CHAPTER I:

INTRODUCTION

Pigs are fast growing and one of the most prolific livestock breeds (Durranc and Maxson 2008; Phookan *et al.* 2006; Prakash *et al.* 2008; Taylor and Roese 2006). Pig is considered as the richest source of animal protein at a lower cost for the peoples who consume pork.

Most of the pig population in Bangladesh is localized in rural areas and domestication is mainly concentrated to low income group families having poor hygiene standards. Pig production systems in Bangladesh are mainly of two types i) Semi-intensive- mainly kept by tribal peoples who rear at their homestead areas and ii) Free range or extensive,- by nomadic peoples who rear pigs in flocks through continuous shifting of their scavenging areas. In most of the areas of Rangamati and Bandarban districts, rearing of pig is done by poor people who neither have means nor know how to improve production.

In pigs, Gastro-intestinal (GI) parasites are prevalent. The main effects of the parasites are loss of appetite, reduction in daily gain, poor feed utilization, and potentiation of other pathogens. Gastrointestinal parasites are responsible for substantial loss of productivity in swine and other livestock industry (Boes *et al.* 2000, Joachim and Daugschies 2000).

The indigenous pig predominates in smallholder areas where it is kept under the free range system and thrives on low planes of nutrition (Mashatise *et al.* 2005). These pigs are primarily scavengers (Holness, 1991) utilizing food scraps thrown away by people. The roaming of pigs favors the uptake of internal parasite eggs (Roepstorff and Nansen, 1994), making the pigs particularly susceptible to infestation with internal parasites. Moreover, the warm and humid conditions of the tropics and the inadequate treatment of local pigs against parasitic diseases invariably cause them to carry heavy burdens of gastrointestinal (GI) nematodes (Mashatise *et al.* 2005).

Human Ascaris is the most prevalent in the area of low socio-economic status where there is presence of poverty and malnutrition; studies indicate that Ascaris infection exerts a chronic influence on host nutrition (Crompton and Nesheim, 2002).

Ascaris lumbricoides, Linnaeus, 1758 and *Ascaris suum*, Goeze, 1782 are parasitic nematode (Family Ascarididae) infections of humans and pigs respectively. The human roundworm *Ascaris lumbricoides* is one of the most common parasites in the world, infecting 1.2 billion people globally (Silva *et al*. 2003). The spectrum of disease associated with *Ascaris lumbricoides* infection is known as ascariasis.

Ascaris suum is a widespread parasitic nematode that causes infection in pigs with high prevalence in hosts (Roepstorff *et al.* 1998, Nansen and Roepstorff, 1999). The prevalence of *Ascaris suum* infection varies with geographical region and farm management practices (Roepstorf *et al.* 1999; 2003). Porcine ascariasis interferes with the health and performance of pigs while resulting in reduced feed to gain ratios and liver condemnation incurring economic losses (Stewart and Hale, 1988).

Despite this, various intervention and clinical studies, the majority of which are focused on school children, demonstrated that infection is associated with appetite loss (Hadju *et al.* 1996), lactose mal-digestion (Carrera *et al.* 1984) and impaired weight gain (Hadju *et al*. 1996) (Stephenson *et al.* 1980). Age-intensity profiles indicate that those harboring heavy infections are young children at vulnerable stages of growth and development, and for this reason the impact of infection on nutritional status remains of primary concern and interest.

The present study is undertaken to investigate the presence of GIT parasites in pigs in hilly and plane area of Chittagong division and Ascariosis in children at the plane area. Considering the above facts the present study was undertaken to full fill the following objectives:

1) To investigate the presence of parasites in pig in hilly and plane area of Chittagong division, Bangladesh.
2) To determine the effect of age, sex and topography in the occurrence of such parasites.
3) Determine the occurrence of Ascariosis both in pigs and children closely living in same area.

CHAPTER II:

MATERIALS AND METHODS

2.1. Description of the study area and duration:

The study was conducted in three districts, Rangamati, Bandarban and Chittagong under the Chittagong division, Bangladesh. Manikchari in Rangamati and Moghpara in Bandarban were selected as hilly area and Firingi bazar in Chittagong city as plane area. The study was under taken for a period of 4 months starting from March'2017 to June'2017.

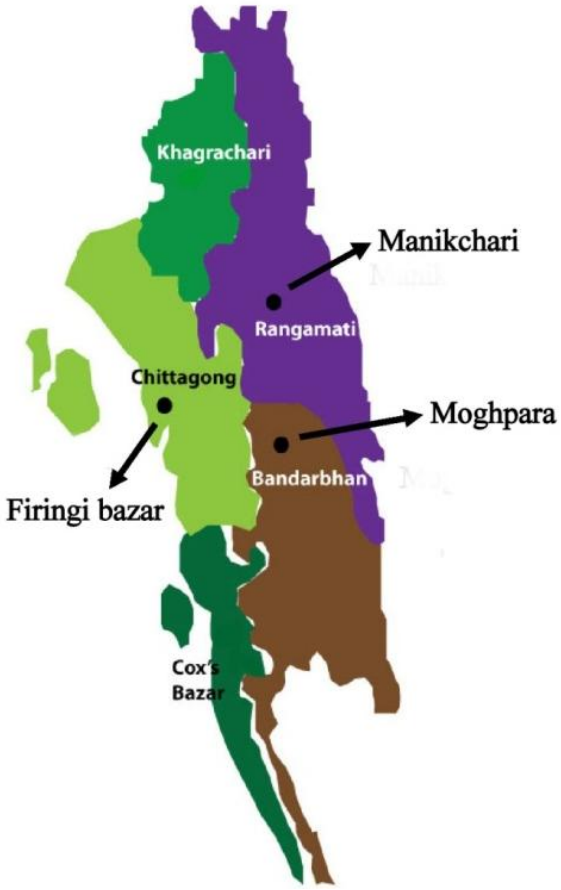

Figure 1: Geographical area and sources of sample

2.2. Target animals and samples:

Indigenous pigs were selected for this study as target animal. All the samples are collected form pigs age of 1.5 to 6 month.

Fecal samples from 70 pigs and stool samples from 20 children were collected randomly from the three areas. A prototype questionnaire was used to record the information like area, age and sex.

2.3. Collection and preservation of sample:

A total of 70 faecal samples were collected from the pigs and total of 20 faecal samples were collected from children of 10 years of age. The samples were collected in sterile plastic containers and kept in 10% buffered formalin as recommended by Williams and Anne and Gary (1999) and stored at 4°C at the Parasitology laboratory at the Department of Pathology & Parasitology, CVASU, Chittagong. Faecal samples were examined in the following day of collection.

2.4. Parasitological examination:

Gross examinations of fecal samples were done. All the faecal samples collected were processed using direct smear, sedimentation and flotation techniques for coproscopy as described by Soulsby (1982) to identify the development stages of parasites, for example eggs, cyst and oocyst the study followed proper morphological characteristics described by different authors (Hendrix, 2006; Urquhart *et al.*, 1996; Hansen and Perry, 1993, Soulsby, 1982; Benbrook and Sloss, 1962).

2.5. Procedure

2.5.1 Direct smear:

For each sample, small amount of faeces was taken on a clean microscope slide and applied a drop of tap water so that a relatively homogeneous and sufficiently transparent preparation is obtained. The largest particles can be moved aside. A cover glass is laid on the transparent liquid and the preparation is examined systematically under low magnification.

2.5.2 Sedimentation technique:

For each sample, 3 g of faeces was deported into the first container and suspended in 40-50 ml of distilled water. The mixture was then stirred thoroughly with a stirring device (tongue blade/ fork) and passed through a tea strainer, and the filtrate was collected in a second container. The filtrate was then poured into a test tube and allowed it to sediment for 20-30 minutes. Then the supernatant was discarded very carefully. Finally the sediment was examined under a microscope using 10X to 40X of magnification.

2.5.3 Floatation technique (Test tube floatation):

For each sample, 2 to 5g of feces is put in to a suitable container and suspended in 50 ml of floatation fluid. The mixture was then stirred thoroughly with a stirring device (tongue blade/

fork) and passed through a tea strainer the filtrate was collected in a second container. The filtrate was then poured into a test tube until a meniscus is formed (Convex meniscus at the top of the tube). A glass-cover slip was placed over the meniscus and allowed to stand for 15 - 30 minutes. Finally lift off the cover slip from the tube, together with drop of fluid adhering to it and immediately placed the cover slip on a glass slide and observed under microscope using 10X to 40X of magnification.

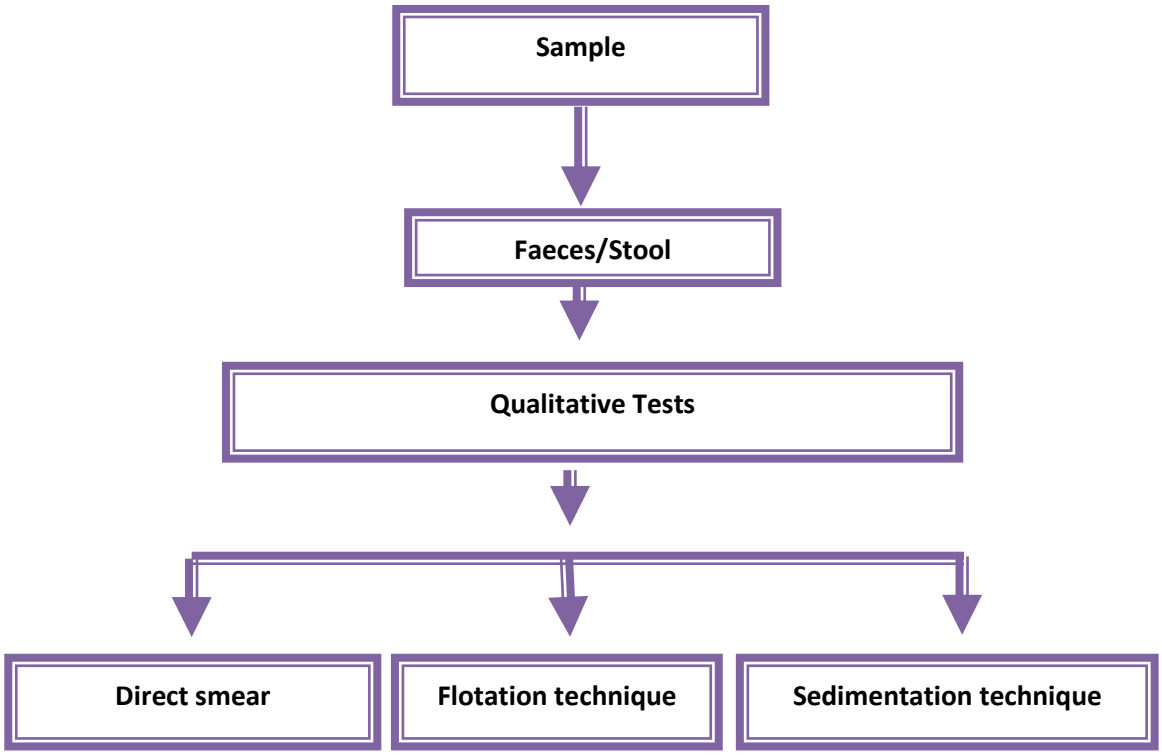

Figure: 2: Coproscopy

2.6. Statistical analysis:

Data generated from laboratory investigations were recorded and coded accordingly using Open Epi (Open source Epidemiological Statistics for Public Health, version 3.01) for analysis. The prevalence of gastrointestinal parasite was calculated as the number of positive (egg/oocytes present) samples divided by the total number of samples tested. Fisher exact test was followed to find out the P-value. $P<0.05$ was considered as statistically significant at confidence interval 95%**.**

Chapter III:

RESULTS AND DISCUSSION

3.1. GIT parasites in pigs:

About 85.7% (n=60/70) pigs were infected with one or more endoparasites where five different parasites were identified. *Ascaris suum* (44.3%), *Trichuris suis* (2.8%); *Isospora suis* (11.4%), *Balantidium coli* (12.8%) and *Schistosoma suis* (1.4%) (Table 1).

Similar results were reported by Sowemimo *et al*. (2012) in Southwest Nigeria (80.4%), Obonyo *et al.* (2012) in Kenya (83%), Nissen *et al.* (2011) in Uganda (91%), The present report is nearly similar with the findings of Kagira *et al.* (2010) in Western Kenya (84.2%), Järvis *et al.* (2007) in Western Estonia (82%) . And other results were reported by Waiswa *et al.* (2007) in South Eastern Uganda (94.8%), and Tamboura *et al.* (2006) in Burkina Faso (91%). The present study is higher than Ismail *et al.* (2010) in Korea, Nganga *et al.* (2008) in Kenya, Marufu *et al.* (2008) in Zimbabwe, Borthakur *et al.* (2007) in Aizawl, Solaymani-Mohammadi *et al*. (2003) in Western Iran and who reported 73.5%, 67.8%, 58.7%, 37.5% and 58.3% respectively. The differences in the prevalence might be due to the differences in climatic conditions, husbandry practices, breeds and inherent characteristics such as host immunity in the study regions.

The present finding in case of *Ascaris suum* is in agreement with the earlier findings-
The higher prevalence of *Ascaris suum* was reported by Dey *et al.* (2014) at Mymensingh in Bangladesh (50.9%), Rajkhowa *et al.* (2003) in Nagaland (67.4%), Nsoso *et al*. (2000) in Botswana (54.6%), Salifu *et al.* (1990) in Nigeria (53.1%) and Roepstorff and Jorsal, (1989) in Denmark (88%), and Kasai *et al.* (1979) in Brazil (64.3%) and the lower prevalence was reported by Roesel *et al.* (2017) in Central and Eastern Uganda (5.9%), Atawalna *et al.* (2016) in Ghana (2.0%), Dadas *et al.* (2016) at Mumbai in India (32.59%), Nur-E-Azam *et al.* (2015) at Dinajpur in Bangladesh (38%), Tomass *et al.* (2013) in Northern Ethiopia (25.9%), Nganga *et al.* (2008) in Kenya (28.7%) and Boes *et al.* (2000) in China (36.7%).
The prevalence of *Ascaris suum* in this study was apparently higher might due to the contamination of the habitats as well as scavenging nature of the pig (Lewis *et al.* 2006).

The result of *Isospora* spp. infection is differed with the present study from Dadas *et al.* (2016) at Mumbai in India (1.48%), Matsubayashi *et al.* (2009) in Japan (40%) and Pilarczyk *et al.* (2004) in Poland (58.5%), and highly differ from Zhang *et al.* (2012) in China and Permin *et al.* (1999) in Ghana. And mostly similar result was reported in Dey *et al.* (2014) at Mymensingh in Bangladesh.

The present result of *Balantidium coli* infection is also differ from Dadas *et al.* (2016) in Mumbai (31.85%); Dey *et al.* (2014) in Mymensingh, Bangladesh; Ismail *et al.* (2010) in Korea (64.7%); Kagira *et al.* (2010) in Kenya (64%) and Hindsbo *et al.* (2000) in Danish (>57%). The differences in the prevalence may be due to the differences in husbandry practices, the techniques of sample collection, period and place of study, environmental factors and breed of animal etc.

The prevalence of the second nematode parasite, *Trichuris suis,* is low which is 2.8%. This low prevalence agrees with the findings of earlier studies of Tiwari *et al.* (2009) in West Indies (4.6%), Marufu *et al.* (2008) in Zimbabwe (4.2%), Tamboura *et al.* (2006) in Burkina Faso (1%), Nsoso *et al*. (2000) in Southeast District, Botswana (6.8%), Permin *et al.* (1999) in the upper east region of Ghana (4.6%) and Esrony K *et al.*(1997) in the Morogoro region of Tanzania (5%). This supports the speculations that *Trichuris suis* eggs are highly susceptible to environmental factors. Higher prevalence was recorded by Boes *et al.* (2000) in the Dongting Lake Region in China which was 15.8%. Variation in the occurrence of such infection might be due to geo-climate conditions of the study areas as well as husbandry practices. (Hansen and Perry, 1993)

The prevalence of one and only trematode *Schistosoma suis* is very low which is 1.4%. Infection caused by *Schistosoma suis* of this study was in line with the findings of Permin *et al.* (1999) in the upper east region of Ghana (0.4%).

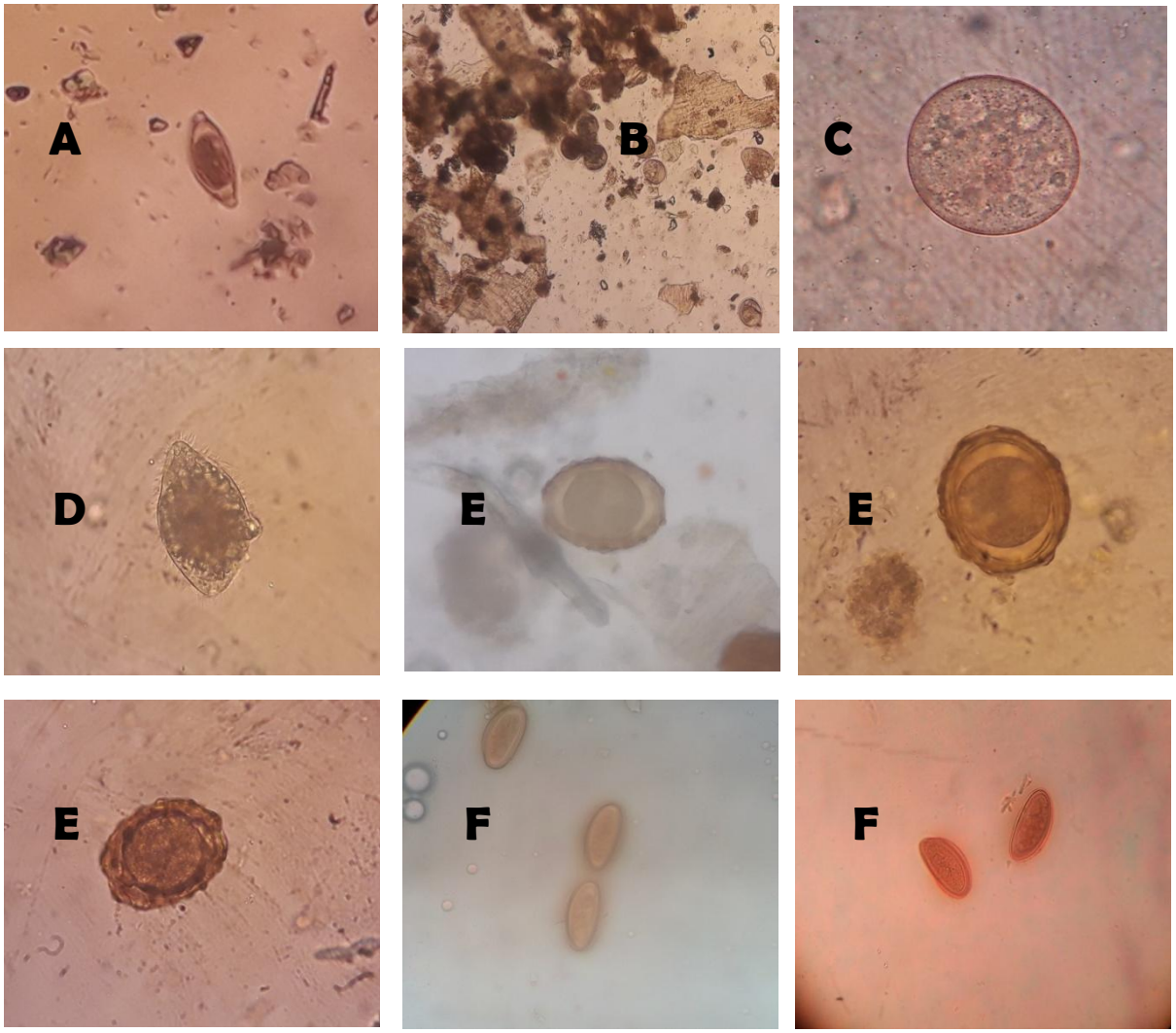

Figure 3: Parasites observed under light microscope (Objective 40X)
(A) *Trichuris suis* egg; (B) *Isospora suis* egg, (C) *Balantidium coli* cyst; (D) *Balantidium coli* trophozoite; (E) *Ascaris suum*; (F) *Enteroviun vermicularis*

3.2. Prevalence of GI parasites in pig: Male vs. Female

In this study, it was recorded that prevalence of GI parasites was significantly higher in female (93.02%) than male (74.07%) ($p>0.05$) (Table 2). This finding is the agreement with the earlier study of Obonyo *et al.* (2012) in Kenya and Tamboura *et al.* (2006) in Burkina Faso. The present study differs from Sowemimo *et al.* (2012) in Nigeria who recorded higher prevalence in male (45%) than female (30.4%) and Nsoso *et al.* (2000) in Botswana reported that prevalence was not significantly different between sexes which agree the present study.

Besides these, the prevalence of *Ascaris suum* is apparently higher in female pig (51.2%) than male pig (33.3%). The reason of higher prevalence of infection in the females cannot be explained exactly but it might be assumed that the alteration of the physiological condition of the female during pregnancy, lactation and parturition (hormonal influence) as well as stress leading to immune-suppression may be associated with this phenomenon (Lloyd 1983). Higher level of lactation and progesterone hormones make the female individual more susceptible to any infection (Lloyd 1983)

3.3. Topography based prevalence of GI parasites in pig:

The prevalence's of gastrointestinal parasites in hilly areas 97% in Rangamati and 80% in Bandarban and in Plane area 70% in Chittagong. The prevalence of parasitic infection was significantly higher in the hilly areas (92%) than the plane area (70%) ($P<0.05$) (Figure 4).

In the present study, *Trichuris suis* (5.7%) , *Schistosoma suis* (2.8%), *Isospora suis* (5.7%) were reported in Rangamati, *Ascaris suum* was appeared apparently with higher prevalent in Bandarban (53.30%) and *Balantidium coli* in Rangamati (Figure 5).

Different local climatic conditions like humidity, temperature, rainfall, vegetation and management practice have a profound effect on prevalence of gastrointestinal tract parasites.

3.4. GIT parasites in children:

Only *Enterovious vermicularis* was reported in the children and the prevalence was 30% (n=6/20). The study did not find any Ascaris from the children stool. Probably this is due to the less chance of interaction with animal.

The prevalence of *Enterovious vermicularis* was apparently higher in boys (44%) than girls (18.2%) ($p> 0.05$) (Table 3). This finding is the agreement with the earlier study of Park *et al.* (2005) where for the prevalence was higher in boys (21.3%) than girls (15.4%). Inadequate personal hygiene could increase the risk of *Enterovious vermicularis* infection among children, particularly among boys. Other factors including playing on the floor, nail biting, a failure to wash hands before meals, and living in non-apartment dwellings have also been reported to be associated with the prevalence of enterobiasis (Sung *et al.* 2001).

In this study we do not find any Ascaris from children stool. This may be due to use of improved sanitation which includes the use of properly functioning and clean toilets (Christina and Celia, 2011), wash of hand with soap after defecation (Fung and Cairncross, 2009) and taking regular deworming by children.

Table: 1 Overall prevalence's of GIT parasites in pigs in the study areas

Parasite identified	Number of positive sample (Total, N=70)	Prevalence (%)
Ascaris suum	31	44.3
Trichuris suis	2	2.8
Schistosoma suis	1	1.4
Isospora suis	8	11.4
Balantidium coli	9	12.8
Total	60	85.7

Study areas: Rangamati + Bandarban + Chittagong

Table: 2 Prevalence of GIT parasites in pigs in the study areas: Male vs. Female

	Animal examined	Number of positive sample	Prevalence (%)	P-value
				0.03321
Boars (Male)	27	20	74.07	
Sows (Female)	43	40	93.02	

Study areas: Rangamati + Bandarban + Chittagong

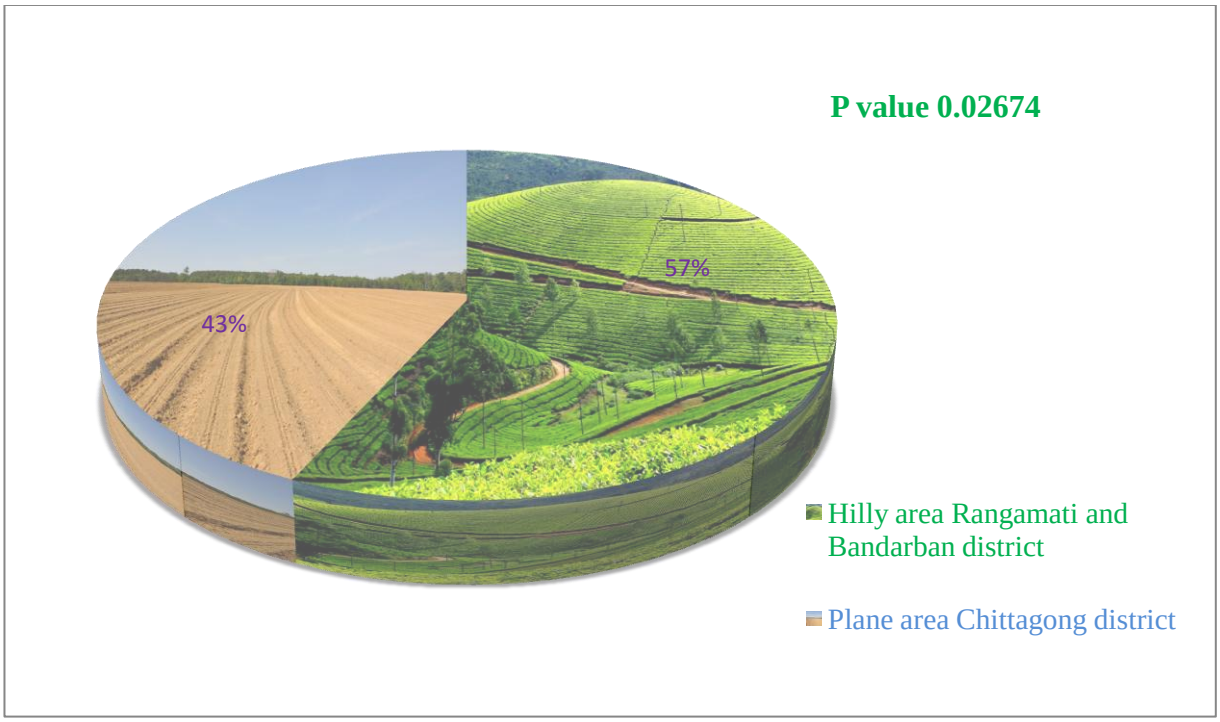

Figure: 4 Topographical based prevalence's of GIT parasites in pigs

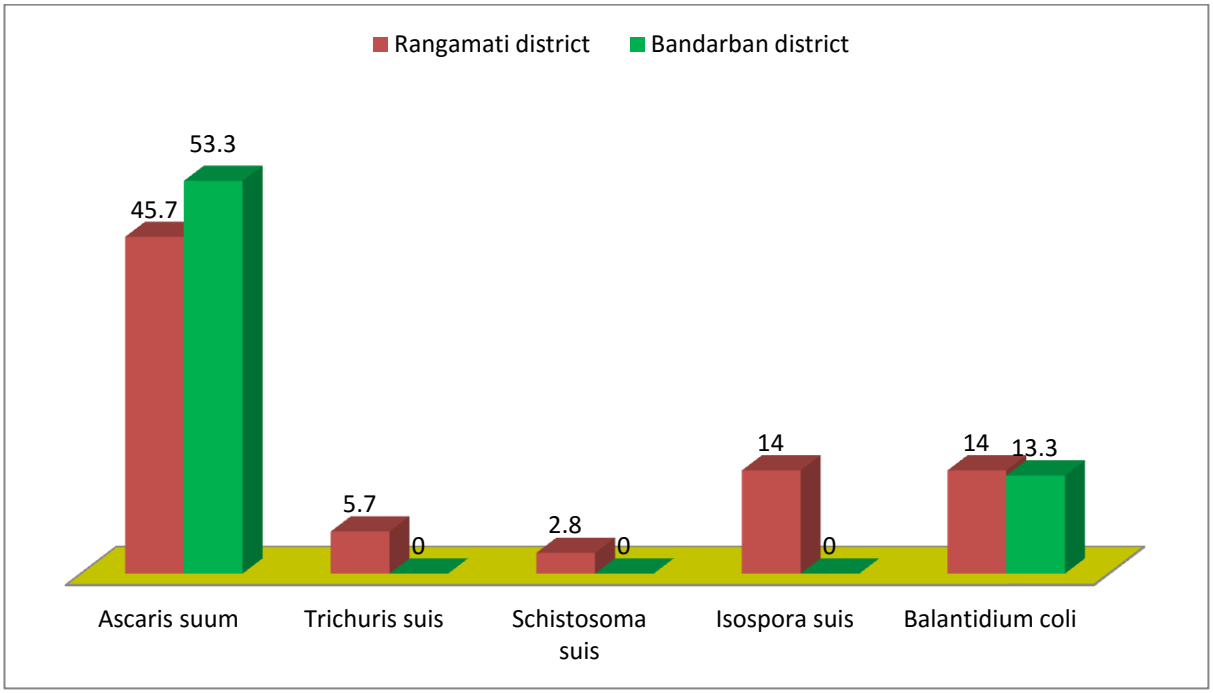

Figure: 5 Topographic distributions of GIT parasites in pigs in the hilly areas

Table: 3 Prevalence of GIT parasites in children in the study areas

Sex	Children examined	Number of positive sample	Prevalence (%)	P-value
				0.2167
Boys	9	4	44	
Girls	11	2	18.2	

Study areas: Rangamati + Bandarban + Chittagong

CHAPTER IV:

LIMITATION OF THE PRESENT STUDY

Breed and age variation, seasonal pattern of the diseases and worms load were not included. So, further extensive investigation should study on gastrointestinal parasitism to overcome the limitations of the current study and the possible impact of parasitic infestations of pigs on public health which will assist to determine the important predictors related to such parasitic diseases.

CHAPTER V:

CONCLUSION

The present study revealed that pigs were susceptible to *Ascaris suum* infection and less susceptible to *Balantidium coli*, *Isospora suis*, *Trichuris suis* and *Schistosoma* suis sand the infections were influenced by sex and topography. The study revealed *Enterovious vermicularis* infection was common in the children less than 8 years of age. The study did not find any Ascaris in children.

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