Mulugeta *et al.,* (2010) found 58% infestation in goats in Ethiopia where the major ectoparasites identified were tick infestations (29.7%), *L. africanus* (27.9%), *Sarcoptes scab*iei var. *caprae* (12.5%), *C.* *felis* (11.1%), and *Demodex caprae* (6.8%). Tefera and Abebe (2007) recorded 56.4% infestation in goats in Ethiopia with the prevalence of *Linognathus* spp. (28.3%), ticks (22.2%), and *Ctenocephalides* spp. (8.1%). Prevalence of dog flea, *Ctenocephalides canis* in goats in the present study indicates the cohabitation or close contact of animals with infested dogs or cats and also the same host. Favorable climatic conditions, backward level of management, poor level of consciousness and awareness of farmers, and weak animal health extension services are believed to have contributed for widespread distribution and occurrences of ectoparasites (Mulugeta *et al*., 2010).

Baroi (2009) stated a definite variation of ectoparasitic infestation among age groups as adult goats infested (71.42%) whereas kids and young were infested 68.75% and 46.66%. Sarkar (2007) found age of the goat had a significant (p<0.005) effect on the ectoparasitic infestation resulting in higher infestation (82%) in kids than in older animals (79.55%). Isa *et al.,* (1995) found that ticks infestation rates ranges from 3.6% in goats under 1 year to 52.9% in goats (3.5-4) years old implying that the younger goats were less tolerant of ticks attack than older goats. Mulugeta *et al*. (2010) noticed a significant difference between the prevalence of *L. africanus* (OR=2.85, p<0.001), *Demodex caprae* (OR=35.66, p<0.001), *S. scabiei* var. *caprae* (OR= 4.61, p<0.001), and tick infestations (OR=2.20, p<0.001) between young and adult goats, respectively and no significant difference (p>0.05) in the prevalence of *C. felis* and *Damalinia caprae* infestations between the two age groups of goats. Manan *et al.,* (2007) found that resistance in the animals was building up as the age advances and the animals became more adoptable than in younger state irrespective of the farm species. It may be assumed that the less developed immune system of the kids and exhausted immune system of the adult animals may be responsible for the higher prevalence of tick infestation in kids and adult goats.

Kumar *et al.,* (1994) who predicted prevalence of *B. microplus, H. bispinosa* and *R. sanguineus* higher on visibly poor body condition goats in Uttar Pradrsh, India. Baroi (2009) also reported a significantly higher (p< 0.01) prevalence of ticks on poor health (80.00%) than that of normal health (50.98%). The present study agrees with the earlier study of Lapage (1962) who found malnourished animals are more susceptible to any infection as they are immune compromised. Mulugeta *et al*. (2010) recorded the overall prevalence of ectoparasites in goats with good and poor body condition was 44.5% and 87.6%, respectively. Tefera and Abebe (2007) found the goats with poor body condition were 4.3 times at risk for sarcoptic mange (OR=4.3, p<0.05), *Linognathus* spp. (OR=2.1, p<0.05) and tick (OR=1.6, p<0.05) infestation than goats of good body condition. The observations from Manan *et al*.*,* (2007) indicated that bony conditioned animals are least resistive to tick infestation and lacking enough body potential to build resistance with age advancement whereas over-conditioned animals showed reasonable combat to the infestation.

Although adequate literature is not available to supplement this observation, Rabbi *et al.,* (2013) found the highest ectoparasitic infestation in semi-intensive system (59.7%) followed by extensive system (33.5%) and intensive system (8.27%) at Jaypurhat, Tangail, Netrakona and Mymensingh districts. Baroi (2009) hypothesized that animals reared intensively get the advantage of their conscious owner who used to take regular hygienic management of barns, acaricidal treatment and other supportive cares (bath, grooming etc.) for their animals and this help them to overcome ectoparasitic infestation. Poor management and poor level of awareness of most of the small ruminant owners on the effect of ectoparasites are strongly believed to have contributed to the widespread occurrence of the infestation (Mulugeta *et al.,* 2010). The differences between the results of present and earlier study might be due to short duration, variation in the geographical locations, climatic conditions of the experimental area, methods of study, selection of sample, breed of animal used and season.

**CHAPTER V**

**CONCLUSION**

Result revealed that 25.61% of goats in the study area were found to be infested with several species of ticks, lice, flies and flea. This study quantifies the level of ectoparasitic infestation in goats which demands immediate control program and more intensive epidemiological study for detail identification of the constraints of goat health and production and will seek for remedies. The chances of transmission of arthropod borne pathogens to farmers and animal handlers are high, raising high questions of zoonoses. It is recommended that livestock owners in these regions have to be properly enlightened on various precautionary measures, including physical, chemical, quarantine methods, which ensure that ectoparasites are, as much as possible, kept away from non infested animals. Good sanitation habits must be ensured at all times. The veterinary personnel at the district level and the veterinary technicians at the grassroots level need to be mobilized to implement mass treatment programs for urgent action which need to be repeated regularly with simultaneous awareness creation to the owners.

**REFERENCES**

Abebe, R., Tatek, M., Megersa, B. and Sheferaw, D. (2011). Prevalence of Small Ruminant Ectoparasites and Associated Risk Factors in Selected Districts of Tigray Region, Ethiopia. *Global Veterinaria* **7 (5)**, 433-437.

Abunna, F., Kasasa, D., Shelima, B., Megersa, B., Regassa, A. and Amenu, K. (2009). Survey of tick infestation in small ruminants of Miesso district, West Harergie, Oromia Region, Ethiopia. *Tropical animal health and production*, **41(6)**, 969-972.

Ahmed, J., Alp, H. and Aksin, M. (2007) Seitzer U (2007). Current status of ticks in Asia. *Parasitol Res* **101(2),** 159–162.

Alam, J. (1993). Livestock sector for more investment in Bangladesh. *Asian Livestock,* **18**, 778.

Amare, S., Asfaw, Y. and Tolossa, Y. H. (2014). Ectoparasites of Sheep and Goats in North-West Amhara Regional State, Ethiopia. *Ethiopian Veterinary Journal*, **17(1)**, 55-67.

Bangladesh Economic Review. (2011). http://www.mof.gov.bd/en/budget/12\_13/ber/en/ chapter-7\_en.pdf

Barker, S. C. and Murrell, A. (2004). Systematics and evolution of ticks with a list of valid genus and species names. *Parasitology*, **129**, 15-36.

Baroi, S. K. (2009). Prevalence of ticks in cattle and goats at Char Bhadrasan of Faridpur, Bangladesh. M.S. thesis, Department of Parasitology, Bangladesh Agricultural University, Mymensingh.

Bayu, K. (2005). Country paper Ethiopia. Proceedings of Regional Workshop on preslaughter defects of hides/skins and intervention options in East Africa: Harnessing the Leather Industry to Benefit the Poor, April, 18-20 Addis Ababa, Ethiopia, 71-84.

Bowman, D. D. (1999). Georges’ Parasitology for Veterinarians, 7th ed., W. B. Saunders Company, 29-35, 38-39, 46-53, 61-62, 294.

Bram, R.A. (1983) Tick-borne livestock diseases and their vectors. 1. The global problem. Wld. Anim. Rev., (FAO). **36,** 1-5.

Campbell, W.C. (1989) Ivermectin and Abamectin. Springer-Verlag, New York.

Campbell, W.C. and Benz, G.W. (1984) Ivermectin: a review of efficacy and safety. *J. Vet. Pharm.  Therap.* **7,** 1-16.

Canga, A. G., Sahagu´n Prieto, A. M., Lie´bana, M. J., Martı´nez, N. F., Vega, M. S. and Vieitez, J. J. G. (2009). The pharmacokinetics and metabolism of Ivermectin in domestic animal species. The Vet Journal. **179,** 25-37.

CSA (Central Statistics Authority), (2004). Prevalence of Ectoparistes fauna of ruminants in Ethiopia, Addis Ababa.

Devendra, C., Thomas, D., Jabbar, M. A. and Kudo, H. (1997). *Improvement of livestock production in crop-animal systems in rainfed agro-ecological zones of South-East Asia*. ILRI (aka ILCA and ILRAD).

Drummond, R.O. (1983) Tick-borne livestock diseases and their vectors. Chemical control of ticks. Wld. Anim. Rev., (FAO). **36,** 28-33.

Elsaid, M. M., El-Arifi, E. O. and El-Buni, A. A. (2013). The Prevalence of Ectoparasites on Sheep and Goats at EL Khoms Region–Libya. *Journal of American Science*, **9(10**), 359-363.

Fentahun, T., Woldemariam, F., Chanie, M. and Berhan, M. (2012). Prevalence of Ectoparasites on Small Ruminants in and Around Gondar Town. *American-Eurasian Journal of Scientific Research*, **7(3**), 106-111.

Ferris, G. F. (1951). The Sucking Lice. New York Lithographing Corporation, New York, **1,** 3 - 285.

Gabaj, M. M., Beesley, W. N. and Awan, M. A. (1992). A survey of mites on farm animals in Libya. Ann. Trop. Med. Parasitol. **86**, 537-542.

Ghosh, S., Bansal, G.C., Gupta, S. C., Ray, D., Khan, M. Q., Irshad, H., Shahiduzzaman, M., Seitzer, U. and Ahmend, J. S. (2007). Status of tick distribution in Bangladesh, India and Pakistan. *Parasitol Res* **101(2),** 207–216

Hassan, M. M., Hoque, M. A., Islam, S. K. M. A., Khan, S. A., Roy, K. and Banu, Q. (2011). A prevalence of parasites in black bengal goats in Chittagong, Bangladesh. *International Journal of Livestock Production*, **2(4)**, 40-44.

Hoogstraal, H. (1956). African Ixodoidea. Department of the Navy, Bureau of Medicine and Surgery, U.S. Naval Medical Research Unit, No. 3, Cairo, Egypt, **1**, 50-360.

Hossain, M.J., Amin, M., Mostofa, M., Sharif, M. and Khalid, S.M.A. (2004). Efficacy of Levanid against natural gastrointestinal nematodiasis and paramphistomiasis in sheep. *The Bang. Vet*., **21** **(2)**, 70-73.

Ibe, D. C., Okonofua, C. and Akwari, A. A. (2012) Comparative prevalence and mean intensities of ectoparasites of goats from two Nigerian regions and their epidemiological implications. *Transnational Journal of Science and Technology,* **2 (10),**75-85.

Isa, J. F. W., Mushi, E. Z. and Modo, J. M. (1995). Ticks in goats at Oodi, Kgatleng District, Botswana. *Bulletin of Animal Health and Production in Africa,* **43**, 17-20.

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. *Trop Anim Health Prod* **38**, 485–490.

Kabir, M. H.B., Mondal, M. M. H., Eliyas, M., Mannan, M. A., Hashem. M. A., Debnath, N. C.,…and Elahi, M. F. (2011). An epidemiological survey on investigation of tick infestation in cattle at Chittagong District, Bangladesh. *Afr J Microbiol Res* **5**(**4**), 346–352.

Kamal, A. H.M., Uddin, K. H., Islam, M. M. and Mondal, M. M. (1996). Prevalence of economically important ticks in cattle and goat at Chittagong hilly areas of Bangladesh. *AJAS* **9**(**5**), 567–569.

Klompen, J. S. H., Black IV, W. C., Keirans, J. E. and Oliver Jr, J. H. (1996). Evolution of ticks. *Annual review of entomology*, **41**(**1**), 141-161.

Kumar, A., Rawat, B. S., Saxena, A. K. and G. P. Agarwal. (1994). Prevalence of ectoparasites on goats in Dehradun (India). *Applied Parasistology,* **35**, 227-236.

Lapage, G. (1962). *Monig’s Veterinary Helminthology and Entomology*, 5th edi. Bailliere, Tindall and Cox Ltd. London, UK. 556-723.

Loftis, A. D., Reeves, W. K., Szumlas, D. E., Abbassy, M. M., Helmy, I. M., Moriarity, J. R. and Dasch, G. A. (2006). Surveillance of Egyptian fleas for agents of public health significance: Anaplasma, Bartonella, Coxiella, Ehrlichia, Rickettsia, and Yersinia pestis. *The American journal of tropical medicine and hygiene*, **75**(**1**), 41-48.

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

McKellar, Q.A. and Benchaoui, H.A. (1996) Avermectins and milbemycins. *J. Vet. Pharm.  Therap.* **19,** 331-351.

Mendenhall, W. and Sincich, T. (2007) Statistics for Engineering and the Sciences, 5th ed. New Jersey: Prentice Hall.

Mulugeta, Y., Yacob, T.H. and H. Ashenafi. (2010). Ectoparasites of small ruminants in three selected agro-ecological sites of Tigery Region, Ethiopia. *Tropical Animal Health and Production*, **42**(**6**), 1219-24.

Rabbi, A. K. M. A., Islam, A., Anisuzzaman, M., Majumder, S. and Rahman, M. H. (2013). Does Feeding System Influence Parasitism in Black Bengal Goats in Bangladesh?. *Progressive Agriculture*, **22(1-2)**, 85-95.

Radfar M. H. and Hajmohammadi, V. (2012). Prevalence of goat warble fly, *Przhevalskiana silenus* in southeastern of Iran; Sci Parasitol **13**(**2**), 73-76.

Radostits, O. M., Gay, C. C., Hinchcliff, K. W. and Constable, P. D. (2007). A textbook of the diseases of cattle, horses, sheep, pigs and goats. *Veterinary Medicine. 10th ed. London: Saunders*, 1585-1612.

Radostits, O.M., Gay, C.C., Blood, D.C. and Hinchcliff, K.W. (2003). Veterinary Medicine-A textbook of the diseases of cattle, sheep, pigs, goats and horses. 9th ed. Book Power (Formerly ELST).

Rahman, M. H. and M. M. H. Mondal. (1985). Tick Fauna of Bangladesh. *Journal of Parasitology,* **9(2**), 145-149.

Rahman, M. M., Khan, M. F. R., Nazir, K. H. M. and Rahman, M. B. (2013). Prevalence of bovine and avian tuberculosis in sheep and goat population of Bangladesh. *Scientific Journal of Microbiology*, **2(1)**, 1-8.

Roberts, F. H. S. (1952). Insects Affecting Livestock. 1st edn, Angus and Robertson Ltd., London, 17-191.

Rony, S. A., Mondal, M. M. H., Islam, A. and Begum, N. (2010). Prevalence of ectoparasites in goat at Gazipur in Bangladesh. *Int. J. Bio. Res*, **2**, 19-24.

Roy, A. K., Rahman, M. H., Majumder, S. and A. S. Sarker. (2000). Ecology of ticks and tick-borne blood protozoa in Madhupur Forest Area, Tangail. *Bangladesh Veterinarian*, **17**(**2**), 90-94.

Rume, F. I., Chowdhury, A. K., Islam, M. S., Islam, M., Rume, M. K. F., Karim, M. R., ... and Karim, M. R (2011). Study on the productive and reproductive characteristics of goats in the selected costal regions of Bangladesh. *Bangladesh research publication journal,* **5**(**3**), 214-220

Sarkar, M. (2007). Epidemiology and pathology of ectoparasitic infestation in Black Bengal Goats in Bangladesh. M.S. thesis. Department of Parasitology, Bangladesh Agricultural University, Mymensingh.

Sarkar, M., Rahman, S. A., Sarker, B. K., Anisuzzaman, A., Begum, N., & Mondal, M. M. H. (2010). Epidemiology and pathology of ectoparasitic infestations in Black Bengal goats in Gaibandha and Mymensingh districts of Bangladesh. *Bangladesh Journal of Veterinary Medicine*, **8**(**1**), 41-50.

Sertse, T. and Wossene, A. (2007b). Effect of ectoparasites on quality of pickled skins and their impact on the tanning industry in Amhara Regional State, Ethiopia. *Small* *Rumin. Res.*, **69,** 55-61.

Sertse, T., and Wessene, A. (2007a). A study on ectoparasites of sheep and goats in eastern part of Amhara Region, northeast Ethiopia. *Small Rumin. Res.*, **69**, 62-67.

Shemshad, K., Rafinejad, J., Kamali, K., Piazak, N., Sedaghat, M. M., Shemshad, M., Biglarian, A., Nourolahi, F., Valad Beigi, E. and Enayati, A. A. (2012). Species diversity and geographic distribution of hard ticks (Acari: Ixodoidea: Ixodidae) infesting domestic ruminants, in Qazvin Province, Iran. *Parasitol Res* **110**(**1**), 373–80.

Shibeshi, B., Bogale, B. and Chanie, M. (2013). Ectoparasite of Small Ruminants in Guto-Gidda District, East Wollega, Western Ethiopia. *Acta Parasitologica Globalis*, **4**(**3**), 86-91.

Siddiki, A. Z., Uddin, M. B., Hasan, M. B., Hossain, M. F., Rahman, M. M., Das, B. C., ... & Hossain, M. A. (2010). Coproscopic and haematological approaches to determine the prevalence of helminthiasis and protozoan diseases of Red Chittagong Cattle (RCC) breed in Bangladesh. *Pakistan Veterinary Journal*, **30**(**1**), 1-6.

Smyth, J. D. (1994). *Introduction to animal parasitology*. Cambridge University Press.

Soulsby, E. J. I. (1982). Helminths, Arthropod and Protozoa of Domesticated Animals, 7th edn, Bailliere Tindal, London, 136 -778.

Steel, J.W. (1993) Pharmacokinetics and metabolism of avermectins in livestock. Vet. Parasitol. **48,** 45-47.

Steelman, C. D. (1976). Effects of external and internal arthropod parasites on domestic livestock production. *Annu. Rev. Entomol.,* **21***,* 155-178.

Sujon, M. A., Mostofa, M., Jahan, M. S., Das, A. R. and Rob, S. (2008). Studies on medicinal plants against gastroinstestinal nematodes of goats. *Bangladesh Journal of Veterinary Medicine*, **6**(**2**), 179-183.

Tadesse, A., Fentaw, E., Mekbib, B., Abebe, R., Mekuria, S., & Zewdu, E. (2011). Study on the prevalence of ectoparasite infestation of ruminanats in and around Kombolcha and damage to fresh goat pelts and wet blue (pickled) skin at Kombolch Tannary, Northestern Ethiopia. *Ethiopian Veterinary Journal*, **15**(**2**).

Tefera, S. and W. Abebe. (2007). A study on ectoparasites of sheep and goats in eastern part of Amhara region, northeast Ethiopia. *Small Ruminant Research*, **69**(**1/3**), 62-67.

Urquhart, G. M., Armour, J., Duncan, J. L., Dunn, A. M. and Jennings, F.M., (1996). Veterinary Parasitology. 2nd Edition, Blackwell Science, London, 141-205.

Vathsala, M., Mohan, P. and Ramessh, S. (2008). Survey of tick species distribution in sheep and goats in Tamil Nadu, India. *Small Ruminant Research*, **74**(**1**), 238-242.

Wall, R. and Shearer, D. (2001): Veterinary Ectoparasites: Biology, Pathology and Control. 2nd ed., Blackwell Science, 1-2, 27-31, 66, 76, 80-81, 149-150, 166-167, 172-177, 179-181.

WHO (2006). Brucellosis in human and animals. Joint report of WHO, FAO and OIE.

Yacob, H. T., Yalew, T. A. and Dinka, A. A. (2008). Part I: Ectoparasite prevalences in sheep and in goats in and around Wolaita Soddo, Southern Ethiopia. *Revue de Médecine Vétérinaire*, ***159*(8-9)**.

Yakhchali, M. and Hosseine, A. (2006). Prevalence and ectoparasites fauna of sheep and goats flocks in Urmia suburb, Iran. *Veterinarski arhiv*, **76**(**5**), 431-442.

Yebegashet, M., Hailu, Y. and Ashenafi, H. (2010). Ectoparasites of small ruminants in three selected agro-ecological sites of Tigray Region, Ethiopia. *Trop. Anim. Health Prod.,* **42**, 1219-1224.

Zangana, I. K., Ali, B. A. and Naqid, I. A. (2013) Distribution of ectoparasites infested sheep and goats in Duhok Province, North Iraq. *Bas.J.Vet.Res.,* **12 (1)**, 54-64.

***Appendix***

**Investigation of Endoparasites in Goat**

**Case Registration No.: …… Date:…./…./….**

1. **Name of the owner:** ………………………………………………………...

**Upazilla** …………………………… **District:** ………………………………….

1. **Patients Data:**

**Breed:** ……………………**Parity:** …………………….

**Age:** ………………… **Sex:** M/F **Weight:** …………………..

**Body Condition Score (BCS):** 1(Cachectic)/ 2(Poor)/ 3(Fair)/ 4(Good)/ 5 (Over weight/Fat)

1. **Clinical History:**

**Onset:** Sudden/Gradual **Duration of illness:** …. hrs/days **Weakness:** Yes/No.

**Grazing system:** Tethering/ cut & carry/ high land/ low land/ zero grazing/ …… **Deworming:** Yes/No.

1. **Clinical Examination:**

**Temperature:** ………. **°**F **Hair Coat:** Shiny/ Rough & Stray/ lesions/ other.

**Mucous membrane:** Pale/pink/icteric/cyanotic/……….

**Secondary infection:** +/-- **General attitude:** Alert/ Dull/ Depressed/ Other.

**Posture:** Normal/ Defective **Gait:** Normal/ Lameness.

**Sample taken:** Feces/swab……………………….

**Type of parasite found:** ……………………………………………

**Intensity/density of parasite:** ………………………

 **Signature**