CHAPTER 1

INTRODUCTION
Helminth parasitism is one of the major health problems severely limiting the animal productivity throughout the world. The internal helminths pose one of the major health limitations for different groups of animals. The diverse agro-climatic conditions, animal husbandry practices and pasture management largely determines the incidence and severity of various parasitic diseases in any region. Different groups of vertebrates like Fish, Poultry and Sheep represent important source of animal protein. These are used in ceremonial festivals throughout the world and in our country, particularly in our state, providing important trade between rural and urban areas.

Sheep provide direct cash income through the sale of live animals, wool and hides (Abebe et al., 2002). Sheep serve as a hand asset and are closely linked to the social and cultural life and resource of poor farmers. Sheep dung is used as an organic fertilizer for increasing the fertility of soil.

Helminth parasites cause the most economic losses ravaging sheep productivity. Sheep are the hosts to multiple species of parasitic helminths that
cause varying degree of diseases ranging from chronic forms, characterized mainly by diarrhoea, dehydration, anaemia and weight loss to highly acute infections resulting high mortality, reduced wool yield and reproductive rate (Ahmad, 1992 and Gorski et al., 2004). The higher incidence of parasitic infection in domestic animals in a grazing system lowers productivity, leading to important economic losses. Pathogenicity of these helminth parasites varies with different intensity. The major endoparasitic diseases of economic importance include gastrointestinal and respiratory nematodiose, fascioliosis and cestodiosis. The incidence and severity of infection with gastrointestinal parasites can be influenced by environmental conditions, such as humidity, temperature, rainfall and managemental practices (Tekeley, 1991). Further, lambs are known to be more susceptible to infections than adults (Dunn, 1978 and Solusby, 1986). There is a tendency for the worm burden in sheep to decrease with increasing age (Regassa et al., 2006). The physiological status of the animal may influence its susceptibility to gastrointestinal nematode infection. Hormonal changes during the late pregnancy and lactation lowers the resistance of sheep and other ruminants to nematodes and consequently results in the establishment of higher worm burden. Poor nutrition lowers the resistance of animal enhancing the establishment of worm burden and increasing the pathogenicity of the parasite (Kusiluka and Kambarage, 2005).

Female nematodes lay eggs which are passed out with faeces of the host. A small first stage larva develops inside egg then hatches and feeds on bacteria in the faeces. It then develops through two stages to become the infective third stage L3, which cannot feed and rely on stored energy sources. Development ceases until the L3 larva is ingested by its potential future host (Rattray, 2003).

Trematodes have indirect life cycle, where the intermediate host plays an important role to their epidemiology. The factors determining the availability,
development and survivability of intermediate hosts in the environment also influences the level and severity of trematode infection. Light, suitable temperature and availability of oxygen are essential for embryonation of trematode parasites (Solusby 1982, Rattray, 2003). The eggs of trematodes are discharged from the host along with faeces. Under optimal conditions of temperature and moisture, eggs hatch into Miracidia. Five larval stages may occur in the life cycle. Miracidium, Sporocyst, Redia, Cercaria and Metacercaria. The metacercaria are ingested by grazing animals with infected herbage or water. They excyst in the duodenum, penetrate the intestinal wall and pass through abdominal cavity to the liver where they penetrate the liver capsule. The immature flukes migrate into liver parenchyma and enter the bile ducts where they mature and start to produce eggs.

The gastrointestinal cestodes are found in the small intestine of animals. In the environment, the eggs are ingested by oribated mites where they develop into Cysticercoids. The Cysticercoids, which are infective, are produced in 1-4 months depending upon temperature. Ruminants are infected by ingestion of the infective mites with herbage (Schmidt, 1998).

Poultry is of great importance in rural production system in small communities throughout the developing world. According to WATT, 1996, poultry production has been constantly increasing over the past decades and a survey made by FAO shows that whole poultry population in the world has reached about 14 billion, 75% among these are in developing countries (FAO, 2000). The domestic fowl and eggs provide an important source of protein for human consumption. The increased mortality and decreased productivity in chickens is mainly due to mismanagement, lack of nutritional feeding, diseases and predation. Among the diseases, both ecto and endoparasites play an important role in decreasing production and causing loss of chickens. Helminthiasis is more common in outdoor
than indoor flocks. The nematodes are widely distributed causing nonspecific clinical signs of infection, such as loss in appetite and growth and on occasions even death. These parasites have either a species specific, direct bird to bird life cycle or they have indirect cycle requiring intermediate host. There are numerous species of nematodes, which cause significant damage to the organs in which they live. Cestodes and trematodes are less pathogenic than roundworms. Tapeworms or cestodes are more commonly found in warm weather when intermediate hosts are abundant. The birds get infected by ingesting or feeding on these infected intermediate hosts. The tapeworms when in large number block the intestinal tract of infected birds.

The prevalence and intensity of helminth infections in birds may be influenced by several factors as distribution of intermediate hosts such as beetles, ants, crustaceans, houseflies etc. and their infection rate and the number of infective parasite eggs or larvae. The free ranging management system and climatic conditions such as temperature and humidity alter the population dynamics of parasites resulting in dramatic change in prevalence and intensity of helminth infections.

Frogs and other amphibian species play essential role in ecosystem and have been identified as effective biological indicators of environmental health (Duellman and Trueb, 1986). The causes that have contributed to the remarkable drop in species abundance include the introduction of exotic trout in to native territories, predator frog species, and fragmentation of habitat. Studies regarding amphibian species, parasitic infection was sited as a cause for sudden death in normal healthy population (Hsu et al., 2004). Limb deformities were also correlated to parasitic infection with the species Xenopus laevis in California (Loeffler et al., 2001).
Amphibians are ecologically and economically important group of animals. Among the amphibians, anurans have been exploited for food and as medicine. A hormone like substance found in the secretion of parotid glands of toad is used as anti serotonin, in treating Schizophrenia, bronchial asthma and several allergic diseases. They play a significant role in controlling harmful insects and pests that damage crops (Ray, 1999).

The study of helminth parasites in amphibians began in 1737 with the observation of Swammerdam of a worm in the lungs of a frog. Swammerdam did not name this worm, which is one of the oldest known trematodes, but in 1800 Zeder described and figured the trematode *Diastoma cylindraceum*, now *Haplometra cylindracea* (Prudhoe, *et al*. 1982). The first record of a cestode from amphibian came with the description of *Taenia dispar* by Goeze (1780) from a toad in Germany. Rudolphi (1809-10) classified and briefly described all known parasitic worms, listing five species of trematodes, one monogenean and one cestode from amphibians.

Amphibians are one of the most fascinating groups of hosts for parasitologists. Aho (1990) showed that amphibians and reptiles both represent excellent system for the study of host parasite relationships, because they occupy a wide variety of habitats, exhibit different life cycle patterns with diverse reproductive strategies and hold different positions within ecosystem food webs.

Fish constitute a very important group of vertebrates and provide a rich source of food, liver oil and a number of other byproducts like fish meal, fish manure, and Isin glass. The importance of fish as food has resulted in the development of fisheries as an industry in several countries. Fish flesh contains proteins, fats, vitamin A and D. It contains high percentage of calcium and phosphates along with vitamins and is valuable for cattle and poultry for increasing milk and egg production.
The parasite fauna of fish species depends on the geographical location of the habitat, the season of the year, the characteristics of water, the type of the bottom, the fauna present in and around the habitat and many other factors. Large numbers of diseases occur in fishes due to nutritional deficiency or unhygienic condition of water or attack of parasites. Fishes are hosts to representative of three major groups of helminths — the Platyhelminths (flatworms), Nematodes (round worms) and Acanthocephalans (spiny headed worms). Helminths damage fish health by inducing variable intensity of infection depending upon the quality of environmental conditions (Read, 1992). The life cycles of most fish nematode parasites require an intermediate host for their completion. The *Rhadhdhochona* spp. (Family: Rhabdhoconidae) require an intermediate host to complete their life cycle. They produce eggs; the eggs contain a first stage larva which hatches after the egg has been ingested by a mayfly nymph. The larva penetrates in to the haemocoel and moults twice to reach the infective stage. Third stage larvae become encapsulated singly or in groups, usually in the dorsal abdominal region of the host. Subsequently, the definitive host ingests infected nymphs and one or two moults occur with in the fish depending whether the larvae were at the third or fourth stage.

Acanthocephalans are widely distributed intestinal worms parasitizing fish (Taraschewski, 2000). Adult helminths live inside the intestines of the final host and absorb nutrients across, as they lack an alimentary canal. The life cycle of acanthocephalans involve a vertebrate definitive host and an arthropod intermediate host which may be an amphipod or copepod. Embryonated eggs of female acanthocephalan reaches the water with the gut contents of the host, where an intermediate host eats the eggs. Eggs contain the first stage larvae, called acanthor. The acanthor hatches inside the intestine of intermediate host into a cystacanath. The fish gets infected by feeding on infected intermediate host having
infective stage cystacanth. The acanthocephalan parasites cause serious damage to the host when found in large numbers. They cause laceration of walls with hole, resulting in inflammation of the tissue.

STUDY AREA

The state of Jammu and Kashmir constitutes the northern most extremity of India, situated between 32.15° and 37.05° North latitude and 72.35° and 83.20° East longitude and occupies a most strategic position in the entire Himalayan region. Its borders touch China in the North East, Afghanistan in North West, and Pakistan in West. It has 22 districts, 74 towns and 6,652 villages (Gupta, 2006).

Doda is the biggest district of Jammu province and the third in the state of Jammu and Kashmir. District Doda is situated between 32.52° - 34.12° latitude North and 76.1° - 76.40° longitude, South. The boundaries of this vast district touch Anantnag/kargil in the North, Kuthua, Udhampur and Chamba (Himachal Pradesh) in the South, Kargil and Leh (Ladakh) in the East and Anantnag and Udhampur in the West. It is situated at 3500 feet above the sea level on a plateau of hilly range. The geographical area of district Doda is 11,691 sq kms. Administratively the district has been divided in four sub-divisions of Ramban, Doda, Bhaderwah and Kishtwar and seven tehsils namely Kishtwar, Bhaderwah, Doda, Ramban, Banihal, Thathri and Bhalessa. District Doda is spread on high and long mountain ranges. The Chenab and its tributaries play a significant role in geographical division of this district.

50.02% of geographical area of district Doda i.e., 584800 km² is under forests. Out of this area 92,704 hectares are under meadows and grazing fields. The important forests of this place have deodar, kail and pine grown on them. These are spread on 44,818, 57, 280, 82,117 and 7581 hectares respectively.
RIVERS, STREAMS AND WATER CHANNELS

Chenab is the biggest river of district Doda. Two streams Chandra and Bhaga flows out of a snowbed called Baralacha and meet at Tandi. They form Chandrabhaga which flows through Pangi valley in Chamba and enter the state at Padder area and then assume the name Chenab. The river Wardwan or Maryu Sadar is the second big river of the area. It starts from Wardwan and enters Marwah. Flowing through Dachan and Tagood areas, the river joins the Chenab at Bhundarkoot. The other important streams or Nallahs, which flow through every area of district Doda, and which influences the geographical condition of that particular area include the Neeru Nallah of Bhaderwah which flows through Bhaderwah and joins the Chenab at Pul Doda. The Neeru is formed by the confluence of two streams, the Neeru and Kalgandi. Rigi Nallah is one of the fastest Nallahs of Tehsil Doda, which carries water of Dranga and Baldari nallah of Marmat area to Chenab. The Dessa Nallah flows between Doda and Kastigarh, which falls in to the Chenab on that side of Khilani and Malhori. The Nallah Pogal, Nallah Peristan and Nallah Neel are important for the internal division of Pogal and Paristan areas of Banihal and reach the Chenab along with the water of Bichlari Nallah. In Chathru, the Sigdi Nallah and Kiber Nallah are bigger ones. All of these Nallahs fall in Chatru Nallah.

CLIMATE

The parts of Doda district that touch Himachal Pradesh, Ladakh and Kashmir are full of glacier. The weather conditions in this area are diverse according to latitude. The spring season starts from mid March to ending May, the summer from June to mid September, autumn from September to mid November and winter from mid November to mid March. On an average the annual rain fall/snowfall in district Doda is 891.032mm which is lowest as compared to other district of the division (Kishtwari, 2003).
MAP OF DISTT. DODA
PURPOSE OF THIS STUDY

Since throughout the world, strategies are being formulated to control the incidence of helminth infestations in economically and ecologically important groups of animals by different means, to lessen the economic losses. Studies on the incidence of helminth parasites in different vertebrates have been carried out throughout the world and so in India and in our state as well. But so far no attempt has been made to know the prevalence of different endohelminths in economically important groups of vertebrates of district Doda.

To propose any control measure against different helminth parasites in any vertebrate group, one should be aware about the type of parasite infecting and the pattern of infection. So the objectives behind the present study were to know the prevalence of endohelminths in different vertebrate groups of district Doda; study the seasonal difference in the prevalence of infection and to study the histopathology of the infected organs.
Sheep (*Ovis aries*)

Domestic Fowl (*Gallus domesticus*)
Toad (*Bufo viridis*)

Fish (*Schizothorax* spp.)
Liver of sheep infected with *Dicrocoelium dendriticum*

Large intestine of sheep infected with nematodes
Moniezia expansa

Asca ridia galli