1
INTRODUCTION

1.1 Study Area

Nepal is a landlocked mountainous country surrounded by China to the north and India to the East, West and South. It is one of the richest countries in the world in terms of biodiversity due to its unique geographical position and latitudinal variation. Geographically, it is 80˚ 4' to 88˚ 12' East longitude and 26˚ 22' to 30˚ 27' North latitude. It is approximately 885 km in length and its mean width is 193 km with a total land area of 1, 47, 181 sq. km.

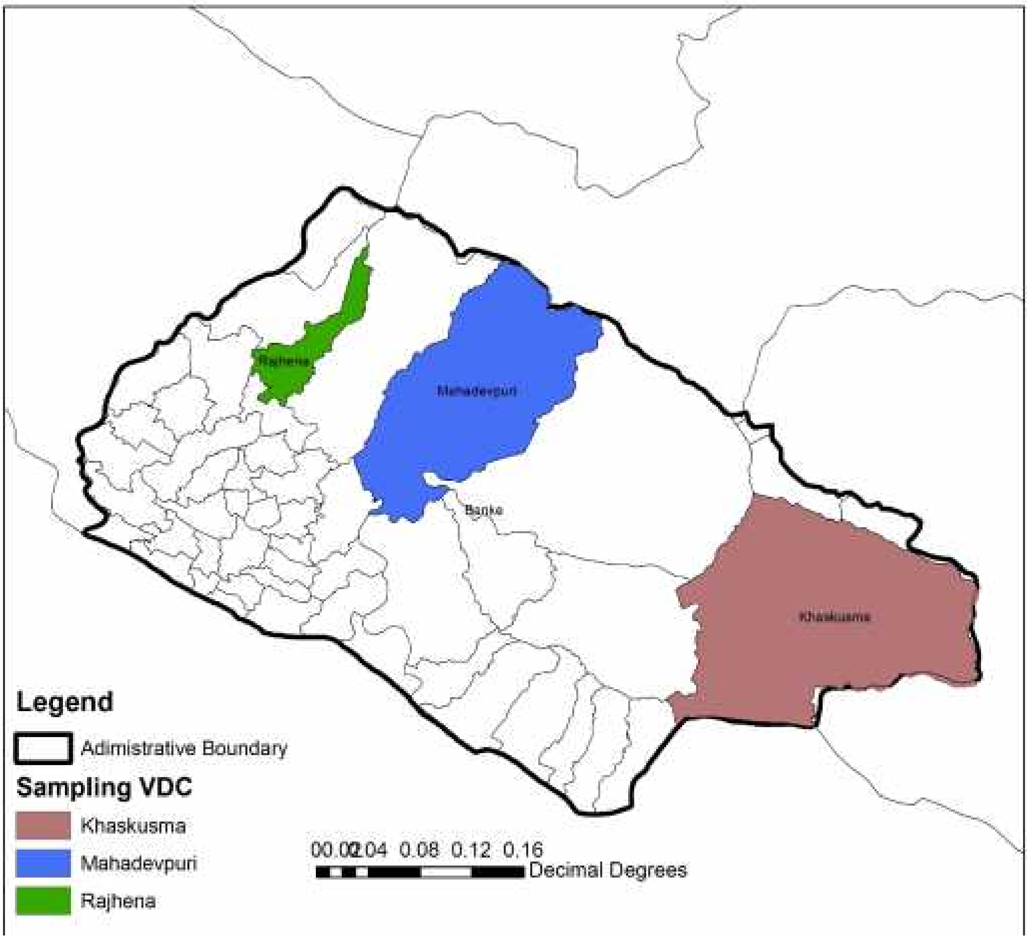
Banke district lies in southern belt of Mid-Western part of Nepal extending from 27° 51' to 28° 20' North latitude and 81° 29' to 82° 80' East longitude with a total land area of 2337 sq.km. The district is consist of 46 VDCs and 1 municipality. The study was conducted in Rajhena, Khaskushma and Mahadavpuri VDCs of Banke district.

The study area selected have contrasting features relating to geographic location, goat husbandry practice, climate, fodder and grazing land availability and availability of veterinary facilities. Khaskushma lies in eastern part of Banke. It is a rural area with temperate climatic condition blended with rivulets and green forest. Goat farming is one of the main agricultural practices in Khaskushma. Goat farming is carried out on cooperative basis. Also farmers own their private goats too. The veterinary care and facilities are very limited in Khaskushma.

Mahadavpuri is sub-urban area on the Northern Banke. Livestock are integral part of people engaged in agriculture. Almost every household rear 5 or more goats. Local fodders, agriculture byproducts and grazing on open field are main sources goat rearing.

Rajhena is small city of Banke and goats are reared on the outskirts of Rajhena. The forest fodder, agricultural byproducts and concentrates comprises the goat diet.


Map of Study Area
Banke
N


Rajhena
Mahadevpuri
Banke
Khaskusma
Legend
Adimistrative Boundary
Sampling VDC
Khaskusma
Mahadevpuri
Rajhena
0 0.02 0.04 0.08 0.12 0.16
Decimal Degrees

1.2 Background

Agriculture is the main source of livelihood in Nepal and more than 65% people are engaged in subsistence agriculture. Livestock contributes about 17% of Gross Domestic Product (GDP) and 24% of Agricultural GDP (MoAC 2010). Livestock farming has great potentialities in Nepal and it is becoming popular among farmers due to fast returns of investment and wide market potentiality. Among the different livestock species reared in Nepal goat is one of the most popular domesticated animal. They are found in all parts of country. Total goat population in Nepal is estimated to be 8.8 millions in the year 2009/10 and it contributes 20% of total meat production of the country (CBS 2010). Several agricultural development plans in Nepal since long time back have also given emphasis to goat farming as a commodity program to increase economic standard of rural people. Goat has played significant role in the employment and income generation and upliftment of the rural economy in Nepal. Goats are popular among small holders because of their efficient conversion of feed into high quality meat, milk and hide. Goats are mainly reared for meat, fiber and manure. They are also used as means of transportation in hilly areas.

Goat(*Capra hircus*) is an important domestic animal and it is herbivorous as well as widely distributed in all over the world.It is a member of the bovine family and subfamily Caprinae is one of the oldest domesticated species.

Goats are reared in almost every parts of Banke district. They are important component of mixed farming however, trends have been changed and farmers have opted commercialization so the numbers of new and small scale entrepreneurs are increasing in goat farming. Goat farming is undoubtly a profitable business and means of living for rural people but the problem of gastrointestinal parasites is always a major constraint. The problem of gastrointestinal helminths is easy to understand but difficult to mitigate. Various researches and studies have been conducted in the past regarding the problems of gastrointestinal parasites and their control but the problem of gastrointestinal (GI) parasitism is still very common and economically important. The GI parasites are affecting domestic livestock species worldwide (Krecek and Waller 2006; Miller et al. 1998). The major parasites of concern differ by the prevailing host animal species and climatic conditions in a particular geographic location and no farm animal species in general is free from GI parasitism. Diseases caused by helminths parasite in livestock continue to be a major productivity constraint, especially in small ruminants in the tropics and subtropics (Perry et al. 2002). Nematode infection is rampant in most developing countries where poor pastures and the quantities of nutritious food consumed do not cover the nutritional requirements of animals (Leng 1991). In addition, there is insufficient veterinary care and the environment is conducive to nematode growth and transmission (Fikru et al. 2006). Nematode infection is a serious veterinary health concern in Nepal as well. The problem is manifested especially in small ruminants (sheep and goats). The consequences of nematode infection include: reduced feed intake and weight gain, reduced immunity, lower fertility, a reduction in milk production and work capacity, treatment expenses and death in critical infections (Fikru et al. 2006, Hale 2006). However, determination of the degree of nematode infection depends mainly upon the age of the host, the breed, the parasite species involved, and the epidemiological patterns which include husbandry practices and physiological status of the animals (Tembely et al. 1997). More importantly, environmental conditions such as temperature, rainfall and humidity are conducive to the development of nematode eggs (Menkir et al. 2007) and free living stages (Tembely et al. 1997).

Gastrointestinal helminths infestation causes direct losses due to drop in production and deaths of animals and indirect economic losses due to increased cost of control strategies (Soulsby 1982). A huge amount of money is spent annually worldwide to combat helminth parasites in livestock (Jabbar et al. 2006). The greatest losses associated with nematode parasitic infestations are subclinical, and economic assessments show that financial costs of internal parasitism are enormous. In Nepal, parasitic disease remains a major problem to livestock across all production areas. About 24% of deaths in goats were reported to be due to internal parasites and total economic losses due to gastrointestinal nematodes in goats were reported to be about 25 % (Lohani and Rasaili 1995).

1.3 Endoparasitism

Parasites are classified as endoparasites and ectoparasites on the basis where they live inside or on the body cavity. Goats are susceptible to internal parasites and may harbor several species of worm at any time.

Endoparasites are those organisms living in their hosts, in the gut, body cavity, liver, lungs, gall bladder and blood and within the intestinal cavities, tissues or cell of the host. Such forms almost live a completely parasitic existence. They totally depend upon their host and causing infection to them. For example, *Tricostrongylus* sp., *Fasciola* sp., *Schistosoma* sp., are typical endoparasites.

1.4 <u>Trematoda</u>

Trematodes commonly known as flukes, often live in the bile ducts or small intestine and may also affect the lungs. Some are ingested but some burrow into the skin for access. Their eggs are passed with the faeces of the host. Trematode especially include *Fasciola* sp., *Dicrocoelium* sp., *Schistoma* sp. and *Paramphistomum* sp. (Shah and Agrawal 1990).

Fascioliasis is well known parasite of herbivorous animals. It has worldwide distribution on the animal reservoir host. A large variety of animals such as cattle, buffaloes show infection rate that varies from 70% to 90% in some areas. The different local names of this disease, such as namle, mate, lew etc. in different regions, are proof of its continued existence for many years in the animal population of the country.

Infection of domestic ruminants with *Fasciola hepatica* and *Fasciola gigantica* causes significant loss estimated at over US $2000 million per year to the agriculture sector worldwide with over 600 million animals affected (Hansen 1994).

The economic loss due to fascioliasis in Nepal was estimated to be Rs.14.2 crore (Lohani and Rasaili 1995). The prevalence of fascioliasis ranging between 50% to 90% has been reported in buffaloes (Mahato 1999). In addition fascioliasis is now recognized as an emerging human disease.

Fascioliasis in ruminants ranges in severity from a devastating highly fatal disease in sheep to an asymptomatic infection in cattle. Acute fascioliasis occurs seasonally and is manifest by anemia and sudden death. Cases of chronic fascioliasis occur in all seasons and the clinical signs may include anaemia, reduced weight gain, decreased milk production, unthriftiness, submandibular odema and possibly death. The subsequent simultaneous migration of many immature flukes through the liver parenchyma causes severe destruction of liver tissue of the host. The penetration of the liver capsule by a large number of young flukes results in an inflammatory response of the capsule (peri-hepatitis). The blood sucking activities of the flukes irritate the lining of ducts, resulting in an inflammatory response and the associated blood loss results in anaemia. Likewise the trematode *Dicrocoelium*, gastrointestinal trematode *Paramphistomes* and *Schistosomes* the blood trematodes affects the host abundantly.

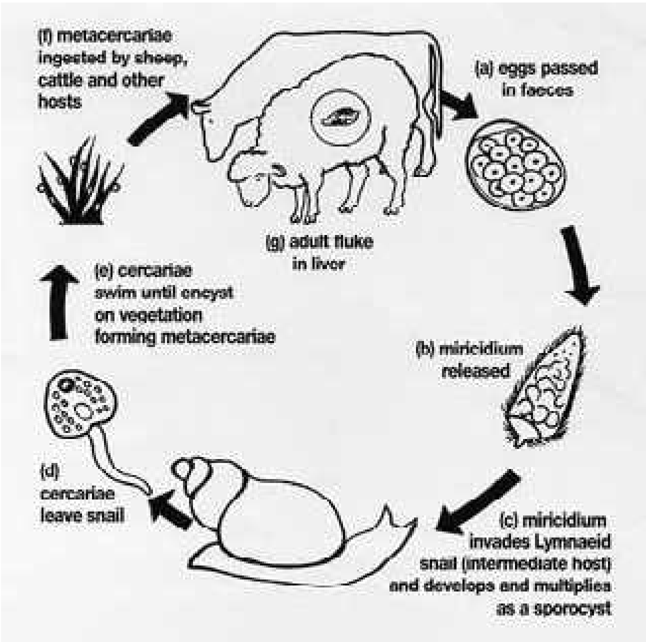


Fig. 1: Lifecycle of *Fasciola* sp.

The important *Lymnaeae* species of snail involved in the transmission of fascioliasis vary in their geographical distribution in the world. Man and herbivorous animals (sheep, cattle, buffalo, etc.) acquire infection by the ingestion of moist and raw aquatic plants such as water cress harbouring infective metacercariae. The metacercariae mature to become adult worms and lay eggs which are passed in the faeces. On coming in contact with water they mature and invade the molluscan host, the fresh water snail and undergo development. The mature cercariae emerge out of the snail and encyst on aquatic grasses, plants and develop into metacercariae which is the infective stage of the parasite.

Similarly, dicrocoeliasis is caused by the liverfluke *Dicrocoelium dendriticum* a common parasite of the biliary passages of sheep and other herbivorous and omnivorous animals. Most of the human infections occurs by the ingestion of the liver of infected sheep.

Rice straw which is the major feed for livestock during winter months has been reported as the potential source of infection for fascioliasis (Joshi 1994). Green grasses from near permanent water sources or water lodging areas in monsoon are another potential source of *Fasciola* infection. Therefore in the Nepalese Terai, the major risk period of *Fasciola* infection is during post monsoon and winter months.

Schistosoma spp. are the only trematodes living in the blood stream of warm blooded hosts. The blood stream is rich in glucose and amino acids. So along with the plasma and blood cells, it represents an environment which is suitable for egg producing trematodes. *Schistsoma* spp. causes disease called Schistosomiasis or Bilharziasis and is the main helminth diseases. The infections are often manifest by acute intestinal signs, the mucosa of the intestine is severally damaged and the animal develops profuse bloody diarrhea, dehydration and loss of appetite. Most of the species like *Schistosoma spindalia, S. japonicum* and *S. bovis* has been reported among buffaloes from Surkhet district (Ghimire 1987).

1.5 Cestoda

Cestodes found in gut are acquired by eating contaminated food or water found to be largely affecting the ruminants. This group comprises of the genera *Moniezia* sp., which is cosmopolitan in distribution and *Taenia* sp., which is commonly found in the rumen of the domesticated and wild carnivores. They have reported from Asia and Africa (Karki 2005).

Moniezia sp. in ruminants of the buffalo and cattle causes infections by ingesting herbage contaminated with the mites carrying the infective stage of the parasite. Heavy infections cause poor growth and diarrhoea in lambs.

Taenia saginata usually called cow or buffalo tapeworm has two hosts viz., definitive host man and intermediate host cow or cattle. It is also called beef tapeworm. The worms (segements) passes out along with the faeces of human being and when ingested by cattle, infects them on reaching alimentary canal of the host, the eggs hatch out and liberated, they penetrate the gut wall and enter mesenteric lymphatics and finally reaches circulation. Then they invade the muscular tissue and undergo further development.

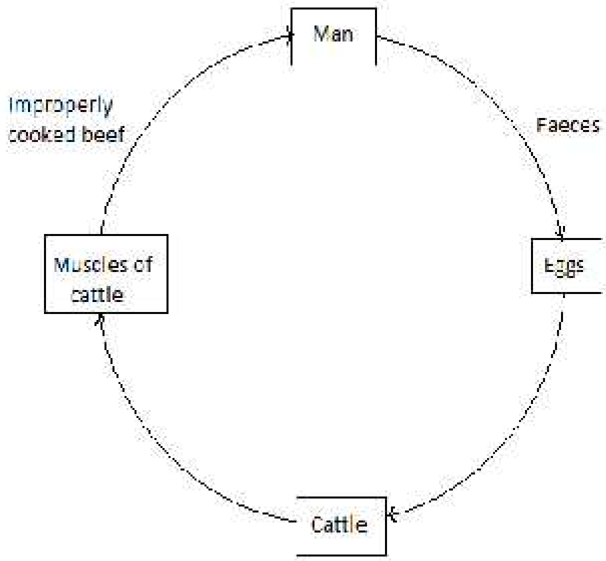


Fig. 2: Lifecycle of *Taenia* sp.

1.6 Nematoda

The most important and widely prevalent nematodes of buffalo are trichostrongyle group i.e. *Haemonchus* sp., *Ostertagia* sp., *Trichostrongylus* sp., *Cooperia* sp., *Oesophagostomum* sp.,etc. These nematodes in the small intestine may cause severe damage to the intestinal mucousal membrane with. *Toxocara* sp., and *Dictyocaulus* sp., has the worldwide distribution and the prevalence is higher in buffalo and cattle (Karki 2005).

Trichostrongyliasis is an infection of the gastrointestinal tract of herbivorous animals and man is the accidental host caused by the members of the genus *Trichostrongylus.* The infection is acquired by ingestion of contaminated vegetables or drinks with the filariform larvae. Strongyloidiasis is an intestinal infection of man caused by the penetration of the skin by the filariform larvae of *Strongyloides stercoralis.*

Toxocariasis in human is widely distributed throughout the world in both temperate and tropical countries. Man acquires infection by the ingestion of larvae of this nematode present in the inadequately cooked food of paratenic host. (Williams 1999)

Haemonchus is another important nematode parasite found in the abomasums of various ruminants. It causes severe blood and protein loss into abomasums and intestine due to damage caused by the parasite and often results in edema in the submandibular region.

Ostertagia occurs in the abomasums of goat, sheep, buffalo etc. the infection with this parasite the functional gastric gland mass and large area of gastric mucosa may be affected. *Cooperia* is relatively small worm found in the small intestine, rarely in the abomasums of ruminants.

Among roundworms of buffalo, the commonest are *Trichostrongylus* sp., *Ascaris* sp., *Strongyloides* sp. Female roundworms lay microscopic eggs that pass in the manure of buffaloes. Within few days the larva hatches from the egg. The larva passes via second and third stage. They infect the pasture. Buffaloes get infected when they graze on the contaminated pasture. The larva mature in the intestine, mate and begins laying eggs. Adult roundworms can cause anaemia, diarrhea, poor growth and even death.

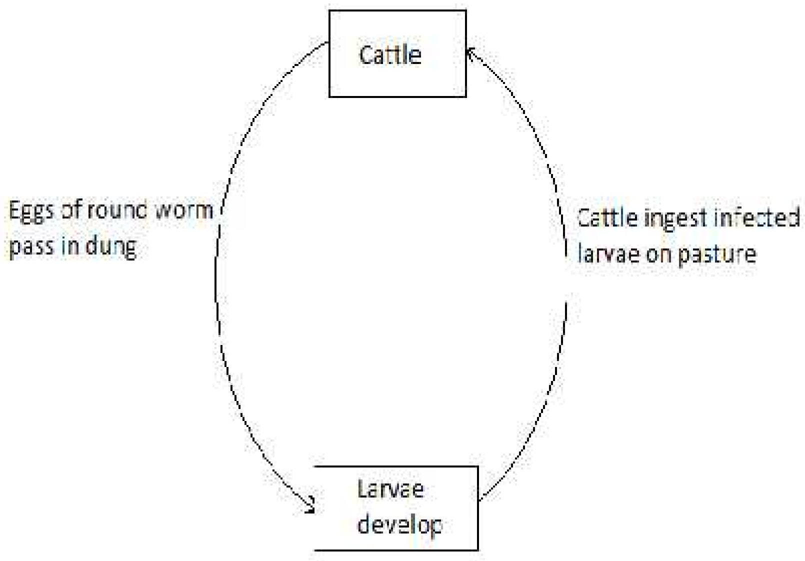


Fig. 3: Lifecycle of gastrointestinal roundworms in general

The pathogenic effect of gastrointestinal parasites may be sub-clinical or clinical. Young animals are most susceptible. The effect of these parasites is strongly dependent on the number of parasites and the natural status of the animals they are infecting. The clinical sign comprise of weight loss, reduced feed intake, diarrhea, mortality, reduced carcass quality and reduced wool production/quality. Severe blood and protein loss into the abomasums and intestine due to damage caused by the parasite often results in oedema in the sub-mandibular region. Some nematode species, especially *Haemonchus* is the most pathogenic of the blood suckers and infectious with large numbers of this parasite often result in severe anaemia in the host.

Cases of gastro-intestinal nematodes have been reported from several countries like Africa, Asia, Ethiopia, Sahel and parts of Somalia and Sudan.The widely prevalent nematodes *Haemonchus, Ostertagia, Trichostrongylus, Cooperia, Nematodirus, Oesophagostomum* and *Bunostomum*. *Toxocara* and *Trichuris* are quite pathogenic to animals throughout the world. Infections with gastro-intestinal nematodes usually occurs by the ingestion of eggs by young calves.

Toxocara sp. cause damage to the liver and lungs. The presence of the adult parasites in the small intestine is often associated with diarrhea and reduced weight gain. In untreated cases and heavy infections, the mortality rate may be upto 35-40 percent of infected animals, and it is believed to be the most serious disease of buffalo calves in Southeast Asia.

But, gastrointestinal parasites are major constraint in livestock production in humid tropics of Southeast Asia. The parasitic infections are worldwide problem for both small and large scale farmers. They cause economic losses in a variety of ways: they cause losses through lowered fertility, reduced work capacity, involuntary culling, a reduction in food intake and lower weight gains, lower milk production, treatment costs and mortality in heavily parasitized animals .

1.7 Statement of Problem

Parasitic disease (gastrointestinal nematodes, liver fluke and external parasites) are regarded as the most important cause of reduced productivity among goats in Nepal. Parasitic diseases are ranked first by farmers and this view has been further supported by studies showing higher prevalence of parasitic infestation in goat (Bashir 2009). Due to lack of adequate studies on parasitic epidemiology and appropriate control strategies large number of goat population is harboring parasitic infestation. The loss due to death of animal and decrease in production is high in Nepalese context and the problem is overwhelming in small ruminants.

1.8. Rationale of the Study

Understanding of the biology and epidemiology of gastrointestinal parasites of goat will led to improvement in control measures and a decrease in population losses however, only a limited number of studies have been undertaken to provide information on the prevalence, distribution and epidemiology of various species of parasites in goat of Banke. This study was designed to determine the prevalence and intensity of gastrointestinal helminthes in goat in relation to season, host, age and physiological status and is an attempt to bridge the gap in knowledge of these aspects. This study on helminthes will definitely aid to devise effective control strategies and it is advisable to plan effective integrated control strategies based on the epidemiological findings.

1.9 Limitations of the study

This study was designed to determine the prevalence and intensity of gastrointestinal helminths in goat in relation to season, host, age and physiological status. The identification of parasites was only based on morphology of parasitic egg and no larvae culture was performed. The study doesn't reveal why some parasites were more predominant and others were not. This study was limited to certain parameters and some of the parts of the study were left untouched due to time and cost factors. This academic study has been carried out for the partial fulfillment of the requirements for the Master's Degree in Zoology at Tribhuvan University,Kathmandu Nepal.

1.10 Objectives

1.10.1 General Objective

- To determine the prevalence of gastrointestinal helminths in goats of Banke.

1.10.2 Specific Objectives

- To determine the general prevalence of GI helminth parasites.
- To determine age, sex, season and location wise prevalence of GI parasites.
- To determine intensity of infection in goats.
- To assess level of knowledge among the goat farmers regarding management and use of anthelmintics.
- To develop the recommendations for the planning regarding the control of helminth parasites in goats.

1.10.3 Hypothesis

The test hypothesis used was stated as follows;

H_0 = There is no relationship between the prevalence of helminthes infection and the risk factors

H_1 = There is a relationship between the prevalence of helminths infection and the risk factors.

2
REVIEW OF LITERATURE

The name ‘‘helminth” is derived from the Greek words ‘‘helmins” or ‘‘helminthos”, meaning a worm, and is usually applied only to the parasitic and non-parasitic species belonging to the phylum *Platyhelminthes* (such as flukes and tapeworms) and *Nemathelminthes* (roundworms and their relatives). So, gastrointestinal helminth of goat mainly comprises of three groups of parasites viz. Cestodes, Trematodes and Nematodes.
Cestodes found in gut are acquired by eating contaminated food or water found to be largely affecting the ruminants. This group comprises of the genera *Moniezia* sp., which is cosmopolitan in distribution and *Taenia* sp. which is commonly found in the rumen of the domesticated and wild carnivores they have reported from Asia and Africa (Karki 2005). *Moniezia* sp. in ruminants of the goats and cattle causes infections by ingesting herbage contaminated with the mites carrying the infective stage of the parasite. Heavy infections cause poor growth and diarrhea in kids and adults.

Trematodes commonly known as flukes often live in the bile duct or small intestine and may also affect the lungs. Their eggs are passed with the feces of the host. Some are ingested but some burrow into the skin after hatching for access. Trematodes especially include *Fasciola* sp, *Schistosoma* sp. & *Paramphistomum* sp. Fascioliasis is a well known parasite of herbivorous animal. It has worldwide distribution on the animal reservoir host. A large variety of animals such as cattle, buffaloes show Infection rate that varies from 70% to 90% in some areas. The different local names of these diseases, such as Namle, Matey, Lew etc. in different regions are proof of its continued existence for many years in the animal population of the country. Infection of domestic ruminants with *Fasciola hepatica* and *F. gigantica* causes significant loss estimated at over US$ 2000 million per year to the agriculture sector worldwide with over 600 million animals affected (Hansen 1994). *Fasciola hepatica* and *Fasciola gigantica* inhabit similarly in the bile ducts of final host. The eggs produced by parasite are expelled with the bile into the intestine. These in turn are shed in the feces.

Gastrointestinal nematodes commonly known as roundworm are major constraints of goat production in Nepal. They belong to phylum *Nemathelminthes* which include many superfamilies of veterinary importance. These are *Trichostrongyloidea, Strongyloidea, Metastrongyloidea, Ancylostomatoidea, Rhabditoidea, Trichuroidea, Filarioidea, Oxyuroidea, Ascaridoidea and Spiruroidea* (Sissay 2007). However, in small ruminants, gastrointestinal nematodes are important members of the order *Strongylida*. This contains *Trichostrongyloidea, Strongyloidea, Metastrongyloidea* and *Ancylostomatoidea*, but most of them belong to the superfamily *Trichostrongyloidea*. Small ruminants are infected with a group of these *strongylid* nematodes, causing clinical effects known as parasitic gastroenteritis (Zajac 2006).

Several genera of roundworm are infective to goats. The major gastrointestinal nematodes of goats *are Haemonchus, Ostertagia, Trichostrongylus, Nematodirus, Chabertia, Oesophagostomum* etc. The pathogenic effects of gastrointestinal parasites may be sub-clinical or clinical. Young animals are most susceptible. The effect of these parasites is mainly dependent on the number of parasites and nutritional status of the animal they are infecting. The clinical symptoms are weight loss, reduced food intake, diarrhea and reduced yield. Severe blood and protein loss intro abomasums and intestine due to damage caused by the parasite often results in submandibular edema. Some nematode species especially *Haemonchus* sp. is most pathogenic among blood sucking worms and infection with large number of this parasite often results in severe anemia in the host.

The life cycle of the nematode may be direct or include an intermediate host. The sexes are usually separated (male and female). However, all of the economically important *strongylid* (gastrointestinal) parasites of small ruminants have direct life cycles, requiring no intermediate hosts (Sissay 2007). The mature parasites (worms) breed inside the host and lay eggs which pass through the host and are shed in the feces. After the eggs pass out of the host, they hatch into first-stage larvae (L_1) and moult into second-stage larvae (L_2) under appropriate conditions of temperature and humidity. The larvae need moisture to develop and move. During this time the larvae feed on bacteria.L_2 moult into infective larvae (L_3), which migrate out of the faces and up blades of grass. When an animal (sheep or goat) grazes, they may ingest parasite larvae along with the grass. Normally L_3 can moult into fourth-stage larvae (L_4) within 2-3 days, remaining for further 10-14 days to moult into young adult parasites (Soulsby 1982; Hale 2006; Coffey et al. 2007).

Parasite numbers rise with time when conditions are suitable and internal parasite burdens impact on the health and well-being of the animal when their numbers grow beyond what the animal can tolerate (Hale 2006).

Nematodes are pathogenic parasites, causing disease in the host. Usually they live in the digestive system of the host. *Haemonchus contortus* attaches to the wall of the abomasum in sheep and goats, feeding on the host's blood, causing aneamia. Other nematodes usurp the nutrients eaten by the host, causing weight loss (Hale 2006). *Teladorsagia circumcincta* in the abomasum reduces feed intake. In the small intestine *Nematodirus battus* dehydrates the animal. *Trichostronglus colubriformis* and *Trichostronglus vitrinus* reduce feed efficiency in small ruminants. In cattle, *Haemonchus placei* in the abomasum causes anemia and *Ostertagia ostertagi* reduces feed intake. *Cooperia oncophora* and *Cooperia punctata* in the small intestine of the cattle reduce feed efficiency (Houdijk & Athanasiadou 2003) and affect protein metabolism. Absorption and/or retention of minerals (especially phosphorus) are particularly affected (Robert & Kyriazakis 2001). The effects of nematode parasites on the host are manifest as a loss of condition, rough hair coat, scours, diarrhoea, bottle jaw, pale mucous membranes (eyelids, gums), anaemia and death (Hale 2006). Holmes (1993) reported that the nematode mode of action results in the loss of considerable quantities of host protein into the nematode tract; the proteins represent plasma and frequently erythrocytes, exfoliated epithelial cells and mucus. Furthermore, Parkins & Holmes (1989) accurately reported losses of blood proteins into nematode tract using radioisotopic technigues to be about 10 % of the total blood volume per day. This is sufficient to explain the pathophysiology of nematode infections. The observation reported the infections are usually associated with hypoalbuminaemia and, in some cases, with anaemia. Nematode parasites also affect the feed digestion, energy and nitrogen utilization in the parasitized animal and reduce the performance of the host and feed intake (Holmes et al. 1986). Feed intake reduction is a primary effect of parasitism. However, the basic reason(s) for that is not clear yet (Parkins & Holmes 1989).

The epidemiology of parasitic infection depends mainly on one or more of the hosts, the parasite and environmental factors. The ultimate occurrence of parasitic disease is as a result of four basic reasons, namely an increase in the numbers of infective stages, an alteration in host susceptibility, introduction of susceptible stock and the introduction of infection (Urquhart et al. 1988).

Host factors include such issues as nutritional status, physiological state, age, sex, breed and level of acquired or innate resistance. The nutritional status of an animal plays an important role in its ability to withstand infection. Poor nutrition increases the host susceptibility to infection and the reverse is true when nutrition is good; adequately fed animals are better able to tolerate the effects of parasitism than those on a poor diet (Faizal and Rajapakse 2001). For example, animals infected with blood sucking parasites such as *Haemonchus* will maintain their hemoglobin levels as long as their iron intake is adequate (Urquhart et al. 1988). This is usual the case especially end of /after winter when the quality of food such that animals do not ingest sufficient iron and start to die. Similarly growth rates may not be adversely affected if protein intake is good. Better nutrition during spring and the beginning of summer has been found to result in a decrease in fecal egg count in small ruminants (Papadopoulos, Arsenos, Sotiraki, Deligiannis, Lainas and Zygoyiannis 2002). Trace elements may also be important.

The physiological status of the host, such as pregnancy and lactation, especially if nutrition is not increased to meet fetus and milk requirements, may increase susceptibility to parasitic infection. Under these circumstances even low worm burdens can have detrimental effects on the food conversions of the dam, ultimately affecting fetal or neonate growth. Goats in particular are more susceptible during pregnancy and early lactation (Urquhart et al. 1988).

Age is well known to have significant influence on the susceptibility to infection. This has been attributed to increased resistance to infection and/or re-infection with age due to immunity as a result of intake of small number of larvae early in life. Even though these animals develop immunity with age, the majority remain susceptible until such time as they have been exposed to infection, for instance if they are moved to an endemic area. Most animals become more resistant to primary infection with internal parasites as they become older but adults not previously exposed to the helminths are at high risk if moved into an endemic area (Urquhart et al. 1988). Bookmker et al. (1994) in their study also found an inverse relationship between the ages of goats and the mean nematode burden. Very young kids were, however, noted to have low burdens and this was attributed to a diet consisting mainly of milk and only small amounts of vegetation containing infective larvae. In contrast, Magona and Musisi (2002) in their study did not find age to have a significant influence on the fecal egg count.

Some breeds may be more resistant to helminths infection than others with the variability being genetically determined (Urquhart et al. 1988). For example it has shown that the Red Masaai sheep, indigenous to East Africa, is more resistant to *Haemonchus contortus* than exotic breeds such as the Dorper (Nginyi et al. 2001). The khari breed of Nepal is more resistant to parasitic infection than exotic breeds. The selection of resistant animals and culling of poor responders could be able to afford anthelmintics. There is also some evidence that entire male animals are more susceptible than females to some helminthes infections (Urquhart et al. 1988). This could be important in communities where castration is not routinely practiced.

Little attention has been given to the variability between different strains of parasites in terms of their ability to infect their hosts or their pathogenicity. Parasites are, however, generally highly adaptable and it will remain important in animal health and production to conduct further investigations along these lines (Coles 2001). Numerous parasites have developed severe resistance to anthelmintics to use in any situation based on available information and informed research.

The environment plays a crucial role in the epidemiology of helminths infections. Development of infective stages is dependent on temperature and moisture, with levels of pasture contamination fluctuation in relation to rainfall (Nginyi et al. 2001). Similarly, the total gastro-intestinal nematode burden (Pandey et al. 1994) and the fecal egg counts (Specht 1982; Yadav and Tandon 1989; Madu and Richards 2007) were also found to be positively related to climatic conditions, especially rainfall. The microclimatic humidity is also dependent upon other elements such as soil structure, vegetation type and drainage. In humid areas, the prevalence does not show a marked seasonal pattern because favorable conditions exist throughout the year (Yadav and Tandon 1989).

The influence of global warming may play an important role in the occurrence of parasitic diseases. An increase in temperature may permit development of parasites where previously ambient temperatures were too low to allow for it (Coles 2001) or eradicate parasites should the temperature increase above tolerable levels.

A single female parasite generally produces thousand of eggs under favorable climatic conditions such as those in autumn for *Ostertagia* and *Trichostrongylus* and spring and summer for *Haemonchus*. This results in contamination of the environment with eggs of the parasite. The intensity with nematodes has been related to stocking rates in goats (Cabaret and Gasnier 1994) and for it to have impact all or most of the animals must be susceptible. This makes immune status of the host animal very important.

The introduction of new stock plays an important role in the spread of parasitic infections. Today the introduction of a resistant worm population is probably the most important epidemiological consideration.

2.1 Literature review in global context

Opara et al. (2005) conducted a study on occurrence of parasitic helminthes among small ruminants reared under traditional husbandry system in Owerri, south east Nigeria. In this study, out of 2,550 small ruminants examined, 71.4% were goats which had helminth infection rates of 90.1%. Nematode infection was consistently high and gave infection rate of 78.4%, while trematodes and cestodes were recorded 13% and 8.7% respectively. Among trematodes *Paramphistomum* infection was 86.7%, among nematodes Strongyloides 63.2% and among cestodes. *Moniezia* 50% were the highest.

Lima et al. (2006) studied the faecal samples from 20 goats in Paulista, Pernambuco, Brazil, from August 1998 to July 1999.they were subjected to eggs per gram faeces (EPG) determination and nematode larvae culture. It was shown that 82% of the samples were positive for helminths. *Strongyloides*, *Moniezia* and *Trichuris* spp. ova were obtained in 72.8, 8.4 and 2.0% of the samples, respectively, while third stage larvae of *Haemonchus*, *Trichostrongylus* and *Oesophagostomum* spp. were obtained from 75.13, 24.32 and 0.54% of the samples, respectively. The medium number of *Haemonchus* and *Trichostrongylus* spp. larvae per gram faeces was higher in the rainy months. There was a significant correlation between EPG and temperature, EP and rainfall and EPG and the number of *Haemonchus* spp. larvae per gram faeces. *Haemonchus* spp. was present throughout the study period.

Uddin et al. (2006) investigated the prevalence of *Amphistome* parasites in Black Bengal goats slaughtered at different slaughterhouses of Mymensingh district, a total of 144 gastro-intestinal tracts were examined during the period of July 1998 to June 1999 in the Department of Parasitology, Bangladesh Agricultural University, Mymensingh. Out of 144 Black Bengal goats, 105 (72.92%) were infected with a single or multiple species of amphistomes. In present investigation, three species of amphistomes viz *Paramphistomum cervi*, *Cotylophoron cotylophorum* and *Gastrothylax crumenifer* were identified. The highest infection was observed with *Paramphistomum cervi* (65.28%) and lowest infection with *Cotylophoron cotylophorum* (36.11%). Mixed infections with two or more species of amphistomes were found in 60.42%. The prevalence of amphistomes was very high all the year round and the rate of infection was 83.64%, 69.23% and 64.0% during monsoon, winter and summer season respectively.

Regassa et al. (2006) conducted a study to determine the prevalence and risk factors associated with gastrointestinal parasitism in western Oromia, Ethiopia during 2003–2004. A total of 757 ruminants (257 cattle, 255 sheep, and 245 goats) were included in the study using standard coprological parasitological procedure. The study showed that the overall prevalence of gastrointestinal parasites was 69.6% with 50.2%, 75.3%, and 84.1% in cattle, sheep, and goats, respectively. *Strongyles* and *Eimeria* were the most prevalent parasites encountered in the area. Season and age were shown to have association with prevalence but not with EPG while no association was revealed between prevalence and EPG with sex and body condition of the animal

Di Gerbo et al. (2006) carried out a survey of parasites in goat farms in Bergamo province, north Italy from May 2005 to Jan, 2006. Fecal samples of 836 adult female goats from 31 dairy goat farms were examined. *Strongyloides* sp. showed higher values of prevalence in goats housed in summer while Nematodirus in winter in goats at pasture. *Strongyloides* occurred more frequently in autumn in stabled goats.

Yadav et al. (2006) studied 520 faecal samples from sheep (n=245) and goats (n=275) from Jammu district India which revealed a total of 83.07% gastro-intestinal parasite infection. 83.24%, 80.00%, 84.72% and 80.55% infection was observed in sheep, lambs/hoggets, goats and kids, respectively. *Strongyles* (44.62%) were predominant followed by *Amphistomes* (8.07%), *Eimeria* sp. (6.73%), *Fasciola* sp. (3.08%), *Trichuris* sp. (3.08%), *Dicrocoelium* sp. (1.92%), *Strongyloides* sp. (1.15%) and *Moniezia* sp. (0.96%). Mixed infection with one or more gastro-intestinal ova was also detected in

13.46% of animals. Seasonal variation was recorded throughout the year and was highest during rainy season (88.54%) followed by summer (83.15%) and winter (76.01%).

Rehman et al. (2006) assessed the month-wise prevalence of gastrointestinal trematodes, nematodes and cestodes in Damani sheep and goat in Pakistan. A total of 96 positive gastro-intestinal tracts (48 each) of sheep and goats were examined. Trematode infection was 16.66% both in sheep and goats in May, whereas in June, July and August it increased to 25% in sheep. A similar increase was recorded in June and July in goats which dropped to 8.33% in August. Highest cestodial infections in sheep and goats were recorded in June (33.33%) and August (41.16%), respectively. The lowest recorded nematodal infections in sheep were observed in June (41.66%), which increased in July (50%), May (58.33%) and August (58.33%). In goats, the lowest records were observed in June (41.66%), with an equal increase in May and August (i.e. 50%).

Menkir (2007) carried out a two year epidemiology study of helminthes of small ruminants. The study involved the collection of viscera from 655 sheep and 632 goats from 4 abattoirs in eastern Ethiopia. A further more detailed epidemiology study of gastro-intestinal nematode infections used the Haramaya University (HU) flock of 60 Black Head Ogaden sheep. The parasitological data included numbers of nematode eggs per gram of faeces (EPG), faecal culture L3 larvae, packed red cell volume (PCV), adult worm and early L4 counts, and FAMACHA eye-colour score estimates, along with animal performance (body weight change). There were 13 species of nematodes and 4 species of flukes present in the sheep and goat, with *Haemonchus contortus* being the most prevalent (65–80%), followed by *Trichostrongylus* spp. The nematode infection levels of both sheep and goat followed the bi-modal annual rainfall pattern, with the highest worm burdens occurring during the two rain seasons (peaks in May and September).

Nwosu et al. (2007) carried out a survey to determine the prevalence and seasonal abundance of the egg and adult stages of nematode parasites of sheep and goats in the semi-arid zone of north-eastern Nigeria between January and December 2002. Faecal samples collected from 102 sheep and 147 goats and examined by the modified McMaster technique revealed that 44 (43.1%) and 82 (55.8%) of the samples, respectively, contained at least one nematode egg type. Three nematode egg types were recovered with *Strongyle* egg type (22.5% in sheep and 35.4% in goats) being the most prevalent followed, respectively, by *Trichuris* (5.9% in sheep and 4.1% in goats) and *Strongyloides* (4.9% in sheep and 4.1% in goats) egg types. Mean faecal egg counts were generally moderate in both sheep (1052+/-922 *Strongyle*, 1000+/-590 *Strongyloides* and 380+/-110 Trichuris eggs, respectively, per gm of faeces) and goats (2092+/-3475 *Strongyle*, 958+/-854 *Strongyloides* and 683+/-512 *Trichuris* eggs, respectively, per g of faeces). The prevalence and counts of *Strongyle* nematode eggs showed a definite seasonal sequence that corresponded with the rainfall pattern in the study area during the period. In both sheep and goats, counts of *Strongyle* egg type increased with the rains and reached peak levels at about the peak of the rainy season in September. The other egg types encountered during the study did not show much variation with the season of the year.

Shirale and Maske (2007) reported that out of 1173 fecal sample of Goat examined 65.47% (768) were positive in Nagpur, India. They also found that prevalence was high during peak monsoon.

Ijaz et al. (2008) carried out a study to find out the infection rate of gastrointestinal tract (GIT) helminths and its association with diarrhoea in goats in Lahore, Pakistan. For this purpose, 300 faecal samples from goats suffering from diarrhoea presented at the Outdoor Hospital, Department of Clinical Medicine and Surgery, UVAS Lahore and various private as well as government hospitals located in Lahore were examined coprologically for the presence of helminths. The result revealed that an overall infection rate of GIT helminthes was 63.33% in goats. When compared the class wise infection rate, highest infection rat nematodes (42.67%) was observed, followed by trematodes (16.67%) and cestodes (4%).

Rajapakse et al. (2008) collected and examined the gastrointestinal tracts of 218 crossbred goats representing the dry zone of Sri Lanka during a year study period.217 (more than 99%) of the animals examined were infected with one or more species of nematodes. Five species of nematodes were found in the abomasum and intestines. They were *Oesophogostomum columbiamum* (88%), *Haemonchus contortus* (81%), *Trichostrongylus columbriformis* (76%), *Trichostrongylus axei* (59%) and *Trichuris ovis* (59%).

Saiful Islam et al. (2008) carried out a year-round study on 136 Bengal sheep and 224 Bengal goats with the aim to compare the species diversity and prevalence of infections with protozoa, flukes, tapeworms and nematodes parasitizing gastrointestinal tract and lungs of the small ruminants from various parts of Bangladesh. The prevalence of internal parasitic infections was higher in goats (74.55%) than in sheep (55.88%). Liver fluke (*F. gigantica*) was more prevalent in goat (14.28 %) than in sheep (8.82%) whereas tapeworm Infection was more frequent in sheep (24.26%) in comparison to goat (16.52%). Goats (33.48%) showed eight times higher prevalence of *Muellerius capillaris (*lungworm) infections than sheep (4.41%) did. The most prevalent gastrointestinal nematode in both host species was *Trichostrongylus* followed by the occurrence of *Haemonchus*. A total of 10 different types of internal parasites were identified of which 9 were common for both species. The most commonly occurring parasites in both species include *Eimeria*, *Trichostrongylus, Haemonchus*, *Moniezia* and *Fasciola*.

Bilal (2009) reported the prevalence of gastrointestinal parasites on calves (80 of each buffalo and cow). The results indicated that 75% buffalo and 56.25% cow calves were positive for worm infestation. The highest prevalence of nematodes was recorded followed by mixed infection and cestodes, and no calf was found positive for trematodes. Buffalo and cow calves between 1 to 6 months of age exhibited highest prevalence (86.67, 69.05%) compared to the age group of 7 to 12 months (60, 42.10%). Calves on grazing were heavily infected 983.33% buffalo calves, 75% cow calves) than those of stall fed (70% buffalo calves, 46.16% cow calves). Buffalo male calves were more affected (88.38%) than female calves (59.46%) whereas, the same was for cow calves.

Maichomo et al. (2010) conducted a study on the prevalence of gastrointestinal parasites in calves, sheep and goats in Magadi division, South - western Keny. In this study fecal samples were obtained directly from the rectum of 109 calves, 133 goats and 20 sheep. The significance of differences in mean egg per gram (EPG) between animal species and herds (farms) were assessed using analysis of variance. The overall prevalence of nematodes in the calves, sheep and goats was 69.2 %, 80% and 82 % respectively.

Athar et al. (2011) conducted a study to determine the point prevalence of various helminths of cattle and buffalo population of district Toba Tek Singh, Pakistan and economic benefits of deworming with oxyclozanide.Out of 540 faecal samples examined, 205 (37.96%)were found infected with helminths. Significantly higher prevalence of helminths was recorded in buffaloes (40%, 112/28) as compared to cattle (35.77%, 93/260). *Oesophagostomum, Cooperia, Trichostrongylus,Strongyloide, Ostertagia, Fasciola hepatica, Fasciola gigantica* and *Haemonchus contortus* were the helminth species identified in the study area. Oxyclozanide medicated buffaloes (E=96.66%) and cattle (E=95.64%) showed a significant decrease in faecal egg counts on day 14 post-treatment. An average daily increase of 0.89 and 0.71 liters of milk along with 0.42 and 0.37% more fat per buffalo and cattle, respectively was observed in oxyclozanide medication. It can be concluded that single dose of oxyclozanide is effective against all bovine helminths.

Terefe et al. (2012) carried out a study on prevalence of internal parasites infecting Boer goats at Adami Tulu Agricultural Research Center, Ethiopia. This stuy determined the prevalence and intensity of internal parasites infecting pure and cross bred Boer goats, and to determine the risk factors associated with the parasites. The study covered five months from November 2009 to March 2010. During this period, fecal samples from 192 goats (104 pure Boer goats and 88 cross bred goats) were examined. All goats were infected with at least one type of parasite. *Strongyloides* sp. (4.7%), *Moniezia* sp.(7.8%), *Skrjabinema* sp.(11.5%), *Stongyle* - type species (49.5%) and *Eimeria* sp.(100%) were identified.

2.2 Literature review in context to Nepal

Acharya (1999) carried out a study on GI parasites of goat and sheep of IAAS livestock farm and recorded *Haemonchus, Ostertagia, Chabertia, Strongyloides, Trichostrongylus, Oesophogostomum* and *Cooperia*.

Kushwaha (2000) conducted an investigation of goat diseases under commercial rearing system from May 1999 to April 2000 in Surkhet. In the study the prevalence percentage of parasitic disease was 44% of which 88% was due to *Strongyloides* spp., 2% was due to *Ostertagia* spp., 7% was due to *Haemonchus* spp. and 1% due to *Coccidia spp*.

Nirmal (2000) conducted a study of major diseases of goats in far western region of Nepal. In the study, 71% cases were found as parasitic diseases, among which 54.6% due to *Strongyloides* and 61% due to coccidians.

Joshi (2000) conducted a study for a period of 1 year on epidemiology and clinical significance of gastrointestinal nematodes on the health and production of goats raised under the sedentary and migratory management in the hills and mountains in Nepal. The findings showed that the worm burden in the migratory goats was considerably higher than that in the sedentary (management) goats throughout the year. *Ostertagia* was the 21 predominant nematode genus present in migratory system followed by *Trichostrongylus* spp, with a lower proportion of *Haemonchus*. In sedentary system, however, the predominant genus was *Trichostrongylus* followed by *Haemonchus*.

Devkota (2005/2006) conducted a study on outbreak of parasitic gastroenteritis in goats under sedentary management in a low hill village of western Nepal. In this study, *Heaemonchus contortus* was the most prevalent species

Dhital (2006) conducted a study to determine the prevalence of gastrointestinal parasites in goats at the IAAS livestock farm and Manglapur VDC- 2, Chitwan. A total number of 7 gastrointestinal parasites were found from goats. Among them Strongyles types (*Haemonchus, Trichostrongylus, Bunostomum, Cooperia and Ostertagia*) and *Nematodirus* were the common parasites, whereas *Trichuris, Moniezia* and *Oesophagostomum* spp. were less common. The fecal samples examination showed that out of 20 samples collected from goats of IAAS farm, 90% were positive for eggs of one or more types of GI parasites, 22 whereas out of 32 samples collected from Manglapur VDC-2, 76.66% were positive for eggs of these parasites.

Jaiswal (2006) carried a study on fascioliasis in ruminants at Dhanusa district based on examination for fecal sample brought to DLSO, Janakpur from June 15 to November 15, 2005. A total of 2655 fecal samples were examined out of which 70.70% were positive for overall parasitic infestation. Among these, prevalence of fascioliasis was found to be 43.43%, followed by paramphistomiasis 38.09% and roundworms 13.43%. The prevalence of *Fasciola* infection found in goat was 31.25%, in cattle 49.36% and in buffalo was 56.02%.

Acharya (2008) conducted a study on GI parasites of Goat in IAAS livestock farm and recorded *Haemonchous, Chabertia, Ostertagia, Strongyloides, Trichostrongyloides, Oesophagostomum* and *Cooperia.*

Bashir (2009) conducted a study on goat in order to observe the seasonal prevalence of intestinal helminthes parasites in goat brought to Khashi-bazaar, Kalanki. The total numbers of samples collected and examined for the study were 100 and 124 respectively during study period. The overall prevalence of helminthes parasite during December and January were 46% and that in the month of May and June were 90.3%. Mixed infection was observed in 26% and 87.5% in the samples of winter and summer respectively.

Shrestha and Joshi (2010) conducted a study in Kirtipur Municipality. A total of 200 water buffaloes were slaughtered and examined of which 100 were observed during the winter time and 100 were observed during the summer time 2008. Out of them, 93 (46.50%) were male and 107 (53.50%) were female. 54 (27%) of them were calves, 51 (25.50%) were adults and 95 (47.50%) were olds. Female were found more infected with fascioliasis. 38.05% of the female had fascioliasis as compared to 16.09% of male. The difference in sex-wise prevalence of fascioliasis was found significant ($p = 0.0004$). Old animals (35.78%) were infected with *Fasciola* more often than calves (14.81%) and (29.41%) adults. Out of 35 positive cases of *Fasciola* infection observed during winter, 20 (57.14%) buffaloes had only *Fasciola hepatica* while 11 (31.42%) had only *F. gigantica* and 4 (11.42%) had both *F. hepatica* and *F. gigantica.* Similarly during summer, out of 22 animals that had fascioliasis, *F. hepatica* was found in 7 (31.81%) of them while *F. gigantica* was observed in 12 (54.54%) of them and 3 (13.63%) of them had both *F. hepatica* and *F. gigantica.* Infection with *Fasciola hepatica* (59.65%) was found slightly higher than *Fasciola gigantica* (52.63%).

Rijal (2010) carried a study to determine the seasonal prevalence of helminth parasites in goats of Khiljee,Arghakhachi. During examination of samples of summer, winter and rainy season 170 hosts were found to be infected out of 250 hosts. Over all outcome of the study was 68% prevalence. This study showed 48.82% trematode infection, 26.47% cestode infection and 74.70% nematode infection.

3

MATERIALS AND METHODS

3.1 Study design

The study was an observational study and specifically a cross-sectional study where fecal egg counts as an ante-mortem means of diagnosing gastrointestinal helminths infections of goats was used. This technique has been practiced for many years and has provided very good indicative results

3.2 Study period

The study was carried out from August 2009 to December 2009

3.3 Sampling and sample size

The total sample size was 315. The sample size was determined by using formula given by taking 70% Prevalence rate (Bashir 2009). Sampling technique was multistage random sampling and samples were collected in two seasons from both sexes of goats of three age groups.

In first stage three VDCs out of 46 VDCs were selected by simple random sampling using lottery method. Then four wards from each of three VDCs were selected using similar technique. From Khaskushma VDC ward no 1, 5, 6 and 8 were selected similarly from Mahadevpuri VDC ward no 1, 2, 7 and 9 were selected and from Rajhena VDC ward no 1, 2, 4 and 7 were selected. The numbers of goat rearing households were ascertained in each ward of three selected areas by taking aid of community leaders and local veterinary practitioners. From household rearing goats, 5 households from each wards of study area were randomly selected and goats from each household were categorized into three age groups, namely kids (< 4 months), young goats (5-12months) and adult goats (>12 months). The breeds were categorized as indigenous and exotic while the sexes were male and female. Then fecal sample were collected including male and female of each age groups of goats. The selection of goats was not based on whether or not the goats had been treated for internal parasites. Altogether 315 samples were taken from 60 households, 20 households from each area. Of the samples 165 were taken during post rainy season and 150 were taken during winter season. Samples were collected and examined during the period from August to December 2009.

Table 1: **Numbers of samples collected from different study area**

Study area	Number of samples taken		Total
	Wet season	Dry season	
Khaskushma	55	50	105
Rajhena	55	50	105
Mahadevpuri	55	50	105
Total	165	150	315

3.4 Sample collection

The goats were individually sampled. Fecal sample were taken per rectum. The fecal samples were kept in a plastic zipper bag containing cotton soaked in 3% formalin. The zipper bag was then locked, correctly labeled and stored in a refrigerator before being sent to Central Veterinary Laboratory Tripureshwor Kathmandu. Samples were collected during wet season (August/September) and during winter (December) of 2009.

3.5 Data collection

In this study both primary and secondary data was collected. Primary data was in form of egg counts and answer to questionnaires, while secondary data was collected from veterinary records of DLSO, Banke . Farmers were asked to provide answers to two questionnaires (Annex I & II). The first was to collect information on the farmers management practices while the second collected information about the individual goat.

The questionnaire was used to gather all relevant current historical information on the goats. The questionnaire also captured the status of the animal such as body condition or any other observed signs of ill health. The epidemiological risk factors captured were age, sex, location and season.

3.6 Precautions and preservation

To ensure better condition during sample collection the following precautions were taken.

a) The fresh fecal samples were taken.
b) The samples were collected in airtight container to prevent desiccation.
c) 3-4 drops of 10% formalin were used to fix fecal samples.

3.7 Laboratory apparatus and materials

a. Motor and pestle
b. Test tube
c. Cotton
d. Cover slip
e. Slides
f. Glass rod
g. Centrifugal machine
h. Gloves
i. Tea strainer
j. Microscope
k. Pasteur pipette
l. Refrigerator
m Dropper
n. Rack

3.8 Chemicals

a. Formalin
b. Distilled water
c. Zinc sulphate solution (33%)
d. Methylene blue

3.9 Parasitological techniques

3.9.1 ***Qualitative fecal examination***

The sedimentation and floatation technique as described by ***Soulsby, (1986)*** was used to detect the presence of eggs of flukes, tapeworms and roundworms in the samples

3.9.1.1 ***<u>Differential sedimentation</u>***

The majority of trematode eggs are too large and heavy to float reliably in the flotation fluids normally used for nematode eggs. They do however sink rapidly to the bottom of a fecal/water suspension and this is the basis of the fecal sedimentation technique. So, Sedimentation method is most appropriate for examination of heavier egg such as fluke's eggs. The procedures are as follows;

- Approximately 3g feces was weighed
- Feces was homogenized with water (45-50ml) using mortar and pestle
- The suspension was passed through a coarse mesh sieve and the debris was discarded
- The filtrate was then allowed to stand for 5 minutes in a beaker
- The supernatant was removed and sediment was resuspended with water (till the suspension becomes clear)
- The suspension was then allowed to sediment for next 5 minutes
- The supernatant was drawn off
- Few drops of methylene blue was added which stains fecal particle deep blue leaving trematodes egg unstained
- A drop of stained sediment was placed on clear slide, covered with cover slip
- The fecal smear was examined using a compound microscope at 10 x 10 magnifications.

3.9.1.2 ***<u>Differntial floatation</u>***

In this method the eggs were separated from fecal material and concentrated by a flotation fluid of an appropriate specific gravity. Nematodes and cestodes eggs float in a liquid with specific gravity of between 1.10-1.20; trematode eggs, which are much heavier, require a specific gravity of 1.30-1.35. For trematode eggs saturated solution of zinc sulphate (33% w/v) is used and for nematodes and cestode eggs saturated solution of sodium chloride is used. The procedures of floatation method are as follows;

- Approximately 3g feces was weighed
- Feces was homogenized with water (45ml) using mortar and pestle
- The suspension was passed through a coarse mesh sieve and the debris was discarded
- 15ml filtrate was taken in the centrifuge tube.

- The mixture was allowed to sediment for 10-15 minutes on bench, or by light centrifugation (1000rpm for 5 minutes) for two or three occasions, until the supernatant becomes clear and supernatant was drawn off
- The tube was gently topped off with the floatation solution leaving a convex meniscus at the top of the tube
- Cover slip was carefully placed on the top of tube
- Tube was left on stand for 15-20 minutes
- Cover slip was carefully lifted off the tube together with the drop of fluid adhering to it.
- Cover slip was placed on a clean slide
- The slide was examined using compound microscope at 10 x 10 magnifications

3.9.2 ***Quantative fecal examination***

3.9.2.1 ***Stoll's counting method***

The degree of infection was determined by counting the egg per gram feces through Stoll's counting method. According to Doctor Tom Nola, University of Pennsylvania, 2004, Stoll's counting method is the easiest quantitative method to count eggs present in the microscopic field without using McMaster's technique. The procedure for Stoll's counting method is as follows;

- 3 g feces was weighed
- Feces was homogenized adding 42 ml of saturated salt solution using mortar and pestle
- The suspension was strained to remove debris
- The filtrate was thoroughly shaken and 0.15 ml was withdrawn using pipette
- Placed on the slide and covered with long cover slip
- The number of eggs within the whole slide was counted
- Number of eggs counted was multiplied by 100 which represents EPG of original sample

3.10 **Determining the most prevalent helminths parasite**

The most common helminths parasite in terms of prevalence was determined by the number of fecal samples that had eggs of that particular parasite regardless of the number of eggs. In this study, no larval culture was done. Identification of the different helminths parasites was based on the morphology of the eggs (Foreyt WJ 1997). 0n the basis of **EPG, level of infection** was categorized into 3 groups as light (100-500 EPG), moderate (100-500 EPG) and heavy (>1500 EPG) infection as given by (Soulsby 1982) and samples with moderate and heavy infection were considered as significant.

3.11 Data analysis

The prevalence was calculated by dividing the number of samples showing significant EPG by the total number of samples examined. Percentage (%) was used to measure prevalence .The Chi-square test was used to evaluate statistical significance of the association between the risk factors and prevalence and/or the existence of clinical signs of parasitic infection

Data was presented in form of contingency tables showing the observed frequency per risk factor. The expected frequency for each cell of the table was determined by the formula and Chi-square (|$\Re^2$) was then calculated at 5% level of significance.

4
RESULTS

The result has been divided into eight parts:

1. Prevalence of helminths infection in Goats
2. Class wise prevalence of helminth parasites
3. Seasonal prevalence of helminths infection
4. Age wise prevalence of helminths infection
5. Sex wise prevalence
6. Location wise prevalence
7. Intensity of infection
8. Results of questionnaire survey

4.1 <u>Prevalence of helminths infection</u>

4.1.1 ***<u>Overall prevalence</u>***

In this study 315 goat fecal samples were collected. Of these, 165 were sampled during the post rainy season and 150 during the winter season. Of the 315 samples 208(66.03%) samples were positive for one or more parasites. Among the samples having significant EPG 85 were males and 123 were females. All age groups were affected. The most common parasites encountered were *Strongyloides* (24.39%), *Haemonchus* (20.97%), *Moniezia* (20.52%), *Trichostrongylus* (19.45%), *Trichuris* (17.65%), *Fasciola* (17.25%), *Nematodirus* (11.12%), *Paramphistomum* (9.28%), *Oesophagostomum* (8.91%), *Ostertagia* (8.35%), *Chabertia* (7.65%), *Dicrocoelium* (5.45%) and *Capillaria* (2.15). Altogether 13 genera of helminth parasites were found in present study among them one cestode (*Moniezia*), 3 trematodes (*Fasciola, Paramphistomum and Dicrocoelium*) and 9 were nematodes.

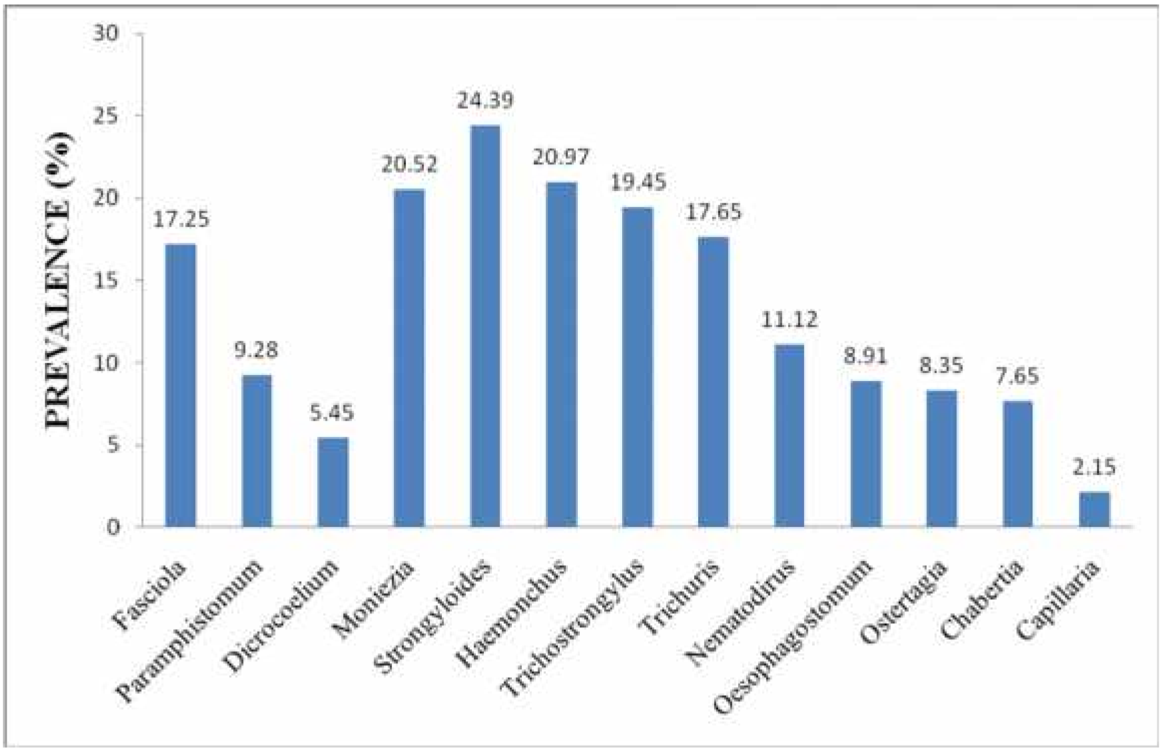


Figure 4: Prevalence of different helminth parasites

4.1.2 *Class – wise prevalence of helminth parasites*

Out of 315 fecal samples, 125 (75.75%) and 83 (55.33%) samples were found to be positive during both the seasons i.e. summer and winter. Therefore, the general prevalence rate of helminth parasites in goats was found to be 66.03%. This study showed 45.67% trematode infection, 24.51% cestode infection and 82.21% nematode infection. The total numbers of genera observed during examination were 13 in number i.e. 3 genera of class trematoda (*Fasciola*, *Paramphistomum* and *Dicrocoelium)* ,1 genera of class cestoda (*Moniezia*) and 9 genera of nematoda were observed (Fig 5). In class nematoda were *Strongyloides* (24.39%), *Haemonchus* (20.97%), *Trichostrongylus* (19.45%), *Trichuris* (17.65%), *Nematodirus* (11.12%), *Oesophagostomum* (8.91%),*Ostertagia* (8.35%), *Chabertia* (7.65%) *and Capillaria* (2.15%). The class-wise prevalence percentage of each species is given in table 2.

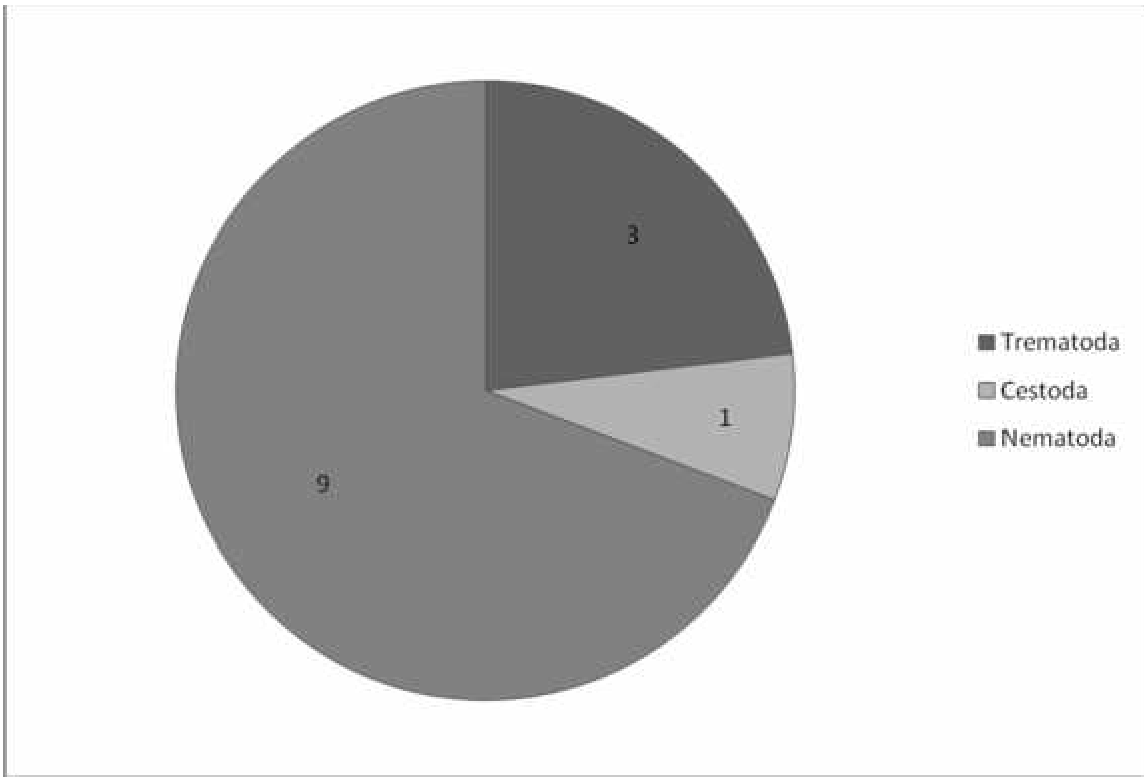


Fig.5: Observed genera of different classes.

Table 2. Class wise prevalence of helminth parasites.

S.No.		Class	Genera of Helminth	Percentage
1.		Trematode	*Fasciola*	17.25
2.			*Paramphistomum*	9.28
3.			*Dicrocoelium*	5.45
4.		Cestode	*Moniezia*	20.52
5.		Nematode	*Strongyloides*	24.39
6.			*Haemonchus*	20.97
7.			*Trichostrongylus*	19.45
8.			*Trichuris*	17.65
9.			*Nematodirus*	11.12
10.			*Oesophagostomum*	8.91
11.			*Ostertagia*	8.35
12.			*Chabertia*	7.65
13.			*Capillaria*	2.15

The result indicates that maximum infection was caused by the genera of nematodes (82.21%) followed by trematodes(45.67%) and cestodes (24.51%). Highest prevalence was shown by *Strongyloides* (24.39%) and lowest prevalence was shown by *Capillaria* (2.15%).

4.1.3 *Prevalence by season*

The prevalence of helminths infection during each of the two seasons was calculated by determining the proportion of positive samples sampled during that of particular season and expressed as percentage. Out of 150 samples of winter, 83 samples were positive (55.33%) and out of 165 samples of summer, 125 samples were found positive (75.75%). The rate of prevalence of helminth was found more during summer i.e. 75.75% than in winter i.e. 55.33%. The difference in the prevalence of different genus of helminth parasites during both the seasons altogether were found statistically significant.

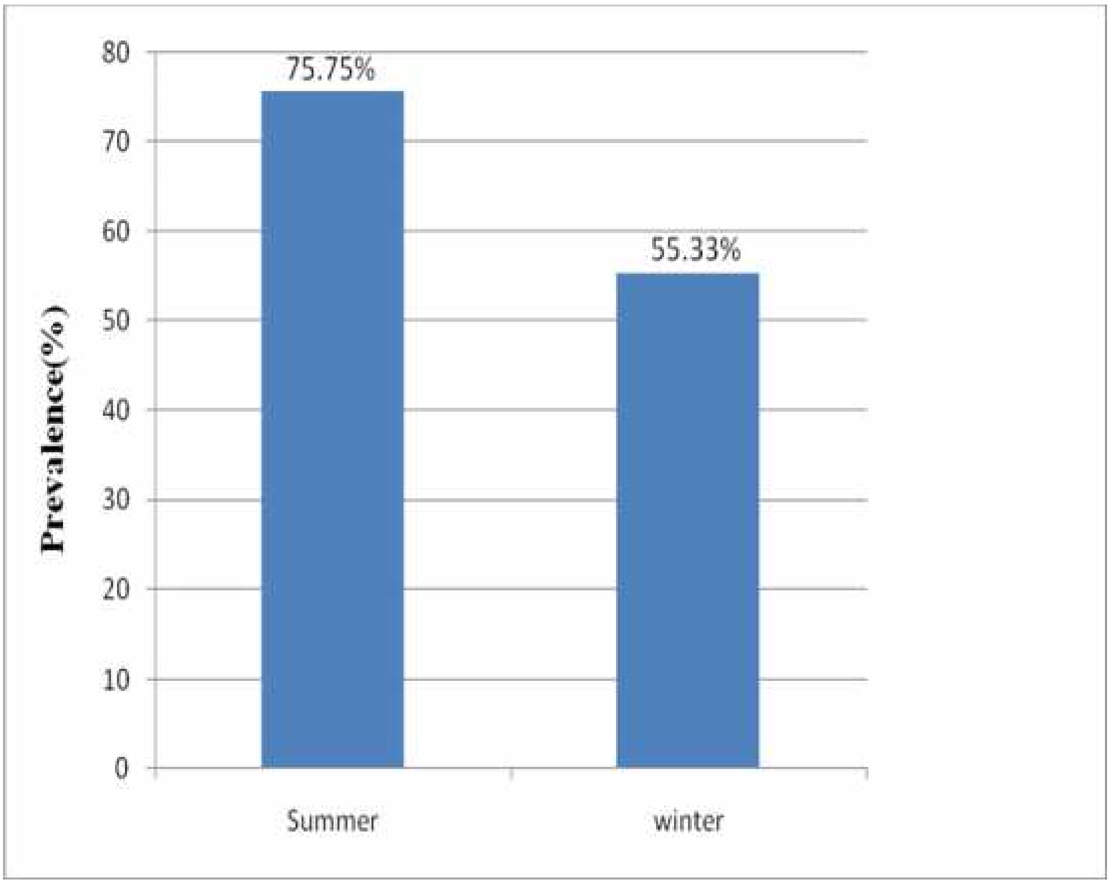


Figure 6: Seasonal Prevalence of GI helminths in Banke.

4.1.4 ***Prevalence by age***

For the purpose of this study, the ages of the goats were classified into three categories namely, kid (0-4 months), young goats (5-12 months) and adult goats (>12 months). Table 3 summarizes the prevalence in each group.

Table 3: showing age wise prevalence of helminths infection.

Age	Total sample	Total positive	Total negative	Prevalence (%)
0-4 months	71	45	26	63.38%
5-12 months	115	72	43	62.60%
>12 months	129	91	38	70.54%
Total	315	208	107	66.03%

The prevalence of helminths infection in the table in absolute figures reflects a higher occurrence in the adults (70.54%) followed by the kids (63.38%) with young goats (62.60%) having the least. While the absolute figures might seem to indicate otherwise, the prevalence of helminths infection in this study did not show any statistical significant ($\Re^2$ =1.27; P>0.05) trend related to the age of the goats.

4.1.5 ***Prevalence by sex***

Of the 315 goats samples collected, 132 were males and 183 were females. 85 males (64.39%) and 123 female (67.21%) were positive for one or more parasites. The prevalence of helminths infection in males and females is summarized in table 4.

Table 4: showing sex wise prevalence

Sex	Total sample	No. positive	No. negative	Prevalence (%)
Males	132	85	47	64.39%
Females	183	123	60	67.21%
Totals	315	208	107	66.03%

The study also looked at the effect of sex on the prevalence of helminths infection. While the absolute figures indicates a higher prevalence in female goats (67.21%), there was no statistical significant difference of the prevalence of helminths infection between males and females ($\Re^2$ =0.176; P>0.05)

4.1.6 ***Prevalence by location***

Equal numbers (105) of samples during post rainy season (55) and winter season (50) were collected from three areas Khaskushma,Rajhena and Mahadevpuri of Banke . The prevalence is summarized in table 5. The prevalence was highest in Mahadevpuri (69.52%) followed by Khaskushma (68.57%) and least in Rajhena (60.01%).

Table 5: location wise prevalence

Location	Total sample	No. positive	No. negative	Prevalence (%)
Khaskushma	105	72	33	68.57%
Rajhena	105	63	42	60.01%
Mahadevpuri	105	73	32	69.52%
Totals	315	208	107	66.03%

Fasciola (17.25%) & *Haemonchus* (20.97%) were more common in Mahadevpuri area whereas *Moniezia* (20.52%) & *Trichuris* (17.65%) were more common in Rajhena area and *Dictyocaulus* (11.75%), *Haemonchus* (20.97%), *Nematodirus* (11.12%) *and Trichostrongylus* (19.45%) were more common in Mahadevpuri area. No trematode parasite was found in Mahadevpuri area & *Strongyloides* (24.39%) was found in all areas. The lower prevalence of helminths infection in Rajhena area may be due to better availability of veterinary care and facilities.

4.1.7 Intensity of infection

In the present study, rate of mixed infection was also observed. Out of 208 (66.03%) positive samples, 158 (75.95%) positive samples were found mixed infections with 2-5 species in each samples. In multiple infections, the intensity of light infection shown by (0 to 2) that is 0-2 ova found per field, intensity of moderate infection shown by (2 to 6) that is 2-6 ova per field and intensity of heavy infection shown by (6 to 8) that is 6-8 ova per field. Similarly, out of 83 positive samples,32 (38.55%)samples were found to have single infection during winter and 19 (15.20%) samples were found in summer out of125 positive samples. Overall outcome of single infection was 50(24.03%).

Table 6: Infection during winter season

S.no.	**Class**	**Name of the genera**	**Light Infection (0-1)**	**Moderate Infection (2-6)**	**Heavy Infection (6-8)**
1.	Trematode	*Fasciola*	4	3	2
2.		*Paramphistomum*	2	1	-
3.		*Dicrocoelium*	1	-	-
4.	Cestode	*Moniezia*	5	4	1
5.	Nematode	*Strongyloides*	11	3	2
6.		*Trichostrongylus*	3	2	1
7.		*Nematodirus*	6	2	-
8.		*Haemonchus*	5	3	3
9.		*Chabertia*	-	-	-
10.		*Trichuris*	4	2	-
11.		*Oesophagostomum*	1	-	-
12.		*Capillaria*	-	-	-
13.		*Ostertagia*	2	-	-

Out of 83 positive samples of winter, mixed infections were observed in 51(61.44%) samples. Among winter helminths, the intensity of light infections were noted due to *Strongyloides* with 11(13.25%) (0 -1) positive samples. Moderate infections were shown by *Moniezia* with (4.82%) (2 - 6) positive samples and heavy infection was noted due to *Haemonchus* with 3(3.61%) positive samples.

Table 7: Mixed infection during summer season

S.no.	Class	Name of the genera	Light Infection (0-1)	Moderate Infection (2-6)	Heavy Infection (6-8)
1.	Trematode	*Fasciola*	25	6	3
2.		*Paramphistomum*	10	2	-
3.		*Dicrocoelium*	7	-	-
4.	Cestode	*Moniezia*	18	4	2
5.	Nematode	*Strongyloides*	19	8	4
6.		*Trichostrongylus*	9	3	1
7.		*Nematodirus*	4	1	-
8.		*Haemonchus*	13	6	5
9.		*Chabertia*	2	1	-
10.		*Trichuris*	14	5	-
11.		*Oesophagostomum*	1	-	-
12.		*Capillaria*	2	-	-
13.		*Ostertagia*	2	-	-

Out of 125 positive samples of summer, mixed infections were observed in 106 (84.80%) samples. Among summer helminthes, the intensity of light infections were noted due to *Fasciola* with 25(20%) (0 - 1) positive samples. Moderate infections were shown by *Strongyloides* with 8(6.40%) (2 - 6) positive samples and heavy infection was noted due to *Haemonchus* with 5 (4%) positive samples.

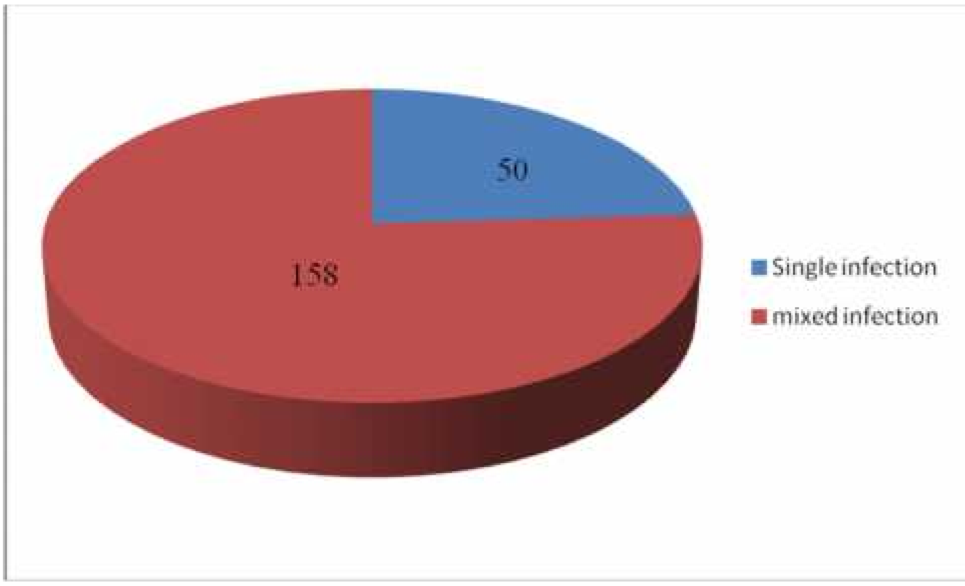


Figure 7: Total number of mixed and single infection.

4.2 Results of questionnaire survey

Among 30 goat farmers randomly selected for questionnaire survey 19 were male and 11 were female. All respondents were owner of the farm. 83% of them were either illiterate or had primary level education while 17% had secondary or above secondary education. 73% of farmers grazed their goats and others not. Backyard grazing was most practiced (15/22) followed by forest (5/22) and community (2/22) grazing. Backyard and community grazing was practiced sometimes but forest grazing was done always by farmers practicing it. 97% of farmers provided supplementary feed to goats. Those providing crop residues, forage leaves and concentrates were 20, 27 and 28 respectively. Only one farmer practiced fodder drying before feeding to goats. 90% of farmers took advice of veterinary practitioner when their goats get sick but others either treat themselves or go to traditional healer. 77% of farmers pointed out wet season being the favorable time for goats showing signs related to parasitic infestations like diarrhea and anemia, while others responded it happened even on dry season.

All goat farmers had heard about internal parasite of goats and treatment with anthelmintics was also regularly carried out but only 70% had knowledge about it and could name at least one internal parasite of goat. 37% of them used to treat their goats when sick and other generally practiced treating at least twice a year. Farmers doing fecal examination of goat before treatment were only 20% while forty percent farmers didn’t use to treat pregnant due to the fear of abortion. 80% of them used to buy drugs from the veterinary clinics while rest either bought from open market like VDC or brought from other farmers. Though all farmers practiced anthelmintics treatment to goats only 7% were aware of the harmful effects of drug overuse. There was a non-significant association (χ^2 = 3.135, $p>0.05$) between the gender of respondent and knowledge of internal parasitism in goat.

5
DISCUSSION

The aim of the study was to investigate the epidemiology of gastrointestinal helminths parasites in goats. The present investigation was carried out in the month of December and August/September. The stool samples were collected from Khaskushma, Mahadevpuri and Rajhena VDCs of Banke district. From the present study, 55.33% samples of winter were found positive out of 150 samples and 75.75% samples of summer were found positive out of 165 samples.

The helminthiasis has been emerged as an important parasitic disease since from the past decades in the world, but in Nepal it had been reported upto certain extent. It can be said that the prevalence of any gastrointestinal parasite is influenced by the climatic condition and geographical factor. Like, the warm and humid condition of South East Asia harbour a suitable condition for most of the parasite to flourish well. The prevailing continous rainfall throughout the year in these regions, helps for the survival of such parasite.

The general prevalence rate of helminth parasites in goats of Banke was found to be 66.03%. This study showed 45.67% trematode infection, 24.51% cestode infection and 82.21% nematode infection. The total numbers of genera observed during examination were 13 in number i.e. 3 genera of class trematoda (*Fasciola, Paramphistomum* and *Dicrocoelium)* ,1 genera of class cestoda (*Moniezia*)and 9 genera of nematodes were observed (Fig 5). In class nematoda were *Strongyloides* (24.39%), *Haemonchus* (20.97%), *Trichostrongylus* (19.45%), *Trichuris* (17.65%), *Nematodirus* (11.12%), *Oesophagostomum* (8.91%),*Ostertagia* (8.35%), *Chabertia* (7.65%) and *Capillaria* (2.15%),.

In the present study 3 genera of trematoda 1 genera of cestoda and 7 genera of nematoda were examined during winter. Similarly from the summer samples 3 genera of trematoda, 1 genera of cestoda and 9 genera of nematoda were observed. Among trematodes, 3 genera were observed in both winter and summer samples, namely – *Fasciola* (17.25%), *Paramphistomum* (9.28%), and *Dicrocoelium* (5.45%). In case of nematodes, 9 genera were found in winter samples, namely -*Strongyloides* (24.39%), *Haemonchus* (20.97%), *Trichostrongylus* (19.45%), *Trichuris* (17.65%), *Nematodirus* (11.12%), *Oesophagostomum* (8.91%),*Ostertagia* (8.35%), *Chabertia* (7.65%) where as *Capillaria* (2.15%), only found in summer.

Among Cestodes, *Moniezia* has been reported by Malakar (1965), Ghimire (1987), Gupta (1989) among buffaloes, sheep, goat and cattle. Overall prevalence rate of cestodes in the current study has been found to be 24.51% reported. Presence of suitable temperature and moisture serve best for the breeding and development of the helminthes parasites. So this could be the reason behind excessive prevalence of certain helminthes parasites.

Although fecal egg counts are generally considered inaccurate indicators of worm burden, they are nevertheless often used for this purpose, as in the present study. This study shows that prevalence of helminths infection among goats of Banke is high (66.03%). The prevalence rate is almost similar 63.33% (Ijaz *et al.*, 2008) and 65.47% (Shirale and Maske 2007). But lower than 70.53% (Bashir 2009) and 81.53 %(Parajuli 2007) and was higher than 58% (Leonard 2009).

The most common parasites encountered were, *Strongyloides* (24.39%), *Haemonchus* (20.97%), *Moniezia* (20.52%), *Trichostrongylus* (19.45%), *Trichuris* (17.65%), *Fasciola* (17.25%), *Nematodirus* (11.12%), *Oesophagostomum* (8.91%),*Ostertagia* (8.35%), *Chabertia* (7.65%).Waruiru et al. (2005) found *Strongyloides* (51%), *Haemonchus* (48%) and *Fasciola* (35.5%). Similarly Kushwaha (2000) and Nirmal (2000) found 88% and 54.6% prevalence of *Strongyloides* respectively. The findings of this study are also in accordance with their findings but Bashir (2009) had recorded *Oesophagostomum* and Shirale and Maske (2007) recorded *Haemonchus* and *Strongyloides* most common helminths.

There was definite seasonal variation in the occurrence of helminths infection as reflected by the fecal egg counts. The prevalence of gastrointestinal helminths was 75.75% and 55.33% respectively during post rainy and winter seasons. The proportion of samples that had a significant EPG during rainy season was significantly higher than during the winter season (X^2=5.311; $P<0.05$) hence it can be concluded that the prevalence of helminths infection was higher during the rainy season as compared to the winter season. This is in consistent with previous findings (Basir 2009; Madu and Richards 2007).*Capillaria* (2.15%), *Necator* (1.98%)and *Strongyl* (1.65%) were found only in post rainy season while *Strongyloides* (24.39%), *Haemonchus* (20.97%), *Moniezia* (20.52%), *Trichostrongylus* (19.45%), *Trichuris* (17.65%), *Fasciola* (17.25%), *Dictyocaulus* (11.75%), *Nematodirus* (11.12%), *Paramphistomum* (9.28%), *Oesophagostomum* (8.91%),*Ostertagia* (8.35%), *Chabertia* (7.65%), *Dicrocoelium* (5.45%) were found on both seasons. *Strongyloides* was more frequent in post rainy season and *Nematodirus* in winter. This is in agreement with findings of (Di Gebro et al. 2006).

The prevalence (75.75%) was higher during the post rainy season as compared to winter season (55.33%). The relative humidity and warm temperatures seemed to provide condition favorable for the development of pre-parasitic stages of nematodes and intermediate host (snails) of flukes. This is in agreement with findings; total gastrointestinal helminthes burden (Basir 2009) and the fecal egg counts (Nwosu et al. 2007) were positively related to climatic conditions, especially rainfall and relative humidity. Shirale and Maske (2007) also found high helminths infection during monsoon season. The presence of infection in the goats even during the winter season when environment conditions preclude the development and survival of their pre-parasitic stages could be an indication of persistence of the adult stage within the host.

A research by Wanjala et al. (2002) in the month of May/June and August/September showed 52% infection. While this study had shown overall 66.03% infection, the main genera prevalent in the study were *Strongyloides, Haemonchus, Trichuris, Trichostrongylus, Nematodiurs, Dictyoculus, Fasciola, Paramphistomum, Moniezia, Oesophagostomum and Chabertia* .Whereas Yadav et al. (2005) reported the highest incidence of *Strongyloides, Haemonchus, Bunostomum, Oesophagostomum* and *Trichostrongylus*.

Prevalence by age is in contrast with the findings of Boomker et al. 1994 found that the prevalence was inversely related to age, however, agrees with those of Basir (2009) and Magona & Musisi (2002) also found age, do not play a major part. In this study there were generally fewer kids and young goats as compared to adults, farmers generally treat their young goats only. This could have created some bias in the results and hence the undefined trend. The majority of the kids were still very young especially during wet season so the low worm burdens could be attributed to a diet consisting mainly milk and only small amounts of vegetation containing infective larvae. *Moniezia* (20.52%), *Trichuris* (17.65%) and *Strongyloides*(24.39%) were more prevalent in kids and young goats while *Fasciola* (17.25%), *Haemonchus* (20.97%) and *Trichostrongylus* (19.45%) were more prevalent in adult goats.

Prevalence by sex contradict the finding of Urquhart et al.(1988) who reported the existence of some evidence that entire male animals were more susceptible than females to some helminths infections. This was not reflecting among the parasitic species that were common in the area under study. The pregnant and lactating females were also included in this study and the proportion of female animal (67.21%) is higher than male (64.39%). Since pregnant and lactating female are more susceptible to helminths infection this may be the cause of higher prevalence in female animals.

During the study, out of 150 samples taken in winter 83 were found positive and out of 83 positive samples, 32 (38.55%) were found to have single infection and 51 (61.44%) had multiple infection. Similarly during summer, single infection was noted from 19 (15.20%) samples and mixed infection was shown by 106 (84.80%) samples out of 125/165 positive samples. The abundance of multiple infections mainly during summer might be due to availability of suitable temperature and moisture. It also might be due to exposure of goats to highly infected pasture land, contaminated water or infected fodder.

Questionnaire survey of in this study shows there was no gender wise variation regarding knowledge of internal parasitism of goat or male and female were equally aware of internal parasites of goat.

6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The current study was carried out in order to observe the epidemiology of gastrointestinal helminths in goats. Samples were collected from Khaskushma, Mahadevpuri and Rajhena V.D.Cs of district Banke. The two different technique used during the detection of helminths parasites were sedimentation and floatation technique. The samples were collected in the months of December and August/September. The total number of samples had collected and examine for the study were 150 and 165 respectively.Infection with gastrointestinal helminths is inarguably the most important constraint to goat production in Banke. The goats are reared in semi-intensive farming system. The hot and humid climate, lowlands and forest based grazing practices in Banke significantly contributes to helminths infection in goats. , the general prevalence rate of helminth parasites in goats was found to be 66.03%. This study showed 45.67% trematode infection, 24.51% cestode infection and 82.21% nematode infection.The most common parasites encountered were *Strongyloides* (24.39%), *Haemonchus* (20.97%), *Moniezia* (20.52%), *Trichostrongylus* (19.45%), *Trichuris* (17.65%), *Fasciola* (17.25%), *Nematodirus* (11.12%), *Paramphistomum* (9.28%), *Oesophagostomum* (8.91%),*Ostertagia* (8.35%), *Chabertia* (7.65%), *Dicrocoelium* (5.45%) and *Capillaria* (2.15%). Altogether 13 genera of helminthes parasite were found in present study among them one cestode (*Moniezia*), 3 trematodes (*Fasciola, Paramphistomum and Dicrocoelium*) and 9 were nematodes. The prevalence is high and has been characterized by low productivity, mortality in goat etc. The prevalence had a defined seasonal trend with higher prevalence during the wet season. The presence of infection in the goats even during the dry season when environment conditions preclude the development and survival of their pre-parasitic stages could be an indication of persistence of the adult stage within the host. There was however, no evidence to suggest that age and sex had any influence on the prevalence of infection. Management practices and different locations influence the prevalence of gastrointestinal helminths infection goats. This finding might be considered while designing control strategies of gastrointestinal helminthes in goats and this finding might be useful to other ruminants as well.

6.2 Recommendations

- Anthehelmintics treatment should be applied to eliminate the parasite from the host.
- The sheds should not be kept wet, moist or humid. These all prove as heaven to helminth parasites for their growth and development.
- The pastures can be made free of helminth parasites by breaking their life cycle by eradicating intermediate host, snail through biological control method.
- The farmers should be made aware of harmful effect of parasites and benefits of deworming.
- Provide adequate veterinary services to goat farmers.
- Impure water should not be supplied.
- Various trainings and awareness programs relating to management and feeding aspects of goat farming should be provided to farmers.
- The concerned authorities like DLSO should take initiatives for providing better veterinary facilities and drugs.
- Similarly the susceptible host like kids, pregnant and lactating animals should be housed separately.
- In light of this study there is need of formulating and following appropriate deworming schedule and there should be continuous monitoring of worm burden in goats by concerned authorities.
- This study will be base for the future investigators and further research work should be carried out.

REFERENCES

Acharya, R.M. 1999. Study on GI parasite of goats and sheep of IAAS livestock farm. Bulletin of veterinary science and animal husbandry, **27**: 35-39.

Athar, L.A., Khan, M.N., Sajid, M.S., Rehman, T.U. and Khan, I.A. 2011. Costs benefits analysis of anthelminthic treatment of cattle and buffaloes. Pak Vet J, **31** (2): 149-152.

Bashir, B.K. 2009. Seasonal prevalence of intestinal helminth parasites of goat (*Capra hircus*) of Khashi Bazaar, Kalanki Kathmandu. M.Sc. Thesis. Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal.

Basier, K. and Love, S. 2003. A study on intestinal parasites in sheep and goats in Australia. *http://www.jarvm.com.*

Bilal, M.Q. 2009. Prevalence of gastrointestinal parasites in buffalo and cow calves in rural areas of Toba Tek Singh, Pakistan. The Journal of Animal and Plant Sciences, **19**: 67-70.

Boomker, J., Horak I.G., Ramsay K.A. 1994. Helminths and arthropod parasites of Indigenous goats in the Northen Transvaal. Onderstepoort J. Vet. Res., **61**:13-20.

Devekota, S.P. 2005/2006. A study on outbreak of parasitic gastroenteritis in goats under sedentary management in a low hill village of western Nepal. Central Veterinary Laboratory Annual Technical Report, **1**: 104-107.

CBS 2010. Nepal Living Standards Survey.Statistical Report Vol.**2**

Coffey, L., Hale M., Terril, T.H., Mosjidis, J.A. and Burke, J.M. 2OO7. Tools for managing internal parasites in small ruminants.Sericea Lespedza.http://www.attra.ncat.org/attra-pub/sericea_lespedza.htm1

Dhital, V.P. 2006. Prevalence of gastrointestinal parasites in goats at the IAAS livestock farm and Manglapur VDC-2, Chitwan. The blue cross, **8**:122.

Di Gerbo, A.R., Roncari S., Zanzani T., Beneetti T. and Manfriedi M.J. 2006. Gastrointestinal parasites in goat farms from Bergamo province. Parasitologia (Rome), **48**(3): 385-389.

Faizal, A.C.M., Rajapaksha, W.R.A.K.J.S. and Rajapakse , R.P.V.J. 2002. Benefit of the Control of Gastrointestinal Nematode Infection in Goats in the Dry Zone of Sri Lanka. Journal of Veterinary Medicine Series B, **49**(3): 115-119.

Fikru, R., Teshale, S., Reta D. and Yosef, K. 2006. Epidemiology of Gastrointestinal Parasites of Ruminants in Western Oromia, Ethiopia. Intern J Appl Res Vet Med.Vol.**4** No.1

Foreyt, W.J. 1997. Veterinary Parasitology Reference Manual. 4th edition.

Ghimire, N.P. 1987. Incidence of common diseases of cattle and buffaloes in Surkhet district. Bulletin of Veterinary Science and Animal Husbandary, Nepal, **15**: 95-101.

Gupta, R. 1989.Some new records of helminth parasites and their hosts from Nepal. Journal of National Museum, **11:**27-40

Hansen, J. 1994. The epidemiology, diagnosis and control of helminth parasite of ruminants. International Laboratory for Research of Animal Disease Nairobi, Kenya, **25 –** 106

Hale, M. 2006. Managing internal parasites in sheep and goats. http://www.attra.ncat.org/attra-pub/PDF/parasitesheep.pdf

Holmes, P.H. 1993. Interactions between parasites and animal nutrition.The Veterinary Consequences,Proceedings of the Nutrition Society.**52**:113-120.

Houdijk, J.S. and Athanasiadou, S.L. 2003. Direct and indirect effectsof host nutritionon ruminant gastrointestinal nematodes.In matching Horbivore Nutrition to Ecosystem Biodiversity, **213**-236.

Ijaz, M., Khan, M.S., Avais, M., Ashraf, K. and Ali, M.M. 2008. Infection Rate and Chemotherapy of Various Helminths in Goats in and Around Lahore. Pakistan Vet. J., **28**(4): 167-170.

Jabber, A., Iqbal, Z., Kerboeuf, D., Muhammed, G., Khan M.N., Afaq, M. 2006. Anthelmintic resistance: the state of play revisited. Life sciences **79**: 2413- 2431.

Jithendran, K.P. and Bhat, T.K. 2001. Epidemiology and control of parasitism in nomadic situations in Hemachal Pradesh. ENVIS Bulletin: Himalayan ecology and development, **9**(1).

Joshi, B.R. 1994. Effects of parasitic gastro-enterities in goats under sedentary management in a low hill village of western Nepal. Veterinary review, **9**:18-20.

Joshi, B.R. 1995. Parasitic gastro-enterities of small ruminants on epidemiology, economic effects and host parasites relationship in the hills of Nepal. Ph.D. Thesis submitted to University of London, **1**: 51-57.

Joshi, B.R. 2000. Infection and effects of GI nematodes in goats raised under the sedentary and migratory management in the hills and mountains of Nepal. Bulletin of veterinary science and animal husbandry Nepal, **26**: 1-10.

Karki, K. 2005. Laboratory introduction to parasitology. http://www.cal.vet.upenn.edu/paralab.com

Krecek, R.C. and Waller P.J. 2006. Towards the implementation of the " basket of options" approach to helminth parasite control of livestock. Emphasis on the tropics/subtropics.Veterinary Parasitology.**139**:270-282.

Kushwaha, P.S. 2000. Investigation of diseases of goat under commercial rearing system prospective study. Proceedings of Workshop on Status of Animal Health in Nepal, **1**: 36-88.

Leng, R.A. 1991. Application of biotechnology to nutrition of animals in developing countries.FAO Animal Product and Health Papers- **90**:146.

Leonard, M. 2009. The prevalence and economic importance of nematode infection in goats in Gweru district, Zimbabwe.

Lima, M.M., Faustino, M.A.G., Santana, V.L.A., Santos, N.V.M. and Alves, L.C. 2006. Pernambuco State, Brazil, through faecal egg count and larval culture.Evaluation of gastrointestinal helminth infection in goats from the metropolitan area of Recife. CAB Abstract.

Lohani, M.N. and Rasaili, D.P. 1995. Bulletin of Veterinary Science and Animal health in Nepal. **21**: 8-13.

Mahato, S.N. 1999. Epidemiological basis of liver fluke control in Nepal. Central veterinary laboratory and animal disease control section Kathmandu VETCON **5**: 32

Maichomo, M.W., Kagira, J.M. and Walker, T. 2010. The prevalence of gastro - intestinal parasites in calves, sheep and goats in Magadi division, South - western Keny. Onderstepoort Journal of Veterinary Research, vol. **71**: 257 - 261.

Menkir, M.S. 2007. Epidemiology, and anthelmintic resistance and its management. Doctoral thesis, Swedish University of Agricultural Sciences, Uppsala, Sweden.

MoAC. 2009–10. Statistical information on Nepalese agriculture.

Muraleedharan, K. 2005. Prevalence of gastrointestinal parasites of livestock in a central dry zone of Karnataka. Journal of Veterinary Parasitology, **19**(1): Print ISSN: 0971-6157.

Nirmal, B.K. 2000. Study of major diseases of goats in far western region of Nepal. Proceedings of Workshop on Status of Animal Health in Nepal, **1**: 77-85.

Nwosu, C.O., Madu, P.P., Richards, W.S. 2007. Prevalence and seasonal changes in the population of gastrointestinal nematodes of small ruminants in the semi-arid zone of northeastern Nigeria. Vet Parasitology. **144**(1-2):118-124.

Odoi, A., Gathuma, J.M., Gachuiri, C.K. and Omore, A. 2007. Risk factors of gastrointestinal nematode parasite infections in small ruminants kept in smallholder mixed farms in Kenya. BMC Veterinary Research, **3:**6doi:10.1186/1746-6148-3-6. http://www.biomedcentral.com/1746-6148/3/6

Opara, M.N., Nwaobasi, J.K. and Okoli, I.C. 2005. Occurrence of parasitic helminthes among small ruminants reared under traditional husbandry system in Owerri, south east Nigeria, Bulletin of animal health and production in Africa, **53**:226-233.

Papadopoulos, E., Arsenos, G., Sotiraki, S. Deligiannis, C., Lainas, T., Zygoyiannis, D. 2003. The epizootiology of gastrointestinal nematode parasites in Greek dairy breeds of sheep and goats. Small ruminants Res., **47**:193-202.

Parajuli, L. 2007. A study on intestinal helminth parasites of goat (*Capra hircus*) brought to Khasibazar Kalanki (Kathamndu) for Slaughter purpose. M.Sc. Dissertation submitted to CDZ, T.U.

Parkins, J.J. and Holmes, P.H. 1989.Effects of gastrointestinal helminth parasites on ruminant nutrition. Nutrition Research Reviews.**2**:227-246.

Pathak, A. K. and Pal, S. 2000. Seasonal Prevalence of Gastrointestinal Parasites in Goats from Durg District of Chhattisgarh. College of Veterinary Science & A.H., Anjora, Durg (Chhattisgarh)-491001, India.

Perry, B.D. and Randolph, T.F. 1999. Improving the assessment of the economic impact of parasitic disease and their control in production animals. Veterinary Parasitology **84**:145-168.

Perry, B.D., Randolph, T.F., McDermott, J.J., Thornton, K.R. 2002. Investing in animal health research to alleviate poverty. ILRI, Nairobi, Kenya, 148 pp.

Rajapakse, R.P.V.J., Faizal, A.C.M., Horadagoda, N.U., Dharmawrdana, I.V.P. and Paranagama W.D. 2008. An abattoir study on the prevalence of gastrointestinal nematodes of goats in the dry zone of Sri Lanka. J. Natn. Sci. Foundation, **28**(4): 265-275.

Regasa, F., Sori, T., Dhungume, R. and Kiros, Y. 2003-2004. Epidemiology of gastrointestinal parasites of ruminants in western Oromia, Ethiopia. http://www.jarvm.com.

Regassa, F., Sori, T., Dhuguma, R. and Kiros, Y. 2006. Epidemiology of Gastrointestinal Parasites of Ruminants in Western Oromia, Ethiopia. Journal of Applied Research in Veterinary Medicine, **4**(1): 51.

Rehman, N.U. and Ali, A. 2006. Monthwise prevalence of gastro-intestinal trematodes, cestodes and nematodes infecting Damani sheep and goats in District D.I. Khan, Pakistan. Pakistan Veterinary Journal, Faculty of Veterinary Science, University of Agriculture.

Rijal, B. 2010. Seasonal prevalence of helminths parasites in goats from Khiljee, Arghakhachi. M.Sc. Thesis. Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal.

Robert, C.L. and Kyriazakis, I. 2001. Influence of host nutrition on the development consequences of nematodes parasitism in ruminants.TRENDS in Parasitology.**17**:325-330.

Saiful Islam, K.B.M. sand Taimur, M.J.F.A. 2008. Helminthic and protozoan internal parasitic infections in free ranging small ruminants of Bangladesh. Slov Vet Res, **45**(2): 67- 72.

Shah, H.L. and Agrawal, M.C. 1990. Helminthic infections (trematode infections) schistosomiasis. Review of Parasitic Zoonoses, **1**: 143-172.

Sharkhuu, T. 2001. Helminths of goats in Mongolia. Veterinary Parasitology, **101** (2): 161- 169.

Shirale, S.Y. and Maske, D.K. 2007. Bionomics of Helminths parasites in goats. Indian Vet. J.,**84**:1237-1239.

Silvestre, A., Chartier, C., Sauve, C. and Cabaret, J. 2000. Relationship between helminth species diversity, intensity of infection and breeding management in dairy goats in South Western France. Veterinary Parasitology, **94**(1-2):91-105.

Sissay, M.M., Uggala, A. and Waller, P.J. 2007. Prevalence and seasonal incidence of nematode parasites and flukes infection of sheep and goats in eastern Ethiopia. Tropical animal health and production, **39**(7): 521-531.

Soulsby, E.J.L. 1982. Helminths, arthropods and protozoa of Domesticatd animals. 7th ed. Lea and Febiger.

Tembely, S., Lahlou-Kassi, A., Rege, J.E., Sivani, S., Diedhiou, M.L., Baker, R.L. 1997. The epidemiology of nematode infections in sheep in a cool tropical environment. Veterinary Parasitiology, **7:** 129-141.

Terefe, D., Demissie , D., Desta, B. and Haile, S. 2012. A prevalence study of internal parasites infecting Boer goats at Adami Tulu Agricultural Research Center, Ethiopia. Journal of Veterinary medicine and Animal Health, vol: **4**(2) pp. 12 - 16.

Uddin, M.Z., Farjana, T., Begum, N. and Mondal, M.M.H. 2006. Prevalence of Amphistomes in Black Bengal Goats in Mymensingh District, Bangladesh. Bangl. J. Vet. Med, **4**(2): 103–106.

Umur, S. and Yukuri, B.A. 2006. Seasonal Activity of Gastro-Intestinal Nematodes in Goats in Burdur Region, Turkey. Turk. J. Vet. Animal Science, **29**: 441-448.

Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, A.M. and Jennings, F.W. 1988. Veterinary Parasitology. ELSB Edition. Longman UK.

Vatta, A.F. and Krecek, R.C. 2000. Trematode infection of goats farmed under resource poor conditions in South Africa.

Wanjala, K., Chemuliti, J., Wesonga, F.D., Munga, L., Ngare, P., Murilla, G.A. and Wesongah, J.O. 2002. Prevalence of parasitic infection in small ruminants in a pastoral community in Narok district, Kenya. *http://www.jarvm.com.*

Waruiru, R.M., Otieno, R.O. and Mutune, M.N. 2005. Gastro-intestinal parasitic infections of sheep and goats in semi-arid areas of Machakos district, Kenya. Bulletin of animal health and production in Africa, **53**:25-34.

Williams, J.C. 1999. Internal Parasites of cattle in Louisiana and Southern States of U.S.A. http://www.isugacenter.com

Woldemariam, D.L. 2002-2003. Nematodes prevalence, helminths management practices and anthelmintic resistance in small ruminants in Mid-rift valley of Ethiopia. *http://www.jarvm.com*.

www.moacwto.gov.np.statistics/livestock/pdf

Yadav, A., Khajuria, J.K. and Khajuria, J.K. 2006. Seasonal prevalence of gastrointestinal parasites in sheep and goats of Jammu, India. Indian Journal of Veterinary Parasitology, **20**(1): 0971-6157.

Yadav, C.L., Banerjee, P.S. , Garg, Y. and Vatsya, S. 2005. All India network program on gastrointestinal parasitism establishment of epidemiology of important parasitic diseases. http://www.helminthparasitespectruminnorth- eastindia.com.

Zajac, A.M. 2006. Gasrtointestinal nematodes of small ruminants: Life cycle,anthelmintics and diagnosis.Veterinary Clinics,Food Animal Practice.**22**:529-541.

PHOTOGRAPHS

EGGS OF TREMATODES OBSERVED

Fasciola sp. (10Xx10X)

Dicrocoelium sp.(10Xx10X)

EGGS OF NEMATODES OBSERVED

Trichostrongylus sp. (10Xx10X)

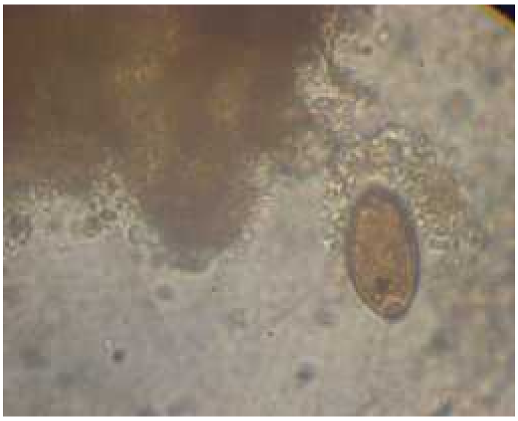
Strongyloides sp. (10Xx10X)

Haemonchus sp. (10Xx10X)

Unidentified sp(10Xx10X)

Trichuris sp. (10Xx10X)

Samples in floatation and sedimentation techniques



Capillaria sp. (10Xx10X)

Ostertagia sp. (10Xx10X)

Microscopic observation of feacal samples

Samples ready in slides to observe

ANNEX- I

Questionnaire for survey of GI Helminths infection in Goats of Banke

A. Respondent and farming practice information.

1. Respondent's name……………….. Date:

   Address:

2. Is respondent…………….owner/relative/employee.

3. Gender…………….Male/female.

4. Level of education………….Nil/Primary/secondary/Tertiary

5. How many goats do you have? ………..

   - 0-4 months Males……. Females……………
   - 5-12 months Males…..... Females……………
   - >12 months Males…….. Females…………..

6. Where do your goats graze?

	Always	Sometimes	Never
Zero grazing			
Backyard/tethering			
Forest			
Community			

7. Do you give supplementary feed to your goats?.......yes/no?

8. If yes, what type?

Hay	
Crop residues	
Forage leaves	
Concentrates	
Others	

9. Do you have practice of drying fodder before feeding?........Yes/ no?

B. Worm control information

10. Do you know about the internal parasites of goat? .... Yes/no?

11. Do you treat goats against worms?......Yes/No?

12. If yes how often per year?

Once	
Twice	
Thrice	
More than three times	
When sick	

13. Do you treat goat after fecal examination?.....Yes/no?

14. Do you treat pregnant animals?......yes/no?

15. If no why? ....

16. Where do you get your drugs?

Source of drugs	Readily available	
	Yes	No
Vet pharmacy		
Open market/VDCs		
Other farmers		

17. Do you know about the harmful effect of Anthelmintics?.....yes/no?

18. When do you think the health of the goats deteriorates?

	Always	Sometimes	Never
Wet season			
Dry season			
All year round			

19. Who takes care of your goats when they fall sick?

Self	
Vet hospital	
Vet pharmacy	
Private practitioners	
Traditional healer	

ANNEX- II

Goat information sheet

Date:

Address:

1. Goat identity…….

2. Sample number………

3. Sex……………………

4. Breed…………………….

5. Age

0-4 months(kids)	5-12 months(young)	> 12 months(adults)

6. Are there any following signs of illness?

	Yes	No
Anemia		
Diarrhea		
Coughing		
Emaciation		
General weakness		

7. Comments on any treatments received…………………………………………

………………………………………………………………………………………