# I

# INTRODUCTION

## Background

Nepal is an agricultural country. Agriculture contributes 38% of the nations GDP and livestock contributing almost 11% to GDP (World Bank, 2002). Livestock population in Nepal for 2004/2005 was estimated to be 6.99 M cattle, 4.08 M buffaloes, 7.15 M goats and 0.86 M sheep (www.moacwto.gov.np.statistics/livestock/pdf). Roughly 70% of households keep some type of livestocks, including cows, buffaloes, pigs and chickens (FAO, 2005). Buffalo is one of the major livestock species for milk and meat production, which constitutes about two thirds of the meat consumption in Nepal (TLDP, 2002).

Meat is an indispensable food consumed by most of the people of this universe from very beginning of human civilization till now. The word meat comes from the old English word mete which referred to food in general. Meat, in its broadest definition, is animal tissue used as food (www.wikipedia.org/meat). Meat is widely used to define flesh and offal including their natural associates' skin and gristle, derived from carcass of any animal and bird normally used for human consumption. Because of essential nutrients it contains, meat eaten in moderate amounts can be considered a valuable component of complete diet and because of its special flavor and taste, meat helps to make eating a joyful experience.

There is a shortage of meat, especially in the cities of Nepal, which is filled by the importation of animals from neighboring countries (TLDP, 2002). About 0.3 millions meat buffaloes are annually imported from India alone (DLS, 2002). Kathmandu has the country's largest per capita consumption of meat. Each resident consumes 18kg of meat a year, whereas the average Nepali eats only 10kg-way below the worldwide average of 40kg per person per year. 140 truckloads of live buffalos are transported to the Valley from the Terai and India every week, and each truck is packed with up to 20 buffaloes. A truck can carry up to 200 goats, and 42 tonnes of goat meat are consumed in Kathmandu every day (Himal Magazine, 2004).

Meat consumption varies widely while comparing different countries as it depends on factors like socio-economic condition, religious beliefs, cultural practices, etc. In a resource poor and developing country like Nepal, natives have included meat as important part of their diet to supplement nutritional requirements. In Nepal buffaloes, contribute about 64% of meat consumed, followed by goat meat 20%, pork 7%, chicken 6% and sheep 3% (Joshi *et al*., 2001).

A slaughter house, also called an abattoir, is a facility where animals are killed and processed into meat products. The design, process and location of slaughter house respond to a variety of concerns. Slaughtering animals on a large scale possess significant logistical problems and public health concerns (www.wikipedia.org/slaughterhouse).

Due to its rich nutrient content, meat is an excellent media for the growth of pathogenic organisms. Meat and other meat products contribute significantly to high incidence of food borne diseases and zoonotic diseases. In Nepal, sub-tropical climate, poor sanitary condition, improper facilities, improper handling, poor food hygienic practices and lack of prevention against diseases has caused a number of diseases to erupt from the meat source. Bryan (1973) listed approximately 200 diseases that can be transmitted to man by food. The list of pathogens which can be transmitted from animals to human by food contain about 16 kinds of bacteria, 3 groups of viruses, 22 parasites and 5 protozoa (Singh and Koulikovski, 1995).

In Nepal, lack of appropriate slaughtering facilities and unsatisfactory slaughtering techniques are causing unnecessary losses in meat as well as valuable byproducts. Animals particularly buffaloes are slaughtered in Kathmandu in slaughtering places which are frequently polluted with street dust, garbage, human excreta, animal blood, intestinal contents and dirty effluents and which are not protected against dogs, rodents and insects. Meat products under such conditions are generally deteriorated due to bacterial infections and which cause food poisoning time to time. Due to lack of meat inspection, meats from the unhealthy and parasitic infected animals are acting as a source for infection to human as well as to animals. Besides, meat quality is adversely affected by careless handling condition in the slaughtering places as well as in the meat markets or shops (Joshi, 1991).

Buffalo is susceptible to most diseases and parasites that afflict cattle, although the effects of disease on the buffalo and its productivity are sometimes less evident (Fagiolo *et al*., 2005). The parasites may cause disease and infection to human if the meat of such infected animals is consumed.

"Those diseases and infections which are naturally transmitted between vertebrate animals and man" have been defined as Zoonotic diseases by World Health Organization. Some of the important parasites that infect buffalo and cause zoonoses to man are

1/ *Echinococcus granulosus* causing Echinococcosis

2/ *Fasciola* spp. (*F. hepatica* and *F. gigantica*) causing Fascioliasis

3/ *Taenia saginata* causing Taeniasis

### 1/ Echinococcosis

Echinococcosis or Cystic Echinococcosis (CE) is caused by the larval stages (hydatid cysts) of *Echinococcus granulosus* and is known as one of the most important parasitic infection in livestock in the world (Capuano *et al*., 2006). It can establish itself in many different hosts, including humans, and is regarded as one of the most widespread zoonoses (Craig *et al*., 2007). Domestic ungulates, including sheep, goats, cattle, swine, buffalo, horses, and camels, serve as common intermediate hosts (Schantz, 1982; Rausch, 1986). The definitive hosts of *E. granulosus* are almost invariably canid carnivores like dogs, wolves and jackals (http://homepage.usask.ca/~shb292/hydatid.pdf).

The prevalence of echinococcosis in Nepal is studied by Khan *et al*., (2006) and observed an over all prevalence of 34.5% in buffaloes. Prevalence of echinococcosis in buffaloes was also observed by Joshi (1991), 5% (153/3065) in Kathmandu; Maharjan (1996), 21%; Khatri (2003), 16.22% (73/450), in Kavrepalanchok, Nepal.

### Significance

**In animals**: Larval cysts may cause problems in host tissue because of the continual growth and expansion of the cyst. It seems that economic impact resulting from the disease is rather more important than the disease itself. The economic losses are mainly due to the carcass condemnation in meat animals (Schantz, 1982), as well as decreased production (Torgerson and Budke, 2003).

**In human**: Humans, like other intermediate hosts becomes infected when eggs that have been shed in the faeces of the definitive host are ingested (Schantz, 1982). The symptoms are determined by organ of localization, size of the cyst and their condition (Schantz, 1982). The organ most commonly involved is the liver (50-70%), followed by lungs (20-30%) and other organs (like the spleen, kidney, heart, bones, etc.) in less than 10% of the cases (Torgerson and Budke, 2003). Mortality and case fatality rate has been recorded to be around 0.2 per 100000 population and 2.2% respectively (McManus *et al*., 2003).

### 2/ Fascioliasis

Fascioliasis is infection caused by one of two liver flukes, either *Fasciola hepatica* or *Fasciola gigantica* (Mas-Coma, 2007). It is a zoonotic disease for which humans act as an accidental host during the life cycle of the parasite (Price *et al*., 1993). Sheep, goats, cattle, horses, donkeys, mules, camels, buffalo, deer, wild sheep, pigs, marsupials, rabbit hare and other rodents and monkeys including human serve as definitive hosts for both *F. hepatica* and *F. gigantica* (Boray, 1982). An aquatic snail of genus *Lymnaea* acts as an intermediate host (FAO, 1977).

The prevalence of fascioliasis in buffaloes in Nepal was observed by Shrestha *et al*., (1992), 20% to 87.5% in Dhankuta; Singh *et al*., (1992-1993), 48.57% in Chitwan; Mahato (1993), 57.9% in the hills and 4.3% in the Terai of Nepal; Parajuli (1996), 83.00% in Surkhet; Adhikari *et al*., (2003), 61% in Kathmandu.

**Significance**

**In animals**: Fasciolosis, in buffaloes, usually appears as a chronic infection, causing anorexia, weight loss, reducing labour and production capacities, similar symptoms to those in cattle (Fagiolo *et al*., 2005).

**In human:** The parasites cause biliary obstruction resulting high fever, diarrhea, chills, bile inflammation, liver enlargement, and jaundice. Pharyngeal form of fascioliasis can be seen among people who eat raw animal liver with characteristic symptoms of bleeding and pain of the pharynx (http://www.stanford.edu/class/humbio103/parasites2001/fascioliasis).

**3/Taeniasis**

An infection due to an adult *Taenia*, in man or animals, is referred to as taeniasis (Smyth, 1996). *Taenia saginata* also known as beef tapeworm is a worldwide zoonotic cestode whose epidemiology is ethnically and culturally determined with estimates of approximately 50 million cases of infestation worldwide with 50,000 people dying from this problem annually (WHO, 1996).

**Significance**

Both adult and larvae forms hazardously affect health of their respective hosts, either directly or indirectly accompanied with severe secondary infections, particularly in human hosts (Neva *et al*., 1994).

**In animal**: The occurrence of the larvae (*Cysticercus bovis*) in the musculature of cattle and buffaloes cause bovine cysticercosis (Neva *et al*., 1994). In them, heavy infestation by the larvae may cause myocarditis or heart failure (Gracey *et al*., 1992). But rather than the disease itself, the economic losses occurring from the condemned and downgraded carcasses due to treatment of carcasses before human consumption are substantial (Onyango-Abuje *et al*., 1996).

**In human**: Human is the only definitive host for *T. saginata*. The adult worms in human small intestines cause taeniasis. In humans, the infestation is accompanied with mild symptoms ranging from nausea, abdominal discomfort, epigastric pain, diarrhea, vitamin deficiency, excessive appetite or loss of appetite, weakness and loss of weight to digestive disturbances and intestinal blockage (Mann, 1983).

## Justification of the study

Meat is consumed everywhere and Kirtipur is no exception. Since major ethnic group contributes to Newars (CBS 2001), buff is consumed in higher proportion. The distribution of slaughtering place is unknown. Type of meat shops found in the municipality is also unknown. Even the municipality had no data. Similarly, the pilot study also showed unhygienic and pathetic way of slaughtering the animals. The infrastructure and facilities present in the slaughter places and meat shops which directly affect the hygienic condition of the meat have never been surveyed. The prevalence of meat parasites has also never been surveyed. In fact no work on slaughter house, meat hygiene and health of the animal has ever been carried out in this municipality.

The present study is an endeavor to document sufficient data to improve the facilities in the slaughtering places and meat shops, to improve or bring the awareness among all the people dealing with animals and meat and ultimately improve the health condition of the people.

The present study is also hoped to awake the related authorities to develop an effective meat inspection system and to implement 'The Slaughterhouse and Meat Inspection Act 1998'.

## Limitation of the study

The present study bears following limitations which are mainly due to time and cost limitations.

- Data of only two seasons were accumulated.
- Since the butchers have to deliver the carcass of the slaughtered animals to the meat shops at very early morning, time spent on observing the carcass was limited and if not always, sometimes, rapid observations of the carcass have to be made.
- Echinococcosis, fascioliasis and taeniasis are known as zoonotic diseases but during research, they have only been studied on the slaughtered buffaloes, their impacts on human have not been studied.

# II

# OBJECTIVES

## General

The general objective of the study is the survey of buffalo slaughtering places and meat shops to observe the hygienic condition of the meat, helminth parasites occurring in the meat and the quality of the meat being sold.

## Specific

I. To observe the distribution of slaughtering places and type of meat shops occurring in Kirtipur.
II. To observe the hygienic condition in and around the slaughtering area and meat shops.
III. To study the prevalence of Echinococcosis/ hydatidosis in buffaloes slaughtered for meat.
IV. To study the prevalence of Fascioliasis in buffaloes slaughtered for meat.
V. To study the prevalence of Cysticercosis in buffaloes slaughtered for meat.
VI. To create awareness among butchers, meat sellers and consumers about meat hygiene.
VII. To recommend the way to get the best hygienic meat.

# III

# LITERATURE REVIEW

## LITERATURE REVIEW IN CONTEXT OF THE WORLD

Fan (1997) collected a large number of adult worms of *T. saginata asiatica* and estimated the annual economic loss caused by this infection by determining the worm load and the weight of worm harbored by each infected person. In the mountainous areas of Taiwan, the infection rate of *T. saginata* asiatica taeniasis was 11.0%, the worm load was 1.6 worms/case, and the average weight of an adult worm was 20.5 g. The annual economic loss was estimated to be US$ 11,327,423. On Cheju Island of Korea, the infection rate was 6.0%, the worm load was 2 worms/case, and the average weight of an adult worm was 19.3 g. The annual economic loss was estimated to be US$ 13,641,021. On Samosir Island of Indonesia, the infection rate was 21%, the worm load was 1.8 worms/case, and the average weight of an adult worm was 22 g. The annual economic loss was estimated to be US$ 2,425,500. These figures indicate that taeniasis is not only a significant public health problem but also an important economic problem in East Asia.

Leslie (1997) under DFID Animal Health Programme carried out a research on epidemiology and control of *Taenia saginata* cysticercosis and found out that the tropical developing countries suffer huge financial losses (US$ 1.8 billion annually in Africa) due to the *Taenia saginata* cysticercosis tapeworm. Their meat inspection methods are not sophisticated enough to identify all infected carcasses, making eradication difficult as infected cattle often remain undetected and export markets stay closed as disease free cattle, demanded by importers, cannot be guaranteed. Similarly, no reliable diagnostic tests exist to identify the tapeworm in cattle before slaughter. The farmer’s ability to treat animals and control the parasite is therefore hampered, as is the scientist's ability to study it and find new ways to eradicate it. The parasite is also found to be a threat to humans who can be infected by eating contaminated meat.

Hardy *et al*., (1999) observed a total of 6,434,093 slaughtered cattle, buffaloes and pigs over a period of 4 years (1994-1997) in Egypt to study human taeniasis and cysticercosis in animals. The study found 0.72% cysticercosis (*bovis* and *cellulosae*) infections. Individual animal species infections were 0.23% in native breed cattle, 7.25% in imported cattle, 0.14% in buffaloes and 0.99% in pigs.

Mehra *et al*., (1999) investigated the effects of *Fasciola gigantica* infection on bodyweight gain, dry matter intake, digestibility of nutrients and feed conversion efficiency in buffalo calves. Nine male buffalo calves of the Murrah breed, aged 12 to 15 months with a mean bodyweight of 166 kg, were randomly assigned to groups of five (group 1) and four (group 2). The animals in group 1 were given 1000 viable, mature metacercariae of *F. gigantica* orally, while the animals in group 2 served as uninfected controls. They were stall fed on diets containing a concentrate mixture and ad libitum wheat straw and were maintained by standard management practices for a period of 165 days after infection. The average daily liveweight gain of the infected animals was 110.6 g, compared with 439.4 g in the uninfected controls, and was associated with the appearance and establishment of immature flukes in hepatic bile ducts. The feed conversion efficiency declined significantly ($P<0.01$) from 41 days after infection and was lowest at the end of the experiment. *F gigantica* infection did not influence the digestibility of the nutrients. The impaired feed conversion efficiency was mainly due to a reduction in dry matter intake due to inappetence.

Nguyen *et al*., (1999) carried out a survey of 955 swamp buffaloes livers in Vietnam from January to July 1998. Out of 955 buffaloes studied, 46.67% were found infected with *Fasciola* spp. The buffaloes infected with *Fasciola gigantica* were 14.14% and both *Fasciola hepatica* and *Fasciola gigantica* were 32.04%. The mean numbers of flukes in the infected organ were 78.

Mehrabani *et al*., (1999) studied prevalence of *Echinococcus granulosus* infection in buffaloes in Iran. During the study, 25 buffaloes slaughtered for meat purposes at different slaughtered houses were examined for hydatidosis. 4% of liver and 8% of lungs of buffaloes were found to be infected.

Khan *et al*., (2001) recorded *E. granulosus* from 110 domestic herbivors; 60 sheep, 25 cattle, 20 goats and 5 camel slaughtered in Benghozoa. The proportion of the cyst from the sheep found to be fertile was 75% which was higher that of the cysts from the goat (55%) and camel (40%).

Lezeriuc *et al*., (2002) studied 28,878 slaughtered cattle between 1995 and 2001 in the abattoir at Bacau, Romania. During this period, 2,220 cattle were diagnosed with fascioliasis. The prevalence of bovine fascioliasis was found higher in 2001 (14%) as compared in 1995 (4%).

Maqbool (2002) undertook an epidemiological study at slaughter house, livestock farms, and veterinary hospitals and on household buffaloes under the different climatic conditions existing in Punjab province. Infection rate was found 25.99% at slaughter house, 20.10% at livestock farms, 13.70% at veterinary hospitals and 10.50% at household buffaloes. Overall highest 24% seasonal prevalence in all types of buffaloes was recorded during autumn, spring and winter. It was found that a higher infection rate was recorded in older buffaloes than in youngsters (below 2 yrs of age). Buffalo of either sex were equally affected.

Oliveria (2002) carried out survey on hepatic fascioliasis. Among 130 slaughtered buffaloes studied at the Cajati abattoir of Vale Do Riberia, Sao Paulo, Brazil from Sept. 2002 to Dec. 2002, the incidence of livers infected by *Fasciola hepatica* was 75%.

Theodoropoulos *et al*., (2002) carried out a long year survey of 10, 277 slaughtered farm animals in the region of Trikala, Greece to estimate the prevalence of parasitic infections responsible for the condemnation of carcasses and viscera during meat inspection, and their economic implication. The organs examined for the presence of parasitic lesions during meat inspection were: liver and lungs of all animals, rumen of cattle, small intestine of lambs and kids, and muscles of cattle and swine. The parasitic lesions observed in the lungs of cattle, sheep and goats were caused only by hydatid cysts. No hydatid cysts were observed in the lungs of swine. The parasitic lesions observed in the liver of cattle, sheep and goats were as a result of hydatid cysts and flukes of *Fasciola hepatica* and *Dicrocoelium dendriticum,* while those of swine were due to milk spots only. The prevalence of parasites responsible for the condemnation of marketable organs was low (0.26%). Parasites were responsible for 22% of the total of condemned organs, and their annual cost was 99,500 GDR.

Akhtar *et al*., (2003) conducted a study on prevalence of helminthiasis on buffaloes in colony, Hyderabad. The prevalence of helminthiasis was found to be 15.2% in buffaloes. Out of 500 samples examined, 9.2% were infected with nematodes and 5.4% were infected with trematodes respectively. The chief trematodes identified were *Fasciola gigantica* 3.2% and *F. hepatica* 2.2%.

Basu *et al*., (2003) reported *Fasciola hepatica* and *Fasciola gigantica* be the major parasites involved in causing economic losses to livestock in East Africa. *Fasciola hepatica* has shown to be the most important fluke species in Ethiopian livestocks with distribution over 3 quarters of the nation except in the arid Northeast and East of the country. The distribution of *Fasciola gigantica* was mainly localized in the Western humid zone of the country. The prevalence of bovine fascioliasis has shown range from 11.5% to 87%. A rough estimate of the economic loss due to fascioliasis in bovine is about 350 million birr per year.

Marques *et al*., (2003) examined 482 livers, 377 from cattle and 105 from buffaloes slaughtered at a meat packing plant between April 1999 and November 1999, in Viamao, a town in the state of Rio Grande do Sul, in southern Brazil. The cattle slaughtered at the meat packing plant belonged to eleven towns. The occurrence rate of *Fasciola hepatica* was 10.34% for cattle in seven of the eleven towns included in the study (63.6%) and 20% for buffaloes in four of the five towns (80%). In terms of age, the occurrence rate was 81% for buffaloes with up to two years of life and 19% for buffaloes older than two years.

Rodríguez-Hidalgo *et al*., (2003) carried out the epidemiological study of the taeniasis/cysticercosis complex in Equador. The data were compiled on the infection of both tapeworms in man and animals in Pichincha and Imbabura provinces in the Andean region, north of Quito. On post mortem inspection 3 out of 806 (0.37%) carcasses had *T. saginata* metacestodes, however, 35 sera out of 869 (4.03%) showed circulating antigen in a monoclonal antibody-based sandwich ELISA (Ag-ELISA). Porcine cysticercosis was detected in 15 out of 2896 (0.52%) carcasses and 93 out of 1032 serum samples (9.01%) were positive in Ag-ELISA. In humans, 4.99% (215 out of 4306) cases of antigen positives were found, whereas coprological examination of 1935 stools resulted in 30 positive cases (1.55%). The limited number of adult tapeworms (29) that were collected does not allow firm conclusions on the proportion of each species, but in total 21 specimens were identified as *T. saginata* and 8 as *T. solium*. These data have been discussed in view of the epidemiology of human cysticercosis.

Wanjala *et al*., (2003) studied the distribution of *Taenia saginata* cysticerci in carcasses of naturally and artificially infested cattle in Kenya. Meat inspection detected cysticerci in 12 out of 24 animals (50%) in artificially infested calves. Of these calves, 10 (41.67%) had cysticerci in the heart, 6 (25.00%) in the cheek muscles (masseter-external muscles and Pterygoid-internal muscles), 5 (20.83%) in the *Masculus triceps brachii* (shoulder muscles) and 4 (16.67%) in the tongue. The six control calves were not found with any cysticerci. All the predilection sites of the carcasses of artificially infested calves were found with cysticerci but most were found in the heart (5.29%), *Masculus triceps brachii* muscles (1.80%), masseter and pterygoid muscles (0.60%) and tongue (0.54%) in that order. In animals with natural infestations, meat inspection revealed a prevalence rate of 48% (12 out of 25 animals) with a considerably varied detection rate of cysticerci in different carcasses and predilection sites. Of these animals, 9 (36%) had cysticerci in the heart, 4 (16%) in the *Masculus triceps brachii* (shoulder muscles) and 3 (12%) in the tongue. In natural infestations, most cysticerci were found in the heart (2.98%), tongue (1.79%) and *Masculus triceps brachii* muscles (1.04%), in that order.

Yadav *et al*., (2003) reported the prevalence rate of Fascioliasis is high in Terai region of India followed by hills and plains respectively. Buffaloes were the most susceptible hosts followed by cattle and sheep.

Asharaf *et al*., (2004) carried out the study to investigate the distribution and natural infections of local lymnaeids, environmental characteristics related to the disease transmission and determining the most prevalent fasciolids and definitive hosts in human endemic areas of Gilan province, Iran. According to the data obtained from slaughterhouse observations in Bandar-Anzali and Rasht, the main fasciolid in local cattle is *F. gigantica*. Of 928 adult liver flukes collected from 13 infected livers of cattle, in Rasht and Bandar-Anzali slaughterhouses, 91.1% were diagnosed as *F. gigantica* and

8.9% as *F. hepatica*. *L. gedrosiana* and *L. palustris* were the most prevalent lymnaeid snails in this endemic zone.

Phiri *et al*., (2005) carried out a study at selected major abattoirs in Zambia to determine the prevalence and some factors influencing occurrence of fascioliasis in cattle. Of 841 cattle livers inspected and 677 faecal samples analyzed, prevalence rates of 53.9% and 48.9%, respectively, were found. Cumulative prevalence of 60.9% (n = 677) was recorded. According to age, no significant difference of infection was found. Female cattle on liver inspection (59.3%) and coprological examination (65.2%) had significantly higher ($P < 0.001$) rates than males (44.5% and 36.3% respectively). Origin of cattle had a significant influence ($P < 0.001$) on the prevalence rate. According to fluke egg count classification, 68.5% of cattle had light infection, 20.9% moderate, 4.4% heavy and 6.2% severe. These results indicate that *Fasciola gigantica* infection is an important condition that leads to high liver condemnations and/or trimmings in cattle tendered for slaughter.

Wanjala *et al*., (2005) studied the distribution of *T. saginata* cysts in carcasses of naturally (n = 25) and artificially (n = 30) infested animals in Kenya using total dissection as a gold standard method. In each group, both live and dead cysts were widely distributed in predilection and non-predilection sites with some carcasses without any cysts. In artificial infestations, 1663 cysticerci were recovered, of which 864 (51.95%) were alive and 799 (48.05%) were dead, while in natural infestations, 671 cysticerci were recovered, of which 361(53.80%) were alive and 310 (46.20%) were dead. Meat inspection revealed 12 carcasses with cysts in each group, with cysts in heart (2.98%), tongue (1.79%), *Triceps brachii* (1.04%) and none in masseter and pterygoid in natural infestations. Artificial infestations had cysts in the heart (5.29%), *Triceps brachii* (1.80%), masseter and pterygoid (0.66%) and tongue (0.54%) during meat inspection. During total dissection, cysts ranked from liver (22.00%), heart (17.13%), hind limbs (15.02%), fore limbs (13.35%), chest (6.49%), neck and back (6.01%), pelvis (4.39%), lumbar (4.09%), lungs (3.91%), tongue (2.52%), head (2.40%), diaphragm (2.10%), rumen (0.54%) to kidneys (0.00%) in carcasses of artificially infested animals. In carcasses of naturally infested animals, the order was from fore limbs (24.74%), hind limbs (23.85%), liver (12.22%), chest (9.24%), heart (8.79%), lumbar (6.56%), pelvis (3.58%), tongue (3.28%), lungs (2.98%), neck and back (2.38%), head (1.49%), diaphragm (0.75%), kidneys (0.15%) to rumen (0.00%).

Jenkins *et al*., (2006) investigated the occurrence of *Echinococcus granulosus* in rural domestic dogs in farming areas around Yass, New South Wales, and Mansfield and Whitfield, Victoria. Feces were collected per-rectally from farm dogs voluntarily presented by their owners in four farming districts in New South Wales and two in Victoria. *Echinococcus granulosus* coproantigens were detected in 99 of 344 dogs (29%) from 95 farms in south eastern New South Wales and 38 of 217 dogs (17.5%) from 43 farms in Victoria.

Khan *et al*., (2006) conducted a study on the prevalence of echinococcosis by examining carcasses at Bikaner slaughter house in Rajasthan, India over a period of nine month. The study found that echinococcosis occurred with an over all prevalence of 34.5% in buffaloes with an infection rate of 40.9% in males & 44.1% in females. In adult buffaloes (above 2 years) the prevalence of hydatid disease was recoded as 43.6% against 11.1% of buffalo of below 2 years.

Opara *et al*., (2006) studied the incidence of cysticercosis due to *Taenia saginata* in both local and exotic breeds of cattle slaughtered for meat in southeastern Nigeria between November 1999 and April 2002 is reported. The examination of various organs of 25,800 cattle in 10 major abattoirs of this region showed that 6750 (26.2%) were infected with *Cysticercus (C.) bovis*. The prevalence rates varied from one abattoir to another while the rates of cysticercosis in local and exotic breeds varied significantly ($P > 0.05$). Sixty percent of all the infected animals had cysts. The tongue, cardiac, and masseter muscles were the main predilection sites of the cysts. Out of 11,720 male cattle, examined, 3215 (27.4%) had cysts of *C. bovis* while 160 (13.6%) of the 1180 female animals investigated were infected. There was an inverse relationship between the ages of the animals and prevalence of infection with *C. bovis.*

Rinaldi *et al*., (2006) carried out survey of cystic echinococcosis (CE) in the water buffalo (*Bubalus bubalis*) of the Italian Mediterranean breed in Campania, a region of southern Italy. In addition, a molecular study was performed on 48 hydatid cysts coming from 48 water buffaloes in order to determine the *Echinococcus granulosus* strain(s) present in this host. Out of a total of 722 water buffaloes examined for CE, 76 (10.5%) were found infected. The average number of cysts per buffalo was 4.3 (minimum 1, maximum 45). Seventeen buffaloes had hydatid cysts only in the liver (with an average of 5 cysts/liver), 34 only in the lungs (with an average of 1.8 cysts/lungs), and 25 buffaloes had cysts both in the liver and in the lungs. Fertile cysts were found in 10 (13.2%) out of the 76 positive buffaloes.

Shirai *et al*., (2006) investigated 117 livers with Fascioliasis in buffaloes. The study was focused on the number of *Fasciola*, the number and intrahepatic localization of affected hepatic ducts and bile ducts, and the degree of fibrosis in the hepatic segments and bile ducts. The degree of pathological changes in bile ducts caused by fascioliasis was classified into five levels. The site of *Fasciola* habitation was most often the hepatic ducts of the porta hepatis: it was the left hepatic duct in 101 livers and the right hepatic duct in 88 livers.

Fakhar *et al*., (2007) randomly examined internal organs of 3000 sheep, 200 goats and 200 cattle slaughtered at industrial abattoir in the Qom area, for hydatidosis. All animals were adult. They found altogether, 9.3% of sheep, 2% of goats and 3.5% of cattle to be infected with hydatid cyst. All sheep and goats with hydatid cysts were female. Cysts were located in the liver and lungs (sheep), lungs (goats) and liver (cattle) more frequently than in other organs, respectively.

Abunna *et al*., (2008) conducted a cross-sectional study from October 2005 to April 2006 on bovine cysticercosis in cattle slaughtered at Awassa municipal abattoir with the objective of determining the prevalence of *Taenia saginata* cysticercosis, cyst viability, distribution and its public health implication. Questionnaire survey involving 120 respondents was also conducted on human taeniasis. A total of 400 carcasses were examined during the study period, of which 105 (26.25%) were infected with *T. saginata* metacestodes. From a total of 3200 samples inspected, 500 cysticerci were detected in 141 samples, of which 221 (44.2%) were alive. The anatomical distribution of cysticerci were 65 (29.2%) heart, 56 (25.3%) shoulder muscle, 59 (26.7%) masseter, 23 (10.4%) tongue, 12 (5.4%) diaphragm, three (1.4%) liver, two (0.9%) lung and one (0.5%) kidney samples. The prevalence varied significantly between local and crossbred animals (OR = 3.15, $P < 0.05$), but not varied between sex, age groups and origin of the animals. *T. saginata*, taeniasis was a widespread public health problem in the town with an overall prevalence of 64.2% (77 of 120). The potential risk factors for disease contraction were raw meat consumption, religion and occupational risks. In conclusion, the study revealed high prevalence of *T. saginata* metacestodes throughout the edible organs together with existence of deep-rooted tradition of raw meat consumption. This may magnify the public health hazards of *T. saginata* in the study area.

Flutsch *et al*., (2008) conducted a case-control study to identify risk factors for bovine cysticercosis on farms in Switzerland. The case group (n=119) consisted of farms with infected cattle identified at slaughter in 2005 and 2006. Infections were confirmed by morphological or molecular diagnosis. The control group (n=66) comprised randomly selected farms with cattle slaughtered in the same period but with no evidence or history of infection. In personal structured interviews with the farmers, information regarding local surroundings and farm management was collected. Logistic regression revealed the following 5 factors as being positively associated with the occurrence of bovine cysticercosis: the presence of a railway line or a car park close to areas grazed by cattle, leisure activities around these areas, use of purchased roughage and organized public activities on farms attracting visitors. This information is considered useful for government authorities to direct control strategies as well as for farmers to take measures tailored to local situations.

Le *et al*., (2008) examined a large number of *Fasciola* spp. collected from domestic stock (cattle and buffalo) at slaughter and also from human patients and reported the presence of hybrid and/or introgressed liver flukes, hybrid between *Fasciola hepatica* and *Fasciola gigantica* in Vietnam. This hybrid form was reported to have serious public health importance.

Rinaldi *et al*., (2008) conducted an epidemiological and molecular survey to investigate the role of cattle in the transmission chain of cystic echinococcosis (CE) in the Campania region of southern Italy. Out of a total of 434 cattle examined for CE, 45 (10.4%) were found infected. A total of 363 cysts were collected from the infected animals: 239 in the liver and 124 in the lungs. The cysts were either sterile (42.7%) or calcified/caseous (57.3%); no fertile cysts were found. Most of the cysts had sizes <3 cm (77.1%) and were unilocular (78.8%). The results of the linear regression model did not show any significant correlation between the age of infected cattle and the number of cysts.

Ziadinov *et al*., (2008) carried out the cross-sectional study of dogs in four villages in rural Kyrgyzstan to investigate the epidemiology and transmission of *Echinococcus* spp. A total of 466 dogs were examined by arecoline purgation and fecal sample test for the presence of *Echinococcus granulosus* and *E. multilocularis*. A total of 83 (18%) dogs had either *E. granulosus* adults in purge materials and/or had *E. granulosus* eggs in feces as confirmed by PCR. Purge analysis combined with PCR identified 50 dogs that were infected with adult *E. multilocularis* and /or *had E. multilocularis* eggs in their feces (11%).

## LITERATURE REVIEW IN CONTEXT OF NEPAL

No literature regarding the topic of the present thesis of the Kirtipur area was found, however, similar such type of works have been performed by different authors at different parts of Nepal. In this connection some relevant literatures are given below.

Joshi (1991) documented the occurrence of infection with *Echinococcus* cyst in domestic livestock. The infection was identified and recorded in animals slaughtered at 77 small scale abattoirs in Kathmandu from May to September 1991. It was found that the number of animals slaughtered and rates of *Echinococcus* cyst infection in different species were: water buffaloes 5% (153/3065), goats 3% (55/1783), sheep 8% (12/150) and pig 7% (10/143).

Parajuli (1992) studied the prevalence of *Fasciola* in cattle and buffaloes in Surkhet. 60.00% of cattle and 83.00% of buffaloes were found to be positive for the flukes.

Shrestha *et al*., (1992) studied the prevalence of fascioliasis in cattle and buffaloes in Dhankuta. The prevalence rate was found range from 15.4% to 31.7% in the cattle and 20% to 87.5% in buffaloes depending upon different age groups of the animals and the ecological condition of the area. The higher prevalence rate was recorded in older animals and in areas, which were ecologically suitable for snail habitats.

Singh *et al*., (1992-1993) conducted a survey in lowlands of IAAS, Rampur to investigate the relationship between snail population and liverfluke infection in ruminants. The liverfluke infection was found 48.57%, 28.57, 25.00% and 21.28% in buffaloes, cattle, sheep and goats respectively. The highest rate of infection was observed in Sept. (50.00%), followed by the month Oct. (43.57%) and Jan. (35.00%). The snail population was negatively associated with population.

Mahato (1993) reported *Fasciola* prevalences of 57.9% in buffalo, 44.8% in cattle, 22.4% in goats and 18.2% in sheep in the hills of Nepal. In the Terai area, prevalences were 51.4% in cattle, 4.3% in buffalo and 13.3% in goats.

Department for international Development (DFID) (1996) worked on epidemiology and pathogenesis of fascioliasis in Nepal from 01/04/1993 to 30/03/1996 and found out that the parasite cause a serious loss to the meat industry. The losses in Nepal is estimated to be about 10-20 Million $US per annum. These losses occur through a combination of poor health, resulting in reduced productivity, death of stock, condemnations of infected livers and reduction in carcass quality. Cost-effective control of these trematodes would thus be of developmental benefits, while improvements in the efficiency in the way control programmes are evaluated and geared to particular areas would assist in the selection of target areas.

Joshi (1996) reported 18% buffaloes, 9% sheep, 4% goats and 9% pig were found positive for hydatid cysts. Livers and lungs were found equally affected and in some of the animals both livers and lungs were found positive for hydatid cyst.

Maharjan (1996) examined a total of 535 slaughtered water buffaloes in different villages of the western part of Kathmandu for hydatid cyst and found 21% buffaloes were positive for it. Lungs 11% were found more infected than liver 5% and both liver and lungs found infected was 4%.

Shrestha (1996) studied the occurrence of helminth parasites in ruminants of Kathmandu valley for 2 years. The study showed that the prevalence rate is more than 75% both in large and small ruminants. For the first year, the positive percentages of helminths parasites were 82.50%, 83.89% and 75.91% respectively for buffaloes, small ruminants and cattle. And for the second year the positive case in percentage were 82.26%, 77.22% and 75.07% respectively for buffaloes, small ruminants and cattle. Buffaloes were more infected with helminths parasites followed by small ruminants and cattle. Paramphistomes infestation was higher in cattle in comparison to *Fasciola* whereas in case of buffaloes it was opposite.

Joshi *et al*., (1997) carried out the epidemiological study of *Echinococcus* in Nepal. Based on the three year study (1993-1995), it has been revealed that the epidemiological cycle (indigenous) of *Echinococcus granulosus* parasite is dog-pig-dog cycle and human acquire infection accidentally through infected dog stool. However, the study has proved also the epidemiological cycle like dog-sheep-dog, dog-goat-dog and dog-buffalo-dog.

This study was supported by International Development Research Centre (IDRC), Ottawa, Canada.

Joshi *et al*., (2001) found that buffalo meat contributes approximately 64% of the total meat consumed in Nepal, followed by goat meat 20%, pig meat 7%, poultry 6% and sheep 3%. In Bhaktapur, Kathmandu and Lalitpur 58.60%, 2.4% and 16.70% respectively of wastes from the slaughtering places were disposed on street. In Kathmandu, 38.70% disposed into main municipality drainage system, 34.30% into solid waste disposal containers, 20% in riverside and 4.30% no where but pilled on the slaughtering site which they use as fertilizer later on. Further, awareness of meat borne diseases was found greater among consumers (37 or 20.56%) in comparison to butchers (4 or 2.68%) and meat sellers.

Pandey (2001) studied the fecal samples of 182 buffaloes and found 50% sample positive for fascioliasis. The prevalence of fascioliasis gradually increased from the month of June (40.00%) to Dec. (58.62%) and again increased from the month of Feb. (48.48%) to April (52.77%). The prevalence of fascioliasis was highest in old buffaloes (65.30%) followed by 56.80%, 48.78%, 35.29% and 14.25% in the age group of 7-8, 5-6, 3-4 and 0-2 years respectively.

Adhikari *et al*., (2003) conducted a study on the prevalence and diversity of *Fasciola* spp. in buffaloes and cattle in areas of Kathmandu Valley from April 2003 to 30 June 2003. The prevalence of *Fasciola* spp. was found to be 36% in cattle and 61% in buffaloes respectively.

Khatri (2003) examined for hydatid cyst. Out of 450 slaughtered buffaloes and 81 slaughtered goats examined in Kavrepalanchok, 73 (16.22%) buffaloes and 17(19.33%) goats were found positive for hydatidosis.

A recent survey done by Himal magazine in 2004 showed that, in case of Nepal, the consumption of meat is higher in Kathmandu. 90% of people of Kathmandu valley were non-vegetarians while only 10% were found vegetarians. In Kathmandu and other big cities, the poor hygienic status of meat shops, lack of good and adequate water supply system, sanitation and slaughter house have worsen the quality of meat contributing the maximum opportunity to microbial infection in meat.

Manandhar *et al*., (2006) carried out the study which aimed at identifying the occurrence of hydatidosis in slaughter buffaloes in Kathmandu Valley, Nepal. The study period was from November, 2004 to April, 2005. A total of 500 buffalo carcasses in a slaughterhouse, at the riversides and individual butchers' sites were examined for the presence of hydatid cysts. The cyst fluid was collected and microscopically examined to determine if it was fertile or not. Of the 500 carcasses examined, 10.6% had hydatid cysts, specifically, the slaughterhouse carcasses had a 6.7% occurrence of hydatid cysts, whereas those examined at riversides and individual butcher places had 10.0% and 12.7%, respectively. Distributions of the hydatid cysts by specific organs showed single occurrence of 6.4% in lungs, 2.4% in livers and 1.8% in both, livers and lungs. In a total of 53 infected buffaloes, 58.5% were fertile and 41.5% sterile cysts.

# IV

# MATERIALS AND METHODS

## MATERIALS

Equipments

i. Gloves
ii. Forceps
iii. Scissors
iv. Refrigerator
v. Sampling bottles
vi. Petridishes
vii. Tray
viii. Measuring scale
ix. Microscope

Chemicals

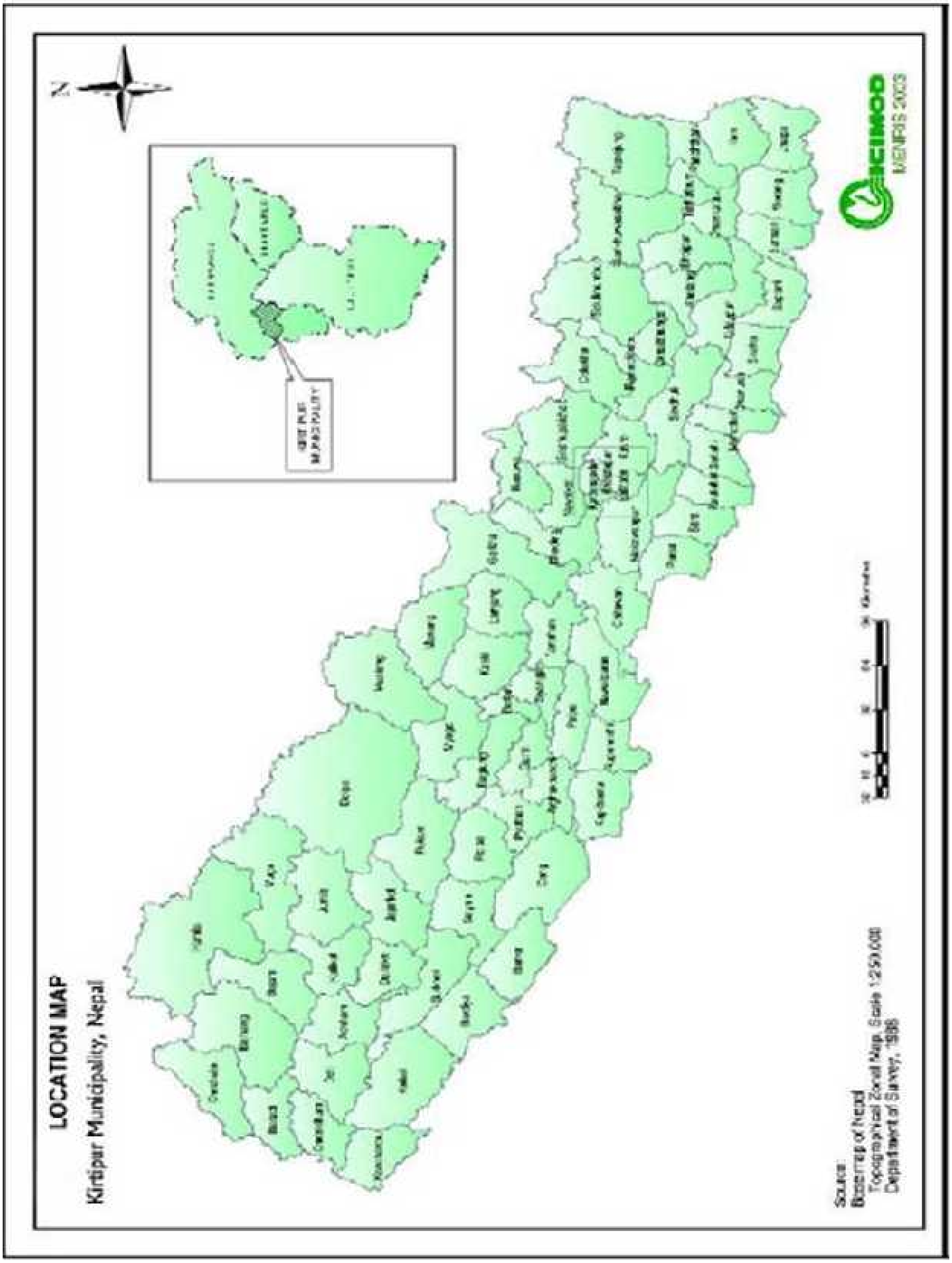
i. Formalin
ii. 70% ethanol
iii. Soap

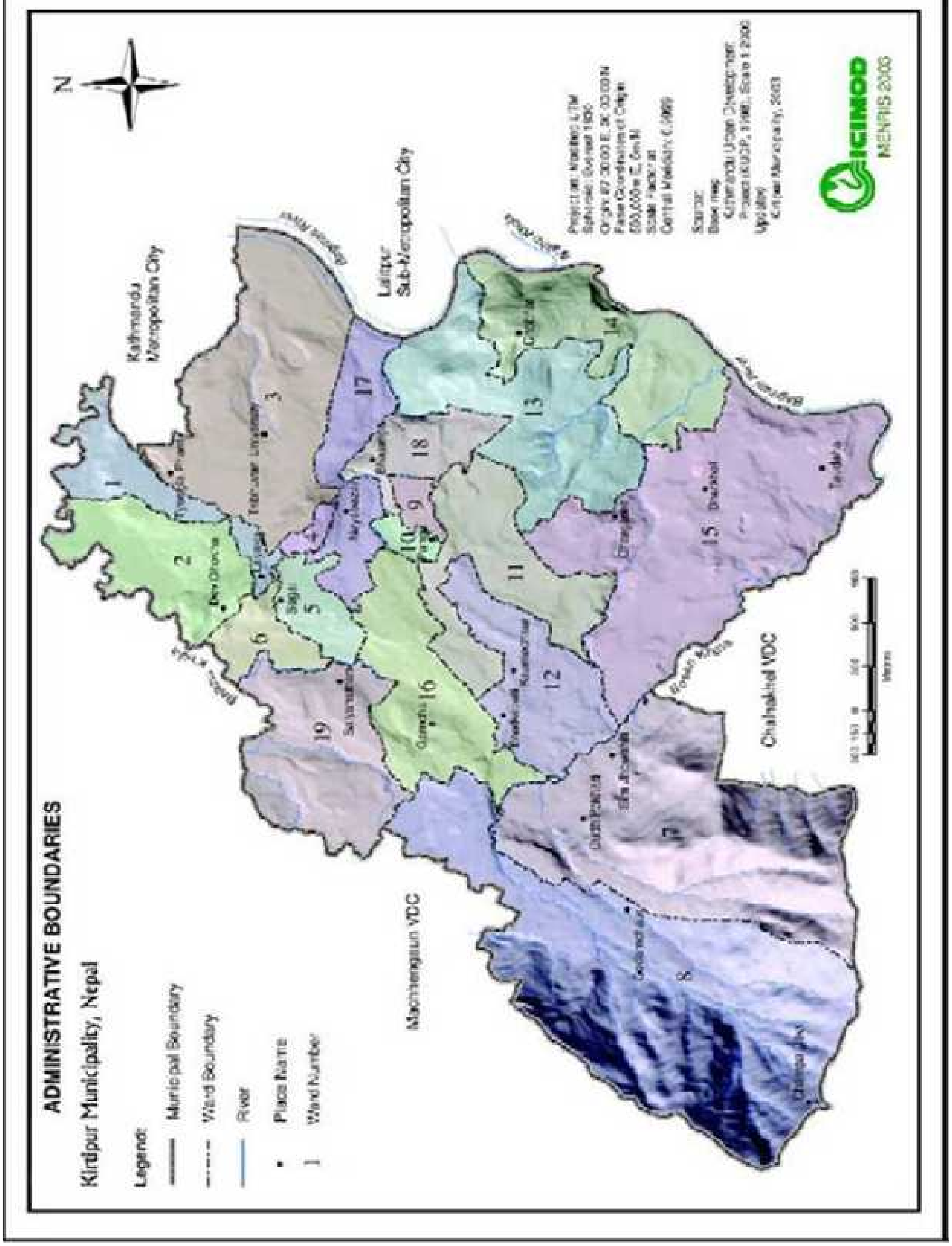
## METHOD

From November 2007 to July 2008, a sample of 200 water buffaloes slaughtered for meat in the whole Kirtipur Municipality was examined for the presence of different parasites.

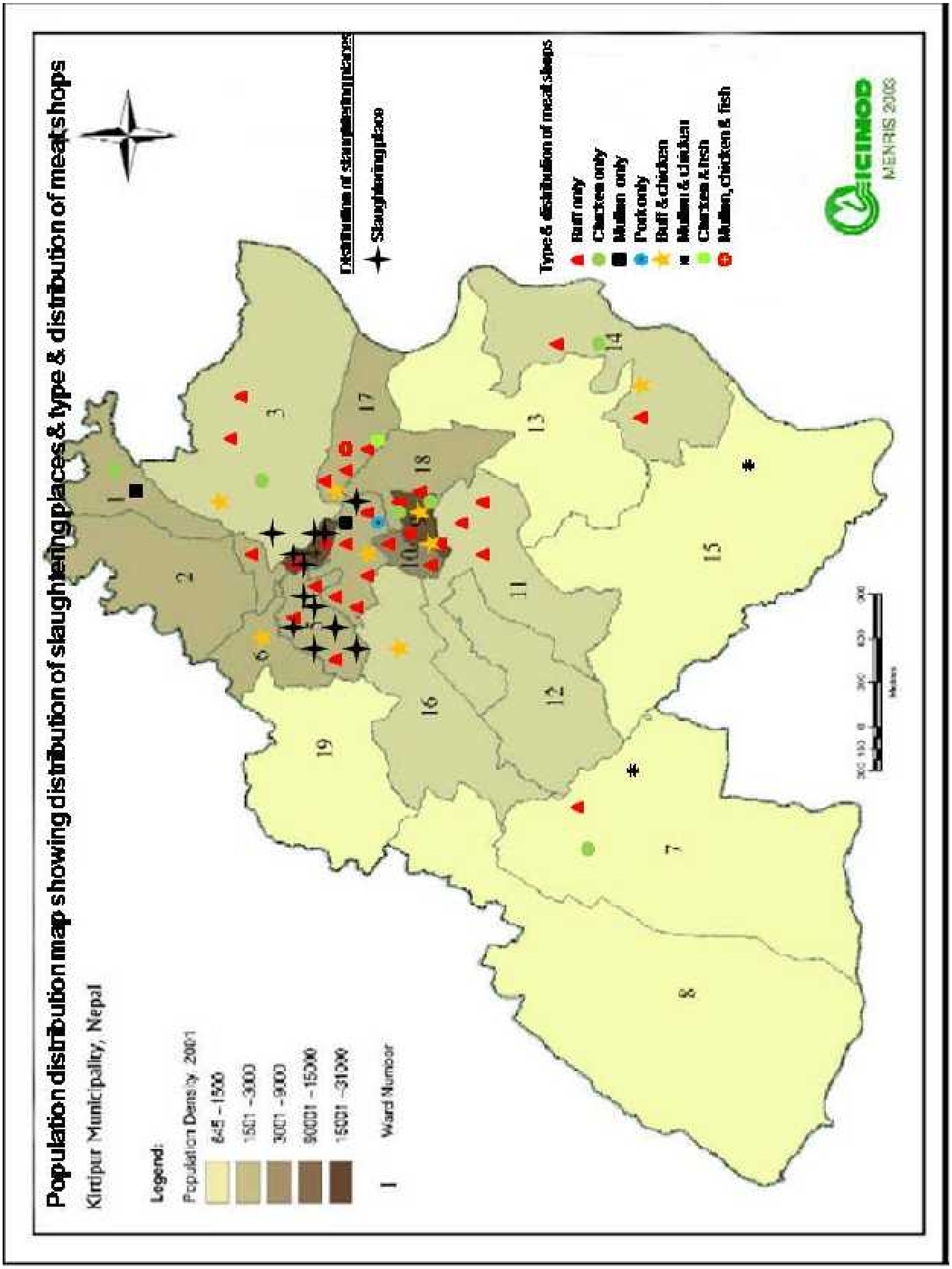
The incidence of parasites and the location of parasites at various organs were studied. Sanitary condition prevailing around the butchering area and meat shops, the type of water used, the place of waste disposal, dog problems around them were studied. The knowledge and awareness of butchers, meat sellers and consumers towards meat and meat borne diseases were also comprehensively studied both by the field observation and through questionnaires.

The cysts and the parasites occurring in the meat and sometimes the meat of the water buffalo itself were then collected and suitably analyzed in the laboratory.


LOCATION MAP
Kirtipur Municipality, Nepal
Source:
Basemap of Nepal
Topographical Zonal Map, Scale 1:250,000
Department of Survey, 1996
ICIMOD
MENRIS 2003



ADMINISTRATIVE BOUNDARIES
Kirtipur Municipality, Nepal
Legend:
Municipal Boundary
Ward Boundary
River
Place Name
Ward Number
Kathmandu Metropolitan City
Lalitpur Sub-Metropolitan City
Machhegaun VDC
Chalnakhel VDC
ICIMOD


Population distribution map showing distribution of slaughtering places & type & distribution of meat shops
Kirtipur Municipality, Nepal
Legend:
Population Density 2001
845 - 1500
1501 - 3000
3001 - 9000
9001 - 15000
15001 - 31000
Ward Number
Distribution of slaughtering places
Slaughtering place
Type & distribution of meat shops
Buff only
Chicken only
Mutton only
Pork only
Buff & chicken
Mutton & chicken
Chicken & fish
Mutton, chicken & fish
ICIMOD
Meters

## STUDY AREA

The proposed study area for the research is Kirtipur Municipality of the Kathmandu district. Kirtipur is one of the recently urbanized city of Kathmandu valley located some 8 kms. South-west of the central Kathmandu. It is declared as municipality in 2053 and is divided into 19 wards. It extends from 27◌̊◌̊ 41´36˝ – 27◌̊◌̊ 38´37˝ N to 85˚18´00˝ – 85˚14´64˝ E. It is surrounded by the Bagmati River in the east, Tinthana and Machchhegaon VDC in the west, ward no. 14 of the Kathmandu Metropolitan in the north and Chalnakhel VDC and Shesnarayan VDC in the south. The shape of the municipality resembles almost a square, the area being 14.76 sq.km (Nepal Gazettes part III 2053) and the study area covers an all over area of the municipality.

The total population of the municipality is 46,670 (WHO, 2006). Its population is increasingly continuously. People of various castes live in the municipality however Newars are in majority (67.37%) followed by Chhetris (17.37%), Brahmans (10.00%), Magars (2.10%) and others (3.16%) (CBS 2001). Nayabazar is the central market and busy area of the municipality.

In the municipality, a total of 12 buffalo slaughtering places and a total of 50 meat shops were surveyed.

## STUDY POPULATION AND SAMPLING

During the study period, 200 slaughtered water buffaloes were examined thoroughly. 100 were observed during the winter; from November 27, 2007 to February 10, 2008 and 100 were observed during the summer; from June 18, 2008 to July 26, 2008.

Out of them, 93 (46.50%) were males and 107 (53.50%) were females. 54 (27%) of them were calves, 51 (25.50%) were adults and 95 (47.50%) were olds.

Samples were collected by visiting the different slaughtering places. The frequency of visit to the slaughtering places and the corresponding number of slaughtered animals observed in them are shown in the table below.

**Table 1:** NUMBER OF SLAUGHTERED ANIMALS OBSERVED IN DIFFERENT SLAUGHTERING PLACE

| | No. of slaughtering place* | Name of the owner/main butcher of the slaughtering place | During winter | | During summer | |
|---|---|---|---|---|---|---|
| | | | Frequency of slaughtering place visit | No. of animals slaughtered observed | Frequency of slaughtering place visit | No. of animals slaughtered observed |
| 1 | 1 | Bishnu Shahi | 8 | 19 | 6 | 17 |
| 2 | 2 | Shanta Shahi | 8 | 9 | 6 | 9 |
| 3 | 3 | Shyam Shahi | 8 | 10 | 7 | 10 |
| 4 | 4 | Bhim Bahadur Shahi | 8 | 14 | 6 | 17 |
| 5 | 5 | Dinesh/Ramesh Shahi | 7 | 7 | 2 | 3 |
| 6 | 6 | Mani Raj Shahi | 7 | 8 | 3 | 4 |
| 7 | 7 | Nanda Bahadur Shahi | 7 | 15 | 4 | 8 |
| 8 | 8 | Raju Shahi | 4 | 4 | 3 | 3 |
| 9 | 9 | Bhai Raja Shahi | 3 | 3 | 5 | 9 |
| 10 | 10 | Rajendra Shahi | 3 | 3 | 5 | 5 |
| 11 | 11 | Ashok Shahi | 4 | 8 | 5 | 12 |
| 12 | 12 | Tari Babu Khadgi | - | - | 3 | 3 |
| | Total | | | 100 | | 100 |

*Numbering of slaughtering places was done for the convenience of studying the results and for comparing the data

## DATA COLLECTION

Field observations were the source of most of the data collected. Besides data were also collected through surveillance study among butchers, meat sellers and meat consumers. Similarly data also come from the laboratory work.

## DATA COLLECTION THOROUGH FIELD OBSERVATIONS

The field observations were directly responsible for the data regarding age, sex of slaughtered animals, and prevalence of different parasites. It also helps for the data regarding sanitation around the slaughtering area and meat shops.

## DATA COLLECTION THROUGH SURVEILLANCE STUDY

During the research work, the surveillance study was carried out among butchers, meat sellers and meat consumers. Different questions were put on to them and formal and informal interviews were carried out to get true and relevant data as much as possible. Separate questions for butchers, meat sellers and consumers were made and were asked orally to each of the participants to answer.

## BUTCHERS SURVEILLANCE STUDY

During the survey, 28 butchers in 12 slaughtering places were asked various questions and their corresponding replies were collected. 23 of them were local residents of the area whereas 5 were outsiders. All the slaughtering places were carefully observed and necessary photographs were also taken.

Data obtained from the survey of butchers gave the status of:

a/ slaughtering conditions

b/ way of slaughtering the animal

c/ animals being slaughtered each day

d/ waste disposal

e/ facilities present in the slaughtering places

f/ dog visit and feed of the meat

g/ knowledge about the meat borne diseases

h/ knowledge about the environment pollution

## MEAT SELLERS SURVEILLANCE STUDY

50 meat sellers of meat 50 shops were put to various questions to know about the facilities of meat shops and the practices of meat selling. The meat shops and their environment were thoroughly observed and relevant photographs were taken too.

Data obtained from the survey of meat sellers gave the status of:

a/ the type of meat sold

b/ facilities present in the meat shops

c/ knowledge about the meat borne diseases

## CONSUMERS SURVEILLANCE STUDY

300 meat consumers were questioned during the survey to know about their meat eating habit and so on. Among them 250 were local residents of Kirtipur and 50 were outsiders.

Data obtained from the survey of consumers gave the status of:

a/ type of meat they consume

b/ frequency of meat eating

c/ knowledge about the meat borne diseases

d/ their health status (getting sick) after consuming meat

e/ satisfaction and complains about meat hygiene and sanitation

## DATA OBTAINED FROM THE LABORATORY

Cysts and *Fasciola* spp. collected form each of the infected animals were kept in the separate plastic bags and were brought to the lab. for further work and analysis.

The hydatid cysts collected from different organs like lungs, livers, spleen, etc of the infected animals were carefully examined in the lab. to check for the sterility or fertility of the cysts samples. For this following steps were carried out.

### 1/ FOR THE CYST OF *Echinococcus*

#### A/ Clearing of the attached muscles and tissues

The cysts brought to the laboratory were kept in clean metal tray and the attached muscles and tissues were very carefully cleared with the help of scissors and blunt forceps.

#### B/ Clearing of the attached muscles and tissues

The cysts were then pricked with the help of needle and the fluid inside it was allowed to get collected in the tray. Little amount of the extracted fluid was transferred into a clean petridish and examined with the help of naked eye (keeping it above a black paper) for protoscolices ad daughter cysts.

a/ Presence of small yellowish white dust-like structures found suspended in the liquid suggests protoscolices. Confirmation was then made by further examination by microscope.

b/ Spherical and smaller cysts, smaller than the mother cysts, suspended in the fluid suggests the presence of daughter cysts.

c/ presence of nothing in the fluid suggests the infertile/ sterile nature of the cyst.

After pricking, the cysts were gently and carefully tore to observe the inner layer of the cyst i.e. the germinal layer,

a/ Presence of yellowish white dust- like structures indicates protoscolices and smaller spherical bodies indicate daughter cysts in the germinal layer confirms the fertility (fertile nature) of the cyst .

b/ Presence of nothing in the germinal layer suggests the infertile/sterile nature of the cyst.

Presence of either or both protoscolices and daughter cysts confirm the fertility of the cyst.

## 2/ FOR *Fasciola* SPECIES

The *Fasciola* species collected from different animals were separately analyzed to differentiate into respective species i.e. they were differentiated into *F. hepatica* and *F. gigantica*. Careful naked eye observation and microscopic observations were carried out for this. Differentiation was made according to difference they have got in their shape and size as shown in the table below.

| ***Fasciola hepatica*** | ***Fasciola gigantica*** |
|---|---|
| 1. Body size: 20 to 50mm by 6 to 13mm.The average length/width ratio is 1.88 to 2.32. | 1. Body size: 24 to 76mm by 5 to 13mm.The average length/width ratio is 4.39 to 5.20. |
| 2. The cephalic cone is large. | 2. The cephalic cone is small. |
| 3. The shoulders are well developed. | 3. The shoulders are less developed. |
| 4. Smaller acetabulum. | 4. Larger acetabulum. |
| 5. The ovary and ceca are less branched. | 5. The ovary and ceca are more branched. |
| 6. The average distance between the posterior border of the body and the posterior testis is shorter (7.78mm; range: 3 to 13 mm). | 6. The average distance between the posterior border of the body and the posterior testis is longer (14.9mm; range: 6 to 19 mm). |

Source: Sahba *et al*., 1972

## 3/ FOR THE CYST OF *Taenia saginata*

The muscles and tissues surrounding the cyst were carefully removed and then the cysts were preserved in 70% alcohol. No further analysis was made for them.

## DATA ANALYSIS

The data obtained were then calculated, classified, tabulated and statistically tested using $\lambda^2$ with the help of supervisor, co-supervisor and other expertises.

**Plate 1**. TRANSPORTING THE ANIMALS

**Plate 2**. ANIMALS KEPT IN SLAUGHTER SHED

**Plate 3**. ANIMALS KEPT ALONG THE ROAD SIDE PRIOR TO SLAUGHTERING

**Plate 4.** BUFFALO BEING PREPARED FOR SLAUGHTER

**Plate 5.** BURNING THE SLAUGHTERED CALF

**Plate 6**. BUTCHERS WORKING WITH THE CARCASS

**Plate 7**. OBSERVING THE CARCASS

**Plate 8**. BUTCHER TAKING PART IN QUESTIONNAIRE

# V

# RESULTS

The results have been presented under following headings. Headings are again divided into sub headings.

## A. DISTRIBUTION OF SLAUGHTERING PLACES IN KIRTIPUR MUNICIPALITY

In Kirtipur area, a total of 12 slaughtering places were found. Most of them were located in Khasibazzar and Nayabazzar sites, the two main market areas. Kirtipur Municipality is divided into 19 wards and the ward-wise distribution of slaughtering places is shown in the Table 2.

**Table 2:** DISTRIBUTION OF SLAUGHTERING PLACES IN KIRTIPUR MUNICIPALITY

| S.N | Wards | Number of slaughtering places |
|---|---|---|
| 1 | 1 | 0 |
| 2 | 2 | 0 |
| 3 | 3 | 1 |
| 4 | 4 | 4 |
| 5 | 5 | 6 |
| 6 | 6 | 0 |
| 7 | 7 | 0 |
| 8 | 8 | 0 |
| 9 | 9 | 0 |
| 10 | 10 | 0 |
| 11 | 11 | 0 |
| 12 | 12 | 0 |
| 13 | 13 | 0 |
| 14 | 14 | 0 |
| 15 | 15 | 0 |
| 16 | 16 | 0 |
| 17 | 17 | 1 |
| 18 | 18 | 0 |
| 19 | 19 | 0 |
| | **Total** | **12** |

**B. NUMBER OF BUFFALO/ES SLAUGHTERED PER DAY IN DIFFERENT SLAUGHTERING PLACES**

In Kirtipur, each day, an average of 25 buffaloes was found slaughtered. However the number was found increased upto 30 to 35 during Saturdays and during festivals due to more demand of meat. Similarly during Ekadashi and Aaunshi, the number was found reduced as the tradition prohibits the consumption of meat in these days. No. of buffalo/es slaughtered per day in different slaughtering places is shown in Fig.1.

**Fig. 1:** No. OF BUFFALO/ES SLAUGHTERED PER DAY IN DIFFERENT SLAUGHTERING PLACES

## C. BUTCHERS' SURVEY RESULT

Following facts were obtained after surveying and questioning the butchers of these 12 slaughtering places in the Municipality.

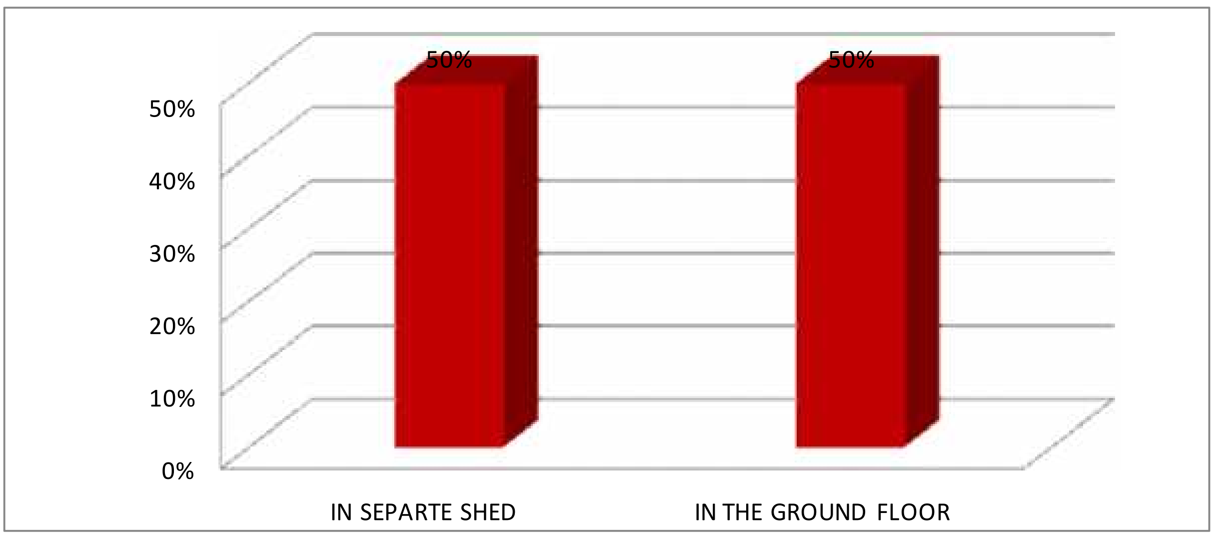
### C.1: PLACES FROM WHERE THE BUFFALOES ARE BROUGHT

The buffaloes, for slaughtering, were all brought from outside the valley. They were mostly imported from India to Birgunj and Nepalgunj and the butchers bought them and brought them to their place in trucks. Some butchers indirectly brought the buffaloes from Thankot which had been brought from the above mentioned places as well.

### C.2: ANIMALS KEPT PRIOR TO SLAUGHTERING

Prior to slaughtering, these buffaloes were either kept in slaughter shed, or in the ground floor of the butcher's house. In fact 50 % of the slaughtering places had separate slaughter shed and in rest 50% of the slaughtering places, buffaloes were just kept in the ground floor of the butcher's house. The Fig.2 shows the place where the animals are kept prior to slaughtering.

**Fig. 2:** ANIMALS KEPT PRIOR TO SLAUGHTERING



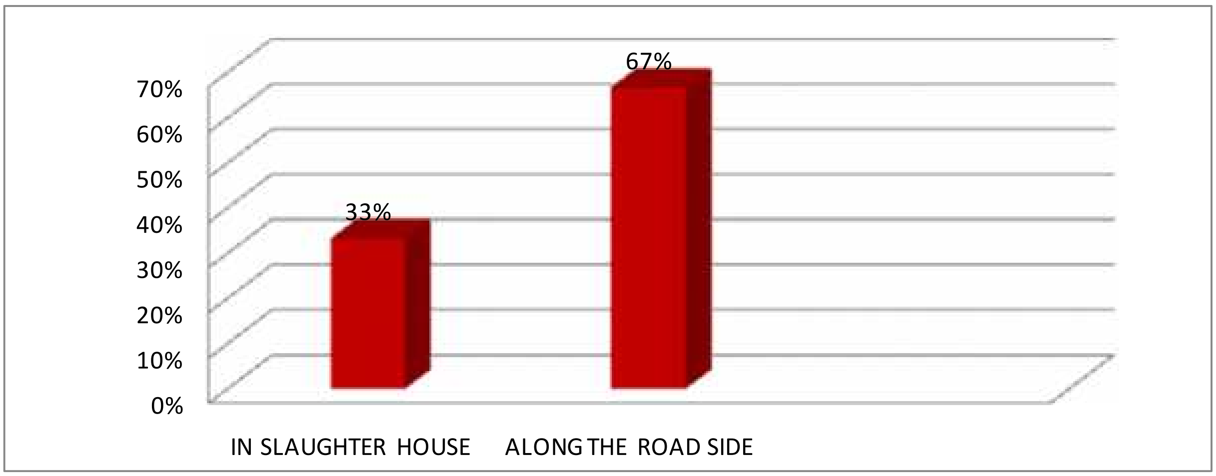

### C.3: PRACTICES OF SLAUGHTERING

The buffaloes were slaughtered at early morning. The slaughtering practices were found traditional and inhumane. The animals were killed by striking on their head with hammer after their legs had been tied with thick rope to prevent from escaping. Their mouth was also tied with the rope to prevent from screaming. They kept striking till the buffalo fell down and got unconscious or die. Then their head was cut off.

C.4: PLACES OF BUFFALO SLAUGHTERING

In most of the slaughtering places, in fact in 66.66%, buffaloes were slaughtered along the road side and they were always found visited by dogs, while in 33.33%, they were slaughtered in the slaughter house. Dogs' movement was not found in these places as they had walls and doors. Places of buffalo slaughtering is shown in Fig.3.

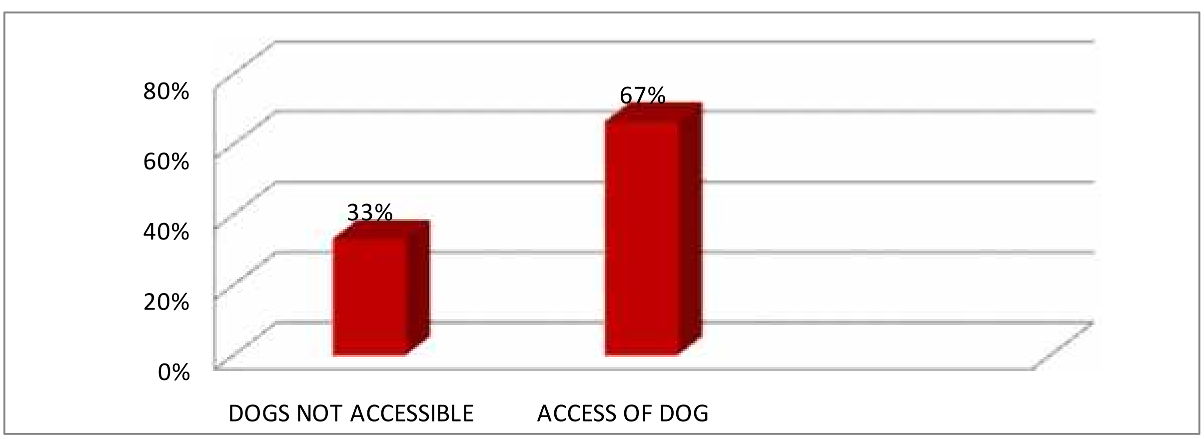
**Fig 3:** PLACES OF BUFFALO SLAUGHTERING




C.5: DOGS' MOVEMENT AROUND THE SLAUGHTERING PLACE

66.66% of the slaughtering areas were easily accessible to dogs while in 33.33% of the slaughtering places, dogs' movement was not found which is shown in Fig.4.

**Fig. 4:** DOGS' MOVEMENT AROUND THE SLAUGHTERING PLACE

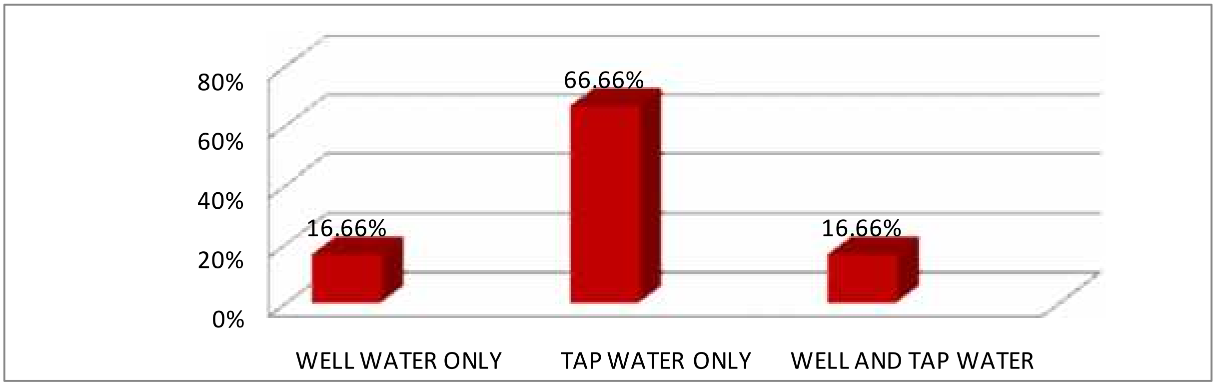



The slaughtered animals were then skinned and internal organs were separated. But most of the calves slaughtered were burnt and their skin also served as a part of delicacy.

C.6: TYPE OF WATER USED IN THE SLAUGHTERING PLACES

For cleaning the burnt calves, cleaning the intestine and stomach of the slaughtered animals, butchers used either tap water (16.66%) or well water (66.66) or both tap and well water (16.66%) according to the access they were with which is shown in Fig.5.

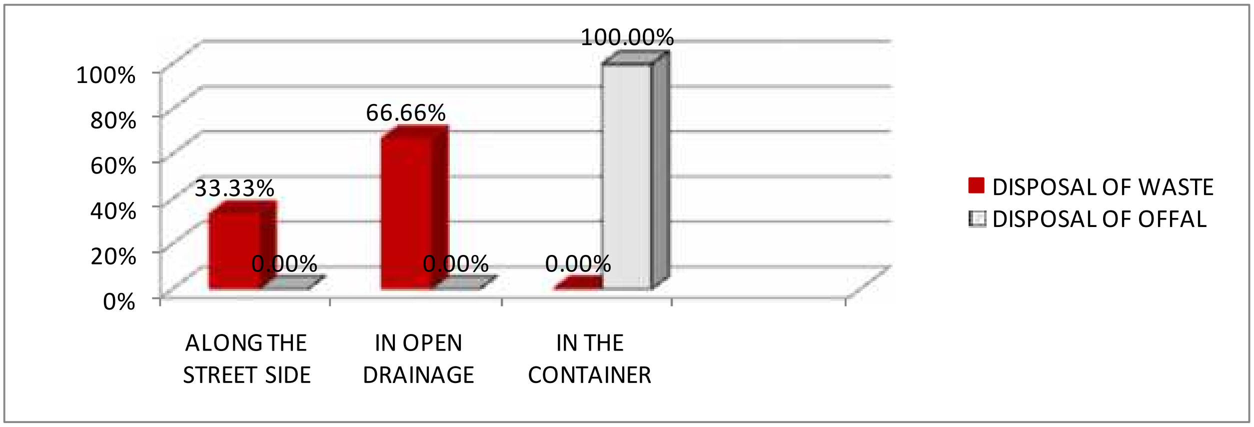
**Fig. 5:** TYPE OF WATER USED IN THE SLAUGHTERING PLACE




C.7: DISPOSAL OF WASTES FROM SLAUGHTERING PLACES

During slaughtering of the animal, large amount of wastes and offal are produced. The wastes mainly constitute the stomach and intestinal content of the animal while offal includes horns, bones, etc. Through observations and questioning of the butchers, it was known that 33.33% of the butchers threw the wastes in the nearby drainage while 66.66% of butchers said that they deposited them along the street side to be used as fertilizer. Regarding the offal, all the butchers or slaughtering places (100%) had container or separate place to store them as they have commercial use. The place, where the wastes and offal from the slaughtering places were disposed is shown in Fig.6.

**Fig. 6:** DISPOSAL OF WASTES AND OFFAL BY BUTCHERS



C.8: FACILITIES PRESENT IN THE SLAUGHTER HOUSES

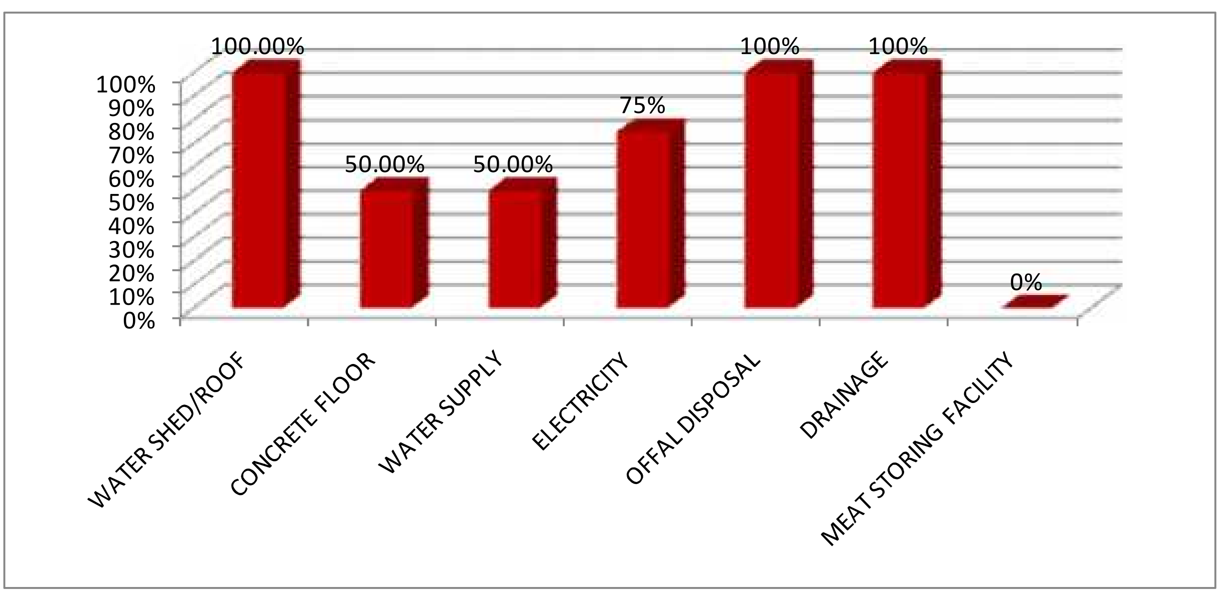
As mentioned earlier, in Kirtipur, 12 slaughtering places were found. Among them only 4 have boundary walls and they have been categorized as slaughter house. They had one or more facilities like facilities of roof, concrete floor, water and electricity supply, space or container for offal disposal drainage, etc. For rest, they had just been called as slaughtering place as they lacked separate boundaries and area too. The butchers used the street nearby their house for slaughtering the animals. They also lacked any of the above mentioned facilities except for the drainage and offal disposing facilities. The floors of them were dirty and dusty during dry seasons and muddy when rain poured on. As they lacked roof, during rainy days, slaughtering activities were found carried out inside the ground floor of their own house. The floors of them were made up of bricks and mud. The water and electricity were found supplied from the nearby source.

All the slaughtering places including slaughter houses were found devoid of meat storing facilities. So, the butchers used to sell the meat to the wholesale meat sellers on the spot. All the butchers, in fact, were found to have one or more meat shops of their own. Meat was usually found carried to those shops in the bamboo basket and mostly without any cover. The meat from the slaughtering places was also found being transported outside of the Kirtipur, to the places like Kalimati, Balaju, Koteswor, etc.

The butchers were found to have no separate clothes, boots or apron for slaughtering. They used to wear the same usual clothing during slaughtering.

Facilities present or observed in the slaughter house are given in Fig. 7.

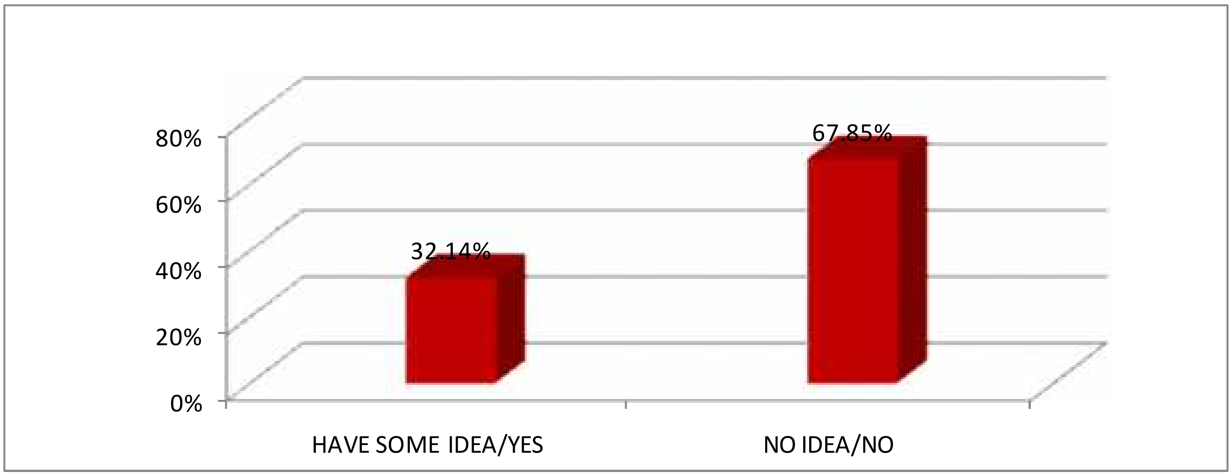
**Fig. 7:** FACILITIES PRESENT IN THE SLAUGHTER HOUSE



C.9: BUTCHERS' KNOWLEDGE ABOUT MEAT BORNE DISEASES

During the survey, 28 butchers in 12 slaughtering places were asked various questions and their corresponding replies were collected. Among 28 butchers questioned, 9 (32.14%) said that they had some idea about meat borne diseases which is shown in Fig. 8.

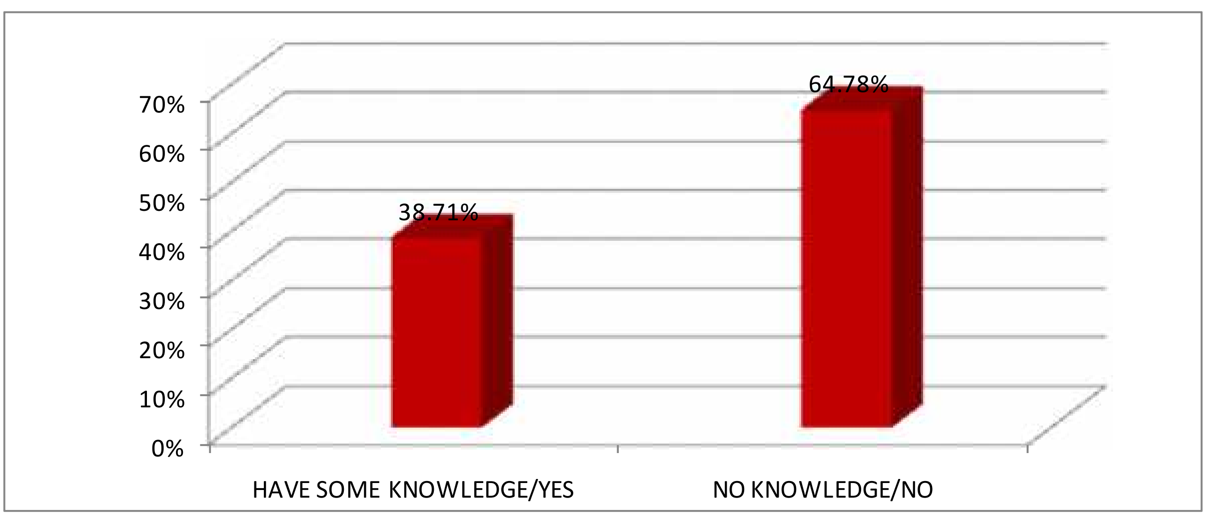
**Fig. 8:** BUTCHERS' KNOWLEDGE ABOUT MEAT BORNE DISEASES




C.10: BUTCHERS' KNOWLEDGE ABOUT ENVIRONMENT PROBLEM

Among 28 butchers questioned, 10 (38.71%) answered that they had knowledge regarding environmental effect due to slaughtering places such as pollution of environment due to disposal of wastes and offal, pollution from the water that had been used to clean the slaughtered animals, etc.

**Fig. 9:** BUTCHERS' KNOWLEDGE ABOUT ENVIRONMENT PROBLEM



## C.11: INSPECTION OF SLAUGHTERING PLACES

When the butchers were asked about visiting of any meat inspection team, they denied of coming anyone for meat inspection. They themselves, however, revealed and accepted that the slaughtering practices and the condition of slaughtering places could have been much better had there been regular meat inspection and had they been aware.

## C.12: PARASITES OBSERVED BY THE BUTCHERS

All the butchers also revealed that they had found or seen water pockets i.e. cyst of *Echinococcus*, liverfluke which they called ‘Namle’ and other parasites during separation of the carcasses. They knew that those water pockets and ‘Namle’ were parasites. The water pockets were ruptured and were sold. The livers infected with the flukes were sold too. Regarding *Taenia* cysts they just answered that they didn’t know them as any sort of parasites.

Through questionnaire, it was also known that none of the butchers had ever taken any training in meat business.

**Plate 9**. SEPARATION OF THE CARCASS

**Plate 10**. MEAT PUT INTO BAMBOO BASKET TO BE CARRIED TO MEAT SHOPS

**Plate 11.** MEAT BEING LOADED ON VEHICLE

**Plate 12.** A SINGLE CYST OF *Echinococcus* IN LUNG

**Plate 13**. LIVER INFECTED WITH *Fasciola* spp.

**Plate 14**. CYSTS OF *Taenia saginata* IN OESOPHAGUS

**Plate 15**. DISPOSAL OF WASTE

**Plate 16**. MEAT BEING SOLD OPENLY

## D. MEAT SELLERS' SURVEY RESULT

Through the survey, number and type of meat shops over the entire Kirtipur municipality were found out. A total of 50 meat shops were found which are shown in the Table 3. Buff selling shops were found to be 36.

**Table 3:** TYPE OF MEAT SHOPS FOUND AND THEIR DISTRIBUTION IN KIRTIPUR

| wards | buff only | chicken only | Mutton only | Pork only | buff and chicken | mutton and chicken | chicken and fish | mutton, chicken and fish | total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | | | | | | **3** |
| 2 | | | | | | | | | **0** |
| 3 | 2 | 1 | | | 1 | | | | **4** |
| 4 | 2 | | | | | | | | **2** |
| 5 | 3 | | | | | | | | **3** |
| 6 | | | | | 1 | | | | **1** |
| 7 | 1 | 1 | | | | 1 | | | **3** |
| 8 | | | | | | | | | **0** |
| 9 | 4 | 2 | | | 2 | | | | **8** |
| 10 | 2 | | | | | | | | **2** |
| 11 | 3 | | | | | | | | **3** |
| 12 | | | | | | | | | **0** |
| 13 | | | | | | | | | **0** |
| 14 | 2 | 1 | | | 1 | | | | **4** |
| 15 | | | | | | 1 | | | **1** |
| 16 | | | | | 1 | | | | **1** |
| 17 | 8 | | 1 | 1 | 2 | 1 | 1 | 1 | **15** |
| 18 | | | | | | | | | **0** |
| 19 | | | | | | | | | **0** |
| **TOTAL** | **28** | **6** | **2** | **1** | **8** | **3** | **1** | **1** | **50** |

During the research, 36 meat sellers i.e. all the buff meat selling shops were surveyed. The shops were surveyed mainly to generate information regarding facilities in the shops and hygienic status of the meat they are selling.

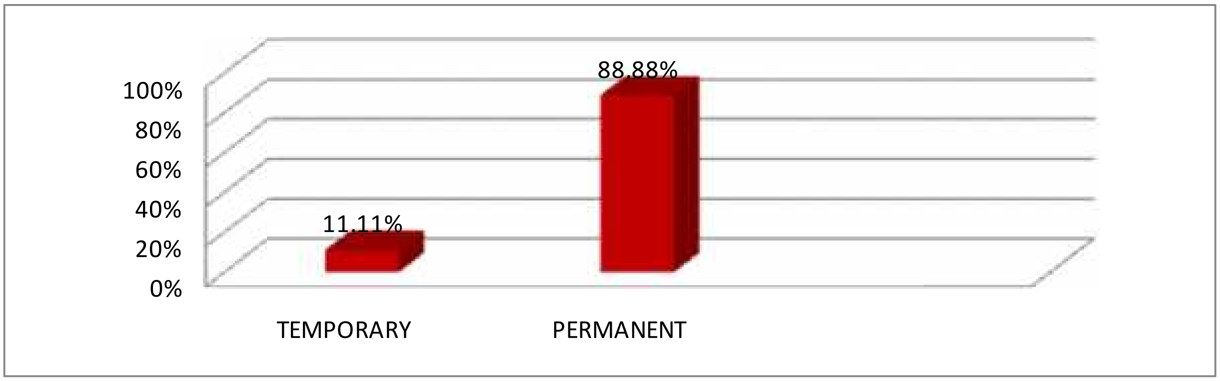
During survey, 14 (38.88%) of the meat sellers replied that they had got their own slaughtering places and they got meat from them. The rest 22 (61.11%) answered that they got meat from the butchers.

11 (30.55%) meat sellers said that they got the meat brought to their shops from the slaughtering places on vehicle (on bike or cycle) while 25 (69.44%) replied that they had men to carry the meat in the bamboo basket to their shops.

D.1: HOUSING CONDITION OF MEAT SHOPS

It was found that 32 (88.88%) of the meat sellers had permanent housing with a roof. 4 (11.11%) of the meat sellers were found selling meat openly on the streets. Fig.10 shows the housing condition of the meat shops. The unsold meat was carried to their home and kept in refrigerator.

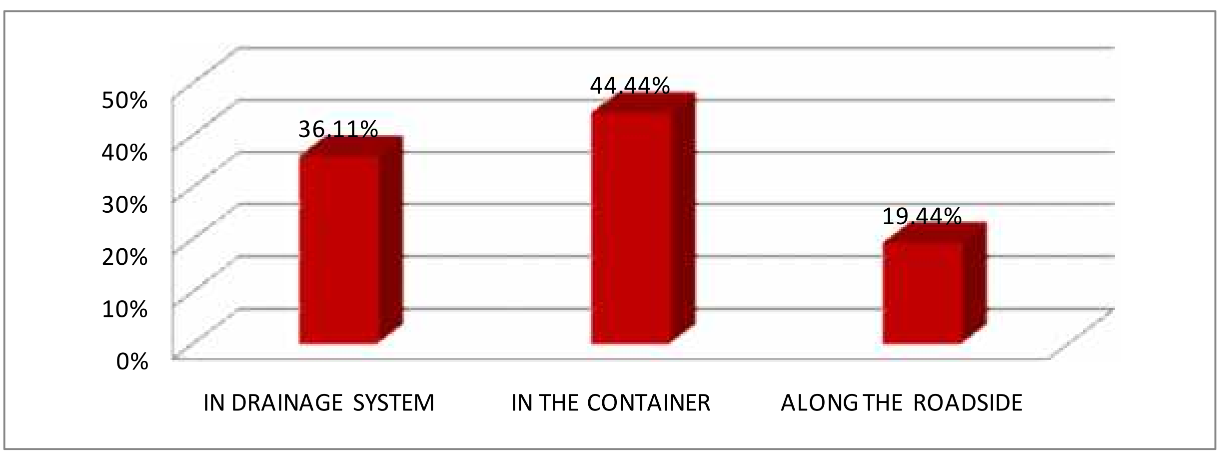
**Fig. 10:** HOUSING CONDITION OF MEAT SHOPS




D.2: DISPOSAL OF WASTES AND OFFAL BY MEAT SELLERS

When the meat sellers were questioned about the waste disposal, 13 (36.11%) of the meat sellers replied that they threw the wastes into the drainage system, 16 (44.44%) of them replied that they threw the wastes in the container and 7 (19.44%) answered that they just casted away the wastes along the road side. Such thrown away wastes and offal materials were very prone to be eaten by dogs as dogs were found roaming around the areas.

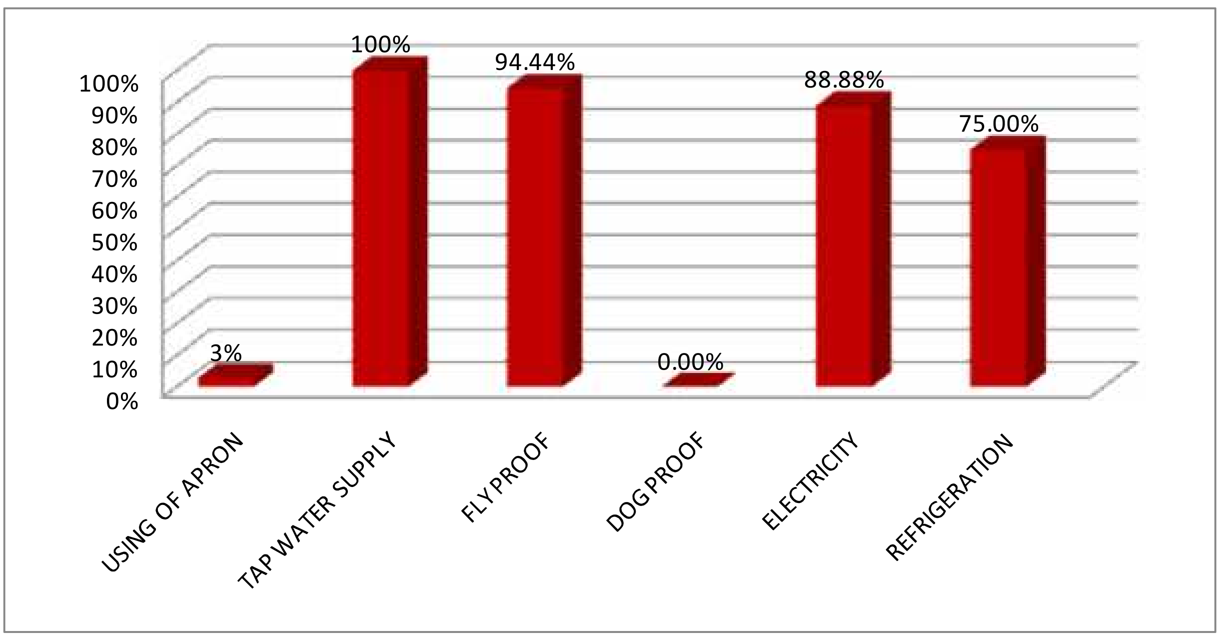
**Fig. 11:** DISPOSAL OF WASTES AND OFFAL BY MEAT SELLERS



D.3: SANITARY CONDITION AND FACILITIES PRESENT IN THE MEAT SHOPS

Regarding sanitation and facilities in the meat shops, all the butchers answered that they used tap water to wash their meat and hands if required. 35 (97.22%) meat sellers didn't have separate clothing or apron to wear on during meat selling. They were found wearing the same usual clothes which they used to wear when they were not selling meat. 34 (94.44%) of the meat sellers replied that their shops were fly proof as they used fly nets. Nets were often found being used. Regarding access to dogs, it was found that all (100.00%) the meat shops were surrounded by dog/s. The meat sellers also used to give bones, hides, etc not bought by the consumers. Regarding electricity and cold storage, 32 (88.88%) meat shops were found to have electricity and 27 (75.00%) meat sellers replied that they had their shops accessed with the facility of cold storage. The sanitary condition and facilities present in the meat shops is shown in Fig.12.

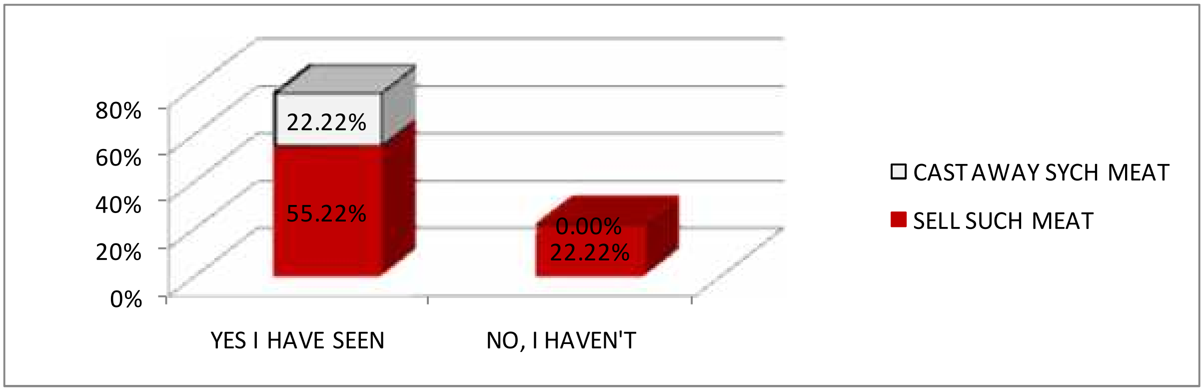
**Fig. 12:** SANITARY CONDITION AND FACILITIES PRESENT IN THE MEAT SHOPS



D.4: PARASITES OBSERVED BY MEAT SELLERS

28 (77.77%) meat sellers replied that they had seen the water pockets (cyst of *Echinococcus*) or ruptured water pockets and other parasites in the meat. 20 (71.42%) of such meat sellers admitted that they sold such meat anyway. The unrutured cysts were at first ruptured and the flukes (‘Namle’) and amphistomes occurring were removed before being sold. The rest of the meat sellers (28.57%) replied that they casted away such meat which is shown in Fig.13.

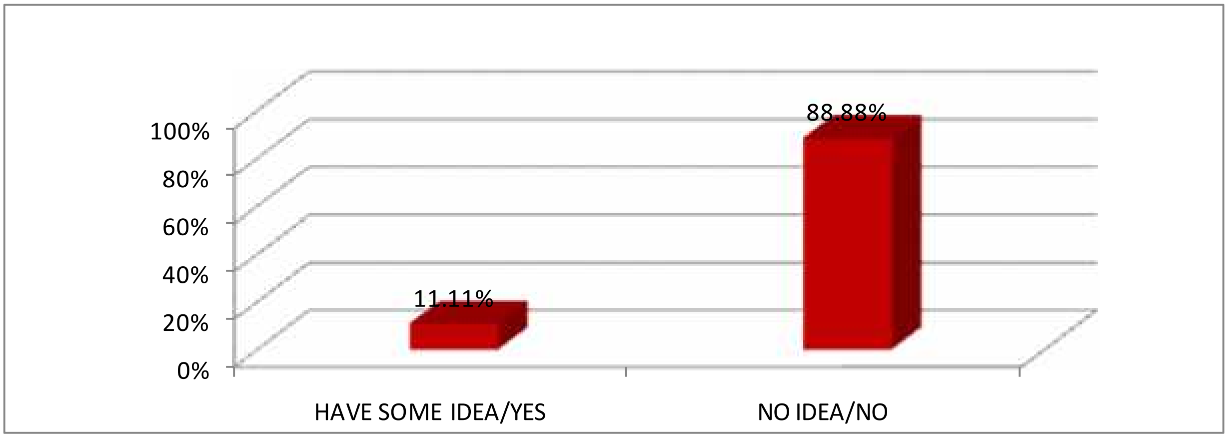
**Fig. 13:** PARASITES OBSERVED BY MEAT SELLERS




D.5: MEAT SELLERS’ KNOWLEDGE ABOUT MEAT BORNE DISEASES

When asked about meat borne diseases, 32 (88.88%) of the meat sellers’ answered that they had no idea about meat borne diseases which is shown in Fig.14.

**Fig. 14:** MEAT SELLERS’ KNOWLEDGE ABOUT MEAT BORNE DISEASES




Again, like butchers, the meat sellers also revealed that no one had ever come for meat inspection. None of them were found to have taken any training in meat business as well.

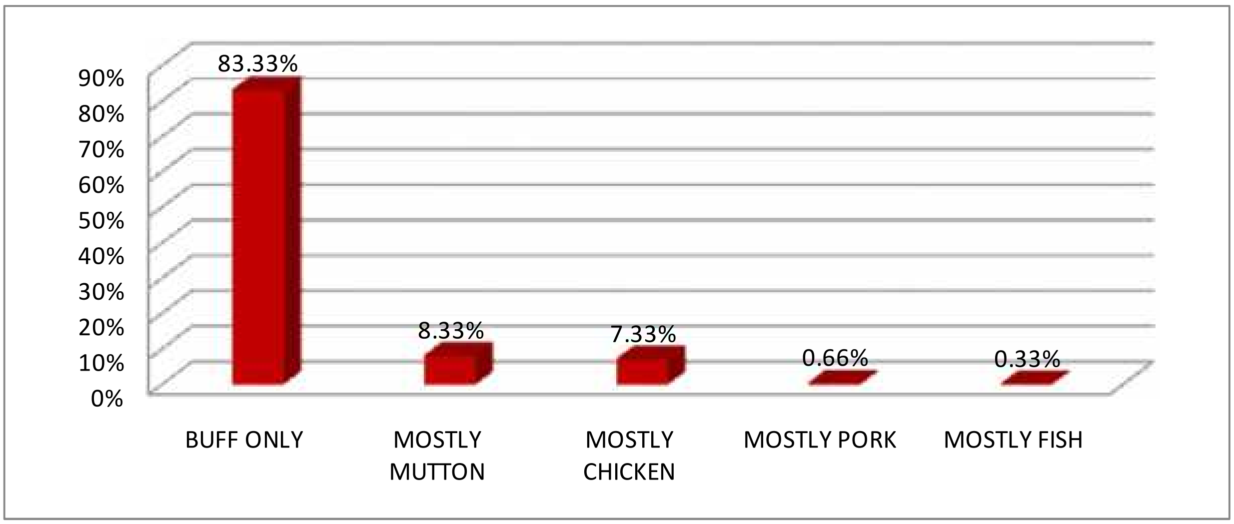
## E. CONSUMERS' SURVEY RESULT

Kirtipur is one of the old villages/town of Newars who have lots of feasts and festivals to celebrate throughout the year and in all these occasions various dishes prepared from meat like 'Daykula' (cooked meat), 'Chhoyala' (burned meat), 'Bhutan' (fried meat), 'Sekuwa' (baked meat), 'Kachila' (raw meat), 'Chhengu' (raw skin attached with flesh), etc are a must. One can't imagine Newari festivals without meat. 'Kachila' and 'Chhengu' are raw meats, so have got much parasitic importance.

### E.1: TYPE OF MEAT CONSUMED

300 meat consumers were surveyed during the research. Among them 250 were local residents of Kirtipur and 50 were outsiders. During the survey, 250 consumers replied that that preferred buff over other meat whereas 50 replied that they had never consumed buff and rather they ate mutton or chicken or pork or any. The type of meat consumed by the respondents is given in Fig.15.

**Fig. 15:** TYPE OF MEAT CONSUMED




### E.2: FREQUENCY OF BUFF CONSUMPTION

During the research, the meat consuming frequency of buff consumers were also surveyed. 133 (53.20%) among 250 buff consumers replied that they consumed meat once a week. 100 (40.00%) of them said that they ate meat much frequently round about twice a week. 4 (1.6%) said they ate meat once a month while 13 (5.20%) consumers answered; they consumed meat in a long gap only during the occasions.

E.3: PARASITES OBSERVED IN THE MEAT BY CONSUMERS

183 (73.20%) buff consumers replied that they had never seen parasites in the meat they had bought while 67 (26.80%) said they had sometimes seen the parasites in liver, rumen intestine, etc.

E.4: CONSUMERS' KNOWLEDGE ABOUT MEAT BORNE DISEASES

167 (66.80%) consumers seemed to be satisfied with the hygienic and sanitary conditions of the meat shops while 83 (33.20%) of them said that the shops should be made fly and dog proof. 90 (36.00%) of the consumers said, they had some idea about meat borne diseases while rest 160 (64.00%) simply replied that they had got no idea which is graphically shown in Fig.16.

**Fig. 16:** CONSUMERS' KNOWLEDGE ABOUT MEAT BORNE DISEASES

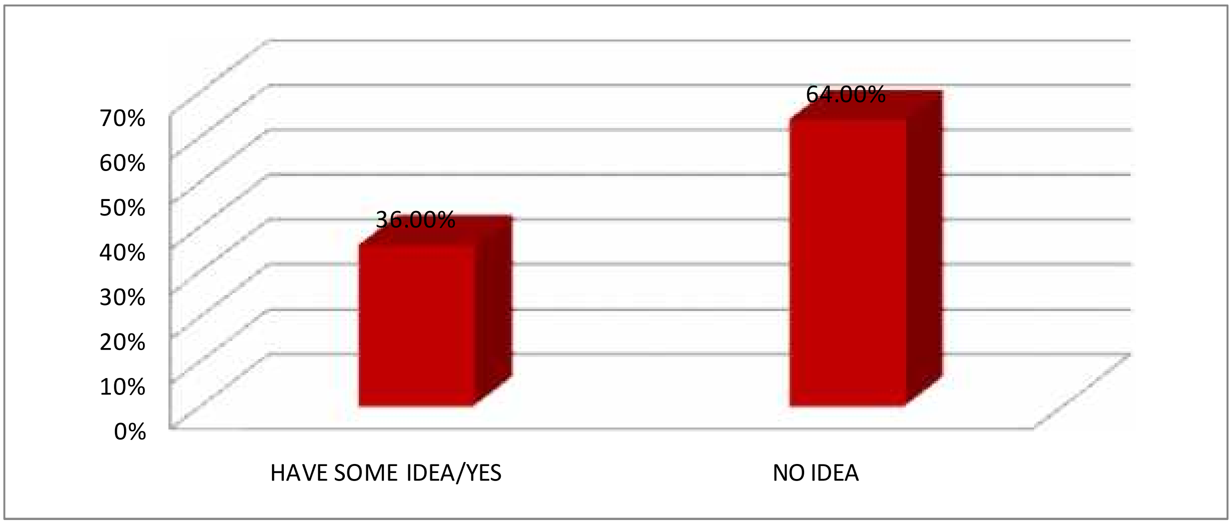


**Plate 17**. DOG ROAMING AROUND MEAT SHOP

**Plate 18.** TEARING THE ATTACHED MUSCLES OF THE CYSTS

**Plate 19.** SHOWING DAUGHTER CYST

**Plate 20.** UPPER *Fasciola gigantica* VERSUS LOWER *Fasciola hepatica*

**Plate 21**. CYSTS OF *Echinococcus* IN LIVER

**Plate 22** . CYST OF *Echinococcus* IN THE SPLEEN

**Plate 23**. *Fasciola* spp.

**Plate 24**. CYSTS OF *Taenia saginata*

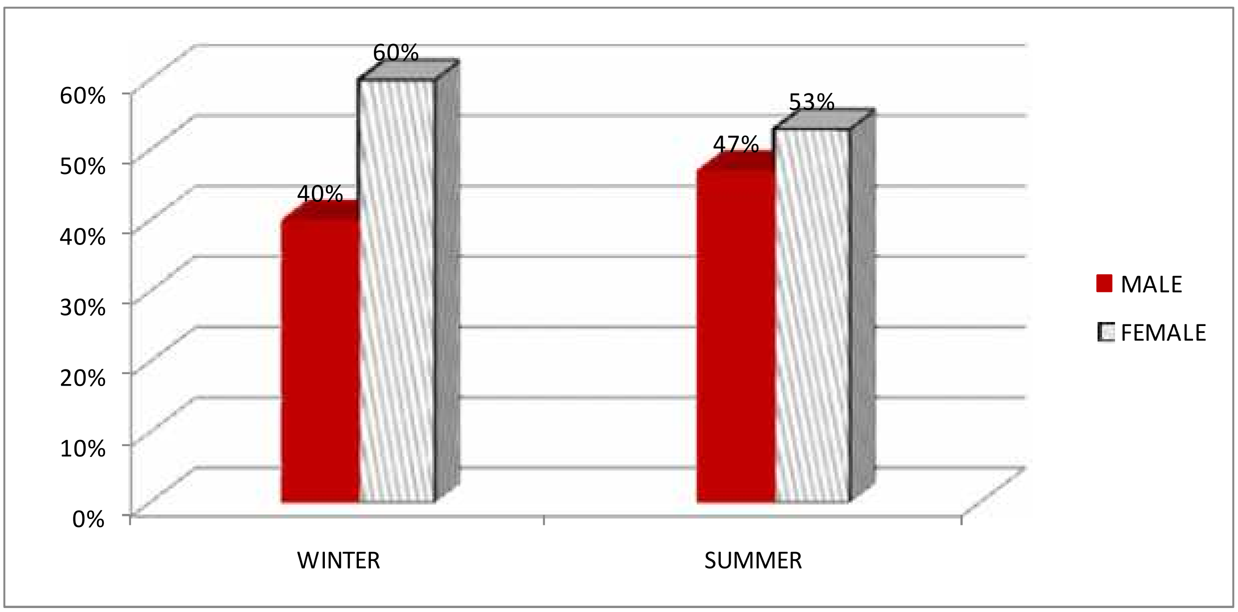
## F. HELMINTH PARASITES OBSERVED IN THE SLAUGHTERED BUFFALOES

During the field visits of the slaughtering places, the carcasses of 200 slaughtered buffaloes, 100 each during winter and summer seasons were carefully observed to find out the comparative prevalence of different helminthes. The meat parasites which were observed and studied included cyst of *Echinococcus*, cyst of *Taenia saginata* (cestodes) and *Fasciola* species (a trematode).

### F.1.a. Sex-wise observation of slaughtered buffaloes

Out of 100 slaughtered buffaloes observed during winter, 40 were males and 60 were females while during summer, out of again 100 slaughtered animals observed, 47 were males and 53 were females i.e. a total of 87 males and 113 females were observed during the research. The sexes of the animals were recorded as accordingly said by the butchers.

**Fig. 17:** SEX-WISE OBSERVATIONS OF SLAUGHTERED BUFFALOES




### F.1.b. Age-wise observation of slaughtered buffaloes

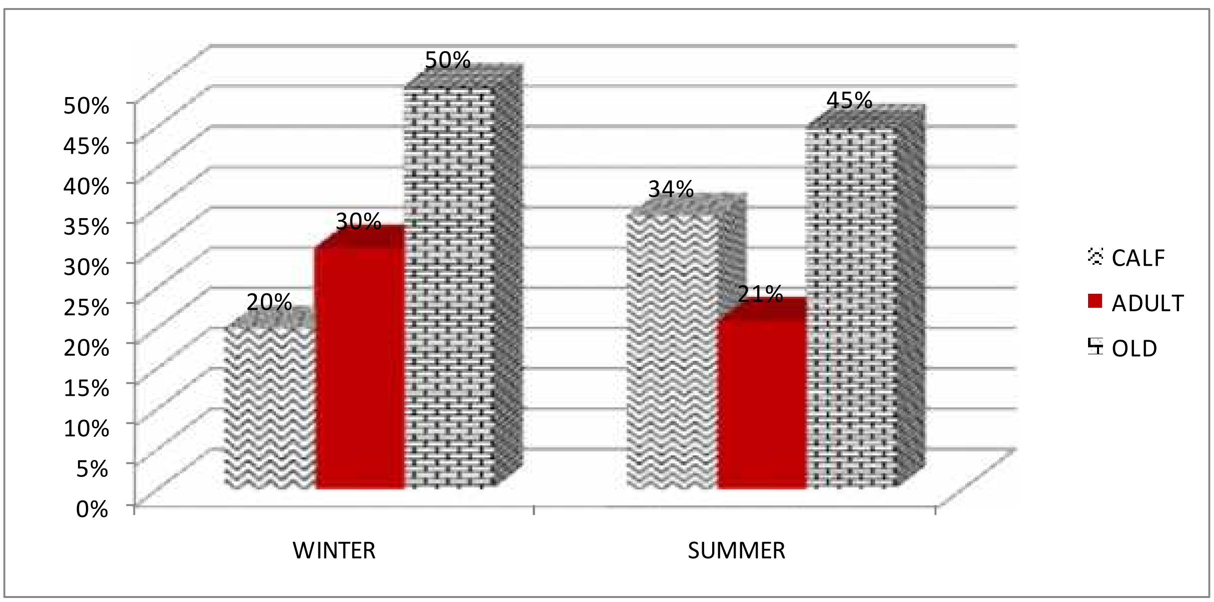
Out of 100 carcasses observed during winter, 20 belonged to calves, 30 belonged to adults and 50 were that of older ones. Similarly out of 100 slaughtered buffaloes observed during summer, 34 were calves, 21 were adults and 45 were olds. So a total of 54 calves, 51 adults and 95 old buffaloes were studied during the research. Age separation was made consulting with the butchers plus by observing the slaughtered animal.

Following things were considered to separate the age of the slaughtered animal:

| | YOUNG | ADULT | OLD |
|---|---|---|---|
| Size | Small | Large | Large |
| Separation of hides/skin | The animal is usually burnt after killed and skin is not separated from flesh. | The animal is not burnt and hides are separated. Not used for eating | The animal is not burnt and hides are separated. Not used for eating |
| Type of body | Usually shining skin. | Usually smooth and shining skin. Incase of female the breast is much swollen and not shrunken. | Skin wrinkled or oldish. Males have clear rough mark on the upper part of their neck as they had been used once for ploughing. Females have shrunken breasts. |

The age-wise observation of slaughtered buffaloes during the winter and summer is shown in Fig.18.

**Fig. 18:** AGE-WISE OBSERVATIONS OF SLAUGHTERED BUFFALOES



## F.2: PREVALENCE OF *Echinococcus* INFECTION

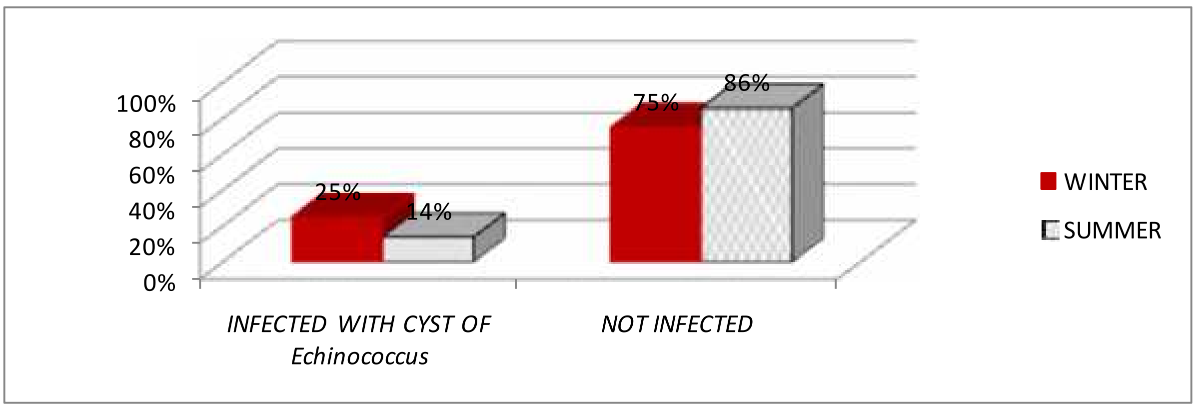
- **General prevalence**

A total of 39 buffaloes (19.50%), out of 200 observed, were found infected with *Echinococcus.*

- **Season-wise prevalence**

Out of each 100 slaughtered buffaloes observed during winter and summer, cysts of *Echinococcus* were found in 25 (25.00%) buffaloes during winter while only 14 (14.00%) positives cases of *Echinococcus* were observed during summer which is pointed out in Fig.19. The chi-square test indicated that the season-wise prevalence of *Echinococcus* was significant ($\chi^2_{0.05}$, 1d.f. =3.851).

**Fig. 19**: SEASON-WISE PREVALENCE OF *Echinococcus*




- **Sex-wise prevalence of *Echinococcus***

Females (23.89%) were found infected with *Echinococcus* more often than males (13.79%) but the chi-square test indicated that the difference in the sex-wise prevalence of *Echinococcus* was not significant ($\chi^2_{0.05}$, 1d.f. =3.851).

**Table 4:** SEX-WISE PREVALENCE OF *Echinococcus*

| **MONTH** | **WINTER** | | | **SUMMER** | | | **TOTAL** | | |
|---|---|---|---|---|---|---|---|---|---|
| **SEX** | Observed | Infected | Prevalence | Observed | Infected | Prevalence | Observed | Infected | Prevalence |
| **MALE** | 40 | 6 | 15% | 47 | 6 | 12.76% | 87 | 12 | 13.79% |
| **FEMALE** | 60 | 19 | 31..66% | 53 | 8 | 15.09% | 113 | 27 | 23.89% |
| **TOTAL** | **100** | **25** | **25.00%** | **100** | **14** | **14.00%** | **200** | **39** | **19.50%** |

) **Age-wise prevalence of *Echinococcus***

Old animals (30.52%) were found more infected with *Echinococcus* than calves (11.11%) and adults (7.84%). The difference in age-wise prevalence of *Echinococcus* was found significant ($\chi^2_{0.05}$, 2d.f. =14.19).

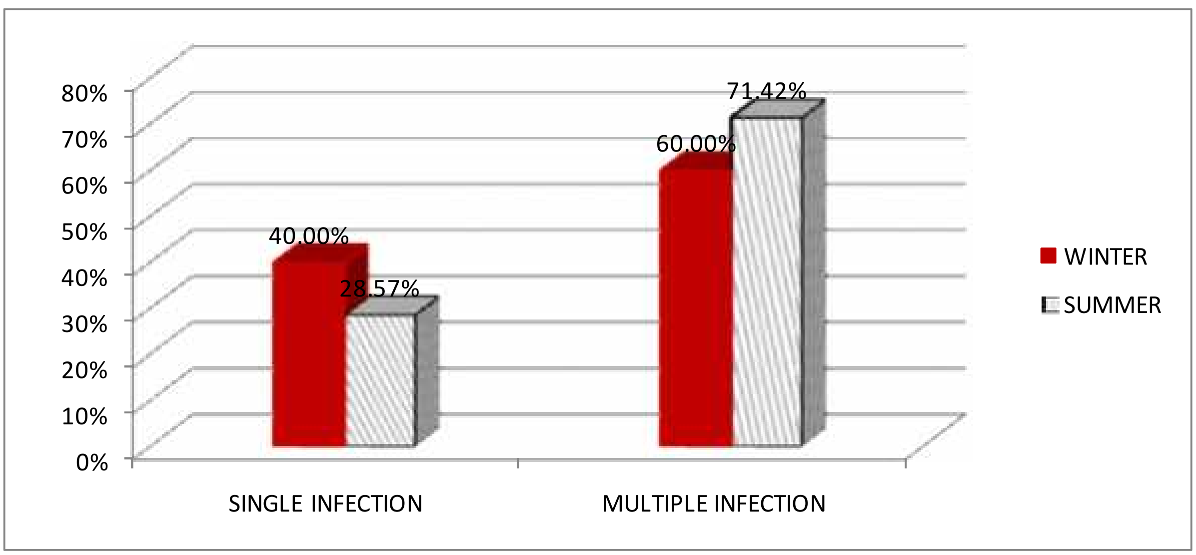
**Table 5:** AGE-WISE PREVALENCE OF *Echinococcus*

| MONTH | WINTER | | | SUMMER | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| AGE | Observed | Infected | Prevalence | Observed | Infected | Prevalence | Observed | Infected | Prevalence |
| **CALF** | 20 | 3 | 15.00% | 34 | 3 | 8.82% | 54 | 6 | 11.11% |
| **ADULT** | 30 | 2 | 6.66% | 21 | 2 | 9.52% | 51 | 4 | 7.84% |
| **OLD** | 50 | 20 | 40.00% | 45 | 9 | 20.00% | 95 | 29 | 30.52% |
| **TOTAL** | **100** | **25** | **25.00%** | **100** | **14** | **14.00%** | **200** | **39** | **19.50%** |

) **Type of infection with *Echinococcus* (single or multiple infections)**

Out of 25 animals found infected with the cyst/s of *Echinococcus* during winter, 10 (40.00%) of them had single infection while 15 (60.00%) had multiple infections. Similarly, out of 14 animals that had hydatid cyst/s during summer, 4 (28.57%) of them had single infection while 10 (71.42%) had multiple infections. The Fig.20 shows the type of *Echinococcus* infection.

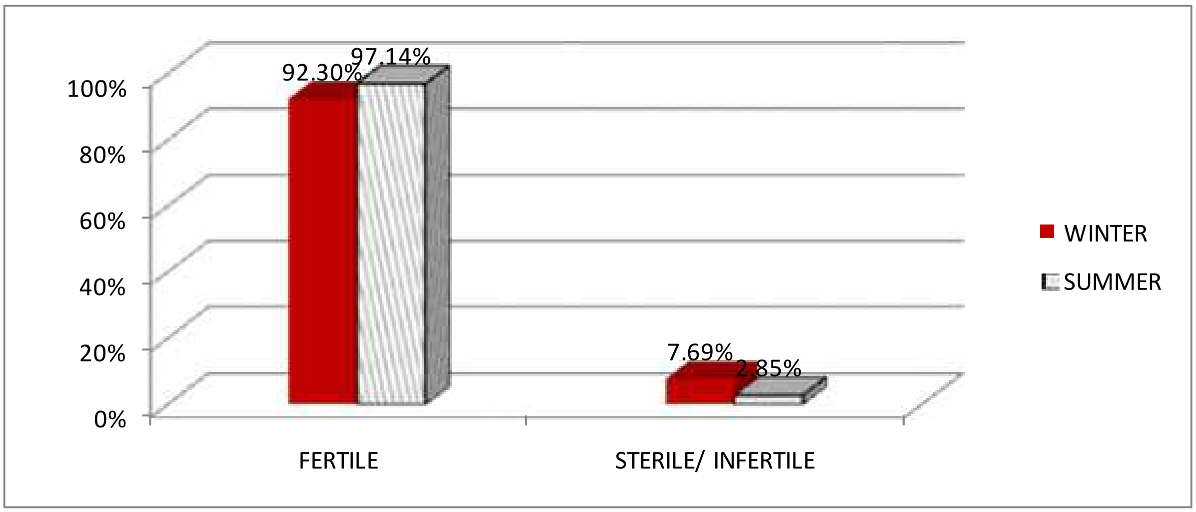
**Fig. 20**: TYPE OF *Echinococcus* INFECTION IN SLAUGHTERED BUFFALOES



- **Prevalence of fertile and sterile hydatid cysts**

During winter, a total of 65 cysts of *Echinococcus* from 25 infected animals were collected and observed for their fertile and sterile nature. Out of 65, 60 (92.30%) were found fertile while 5 (7.69%) of them were sterile. Similarly, during summer, 35 cysts from 14 infected animals were studied. Among them 34 (97.14%) were found to be fertile while 1 (2.85%) was found sterile which is shown in Fig.21.

**Fig. 21:** PREVALENCE OF STERILE AND FERTILE HYDATID CYSTS




- **Prevalence of hydatid cysts in buffaloes by organs**

The study found lungs and livers of the animals were the most susceptible organs as the hydatid cysts were mostly confined in them. Out of 200 animals observed, 34 (17.00%) had only lungs infection, 1 (0.5%) had only liver infection, 1 (0.5%) had spleen infection and 3 (1.5%) had both lungs and liver infection and out of 100 cysts recovered from 39 infected animal (an average of 2.56 cysts per animal), 76.00% were located in lungs, 23.00% in liver and 1.00% in the spleen.

**Table 6:** PREVALENCE OF HYDATID CYSTS IN BUFFALOES BY ORGANS AND DISTRIBUTION OF CYSTS

| Month | Total no. of animals observed | POSITIVE HYDATID CYST | | | | | Total cysts found | DISTRIBUTION OF CYSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lungs only (%) | Liver only (%) | Both lungs and liver (%) | Spleen (%) | Total (%) | | Lungs (%) | Liver (%) | Spleen (%) |
| **Winter** | 100 | 19 (19.0%) | 1 (1.0%) | 1 (1.0%) | 1 (1.0%) | 22 (22.0%) | 65 | 43 (66.1%) | 21 (32.3%) | 1 (1.5%) |
| **Summer** | 100 | 15 (15.0%) | 0 (0.0%) | 2 (2.0%) | 0 (0.0%) | 17 (17.0%) | 35 | 33 (94.3%) | 2 (5.7%) | 0 (0.0%) |
| **Total** | **200** | **34 (17.0%)** | **1 (0.5%)** | **3 (1.5%)** | **1 (0.5%)** | **39 (19.5%)** | **100** | **76 (76.0%)** | **23 (23.0%)** | **1 (1.0%)** |

## F.3: PREVALENCE OF *Fasciola* INFECTION

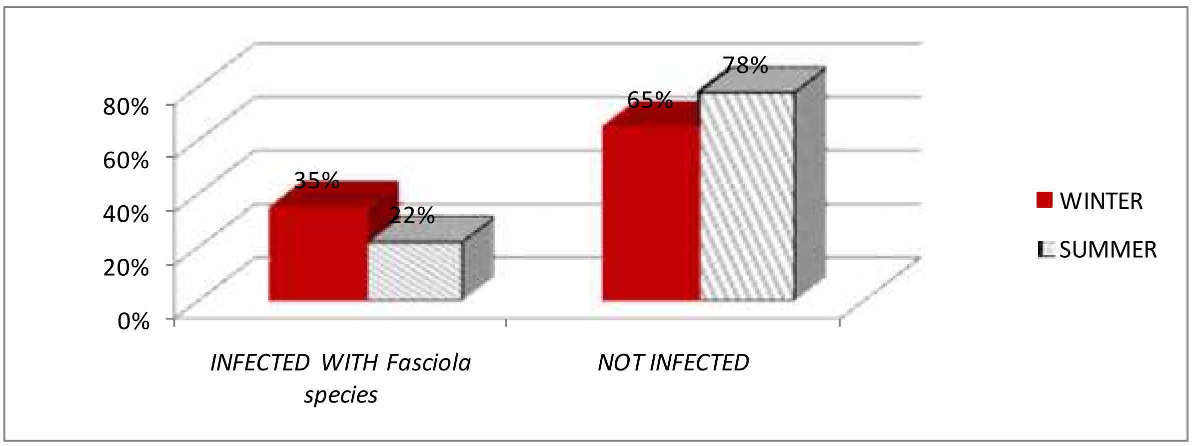
- **General prevalence**

57 (28.50%) buffaloes were found positive for fascioliasis, out of 200 slaughtered buffaloes observed.

- **Season-wise prevalence**

35 and 22 positive cases of fascioliasis were observed out of 200 slaughtered animals observed, 100 each during winter and summer season, which is shown in Fig. 22. The season-wise prevalence of fascioliasis was found significant as indicated by Chi-square test ($\chi^2_{0.05}$, 1d.f. =4.14).

**Fig. 22:** SEASON-WISE PREVALENCE OF *Fasciola* species




- **Sex-wise prevalence of *Fasciola***

Females were found more infected with fascioliasis. 38.05% of the females had fascioliasis as compared to 16.09% of males. The difference in sex-wise prevalence of fascioliasis was found significant ($\chi^2_{0.05}$, 1d.f. =11.63).

**Table 7:** SEX-WISE PREVALENCE OF *Fasciola*

| MONTH | WINTER | | | SUMMER | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| SEX | Observed | Infected | Prevalence | Observed | Infected | Prevalence | Observed | Infected | Prevalence |
| **MALE** | 40 | 8 | 20.00% | 47 | 6 | 12.76% | 87 | 14 | 16.09% |
| **FEMALE** | 60 | 27 | 45.00% | 53 | 16 | 30.18% | 113 | 43 | 38.05% |
| **TOTAL** | **100** | **35** | **35.00%** | **100** | **22** | **22.00%** | **200** | **57** | **28.50%** |

## Age-wise prevalence of *Fasciola*

Old animals (35.78%) were infected with *Fasciola* more often than calves (14.81%) and (29.41%) adults which is shown in Table 8. Difference in age-wise prevalence of *Fasciola* was significant ($\chi^2_{0.05}$, 2d.f. =7.45).

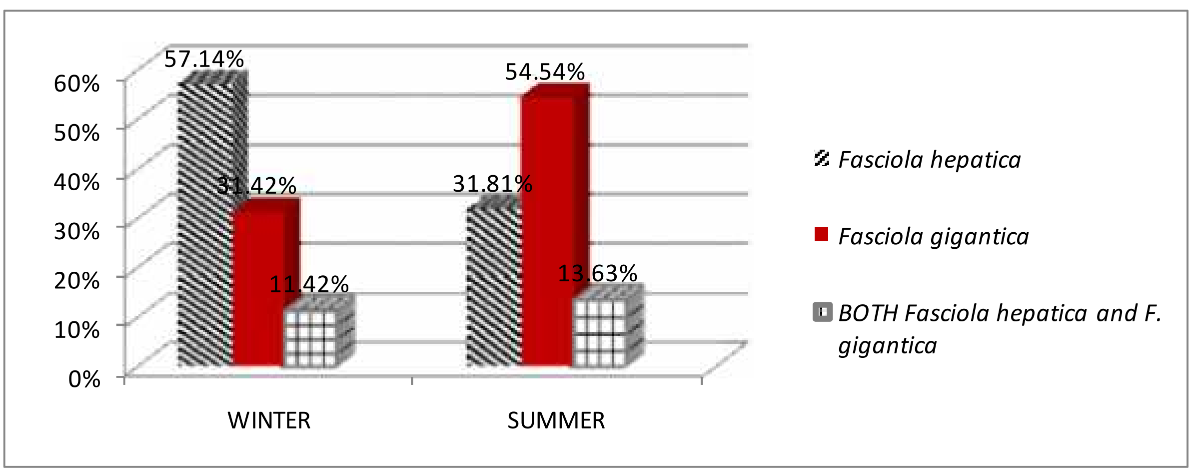
**Table 8:** AGE-WISE PREVALENCE OF *Fasciola*

| MONTH | WINTER | | | SUMMER | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| AGE | Observed | Infected | Prevalence | Observed | Infected | Prevalence | Observed | Infected | Prevalence |
| **CALF** | 20 | 4 | 20.00% | 34 | 4 | 11.76% | 54 | 8 | 14.81% |
| **ADULT** | 30 | 8 | 26.66% | 21 | 7 | 33.33% | 51 | 15 | 29.41% |
| **OLD** | 50 | 23 | 46.00% | 45 | 11 | 24.44% | 95 | 34 | 35.78% |
| **TOTAL** | **100** | **35** | **35.00%** | **100** | **22** | **22.00%** | **200** | **57** | **28.50%** |

## Species-wise Prevalence of *Fasciola*

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%).

**Fig. 23:** SPECIES-WISE PREVALENCE OF *Fasciola*



## F.4: PREVALENCE OF *Cysticercus bovis* INFECTION

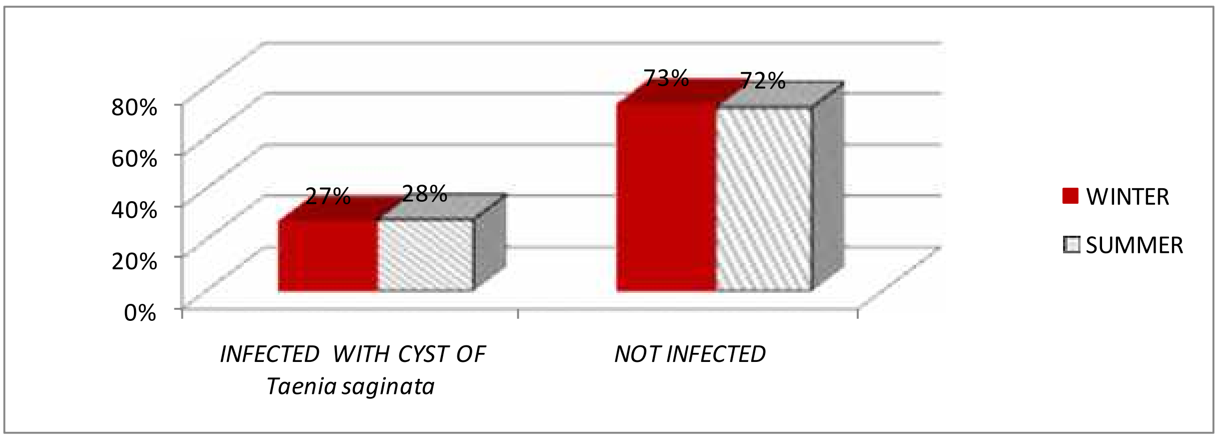
- **General prevalence**

55 buffaloes (27.50%) out of 200 observed were found to have *cysticercosis.*

- **Season-wise prevalence**

Out of 200 slaughtered animals observed, 100 each during winter and summer season, 27 (27.00%) positive cases of *Cysticercus bovis* were observed during winter and 28 (28.00%) animals were found to have *Taenia* cysts during summer. The prevalence of cysticercosis was found not vary according to season as indicated by Chi-square test ($\chi^2_{0.05,}$ 1d.f. =0.024).

**Fig. 24:** SEASON-WISE PREVALENCE OF *Cysticercus bovis*




- **Sex-wise prevalence of *Cysticercus bovis***

*Cysticercus bovis* infection was found more prevalent in females (33.62%) than in males (18.39%). The sex-wise prevalences of *Cysticercus bovis* was found significant as indicated by Chi-square test ($\chi^2_{0.05,}$ 1d.f. =6.39).

**Table 9:** SEX-WISE PREVALENCES OF *Cysticercus bovis*

| MONTH | WINTER | | | SUMMER | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| SEX | Observed | Infected | Prevalence | Observed | Infected | Prevalence | Observed | Infected | Prevalence |
| MALE | 40 | 6 | 15.00% | 47 | 10 | 21.27% | 87 | 16 | 18.39% |
| FEMALE | 60 | 21 | 35.00% | 53 | 18 | 33.96% | 113 | 39 | 34.51% |
| **TOTAL** | **100** | **27** | **27.00%** | **100** | **28** | **28.00%** | **200** | **55** | **27.50%** |

- **Age-wise prevalence of *Cysticercus bovis***

Here too, old animals (41.05%) were found infected with the cyst of *Taenia saginata* more often than the calves (9.26%) and adults (21.56%). The difference in age-wise prevalence of *Cysticercus* was found significant ($\chi^2_{0.05}$, 2d.f. =18.66).

**Table 10:** AGE-WISE PREVALENCES OF *Cysticercus bovis*

| MONTH | WINTER | | | SUMMER | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| AGE | Observed | Infected | Prevalence | Observed | Infected | Prevalence | Observed | Infected | Prevalence |
| **CALF** | 20 | 2 | 10.00% | 34 | 3 | 8.82% | 54 | 5 | 9.26% |
| **ADULT** | 30 | 4 | 13.33% | 21 | 7 | 33.33% | 51 | 11 | 21.56% |
| **OLD** | 50 | 21 | 42.00% | 45 | 18 | 40.00% | 95 | 39 | 41.05% |
| **TOTAL** | **100** | **27** | **27.00%** | **100** | **28** | **28.00%** | **200** | **55** | **27.50%** |

- **Prevalence of *Taenia* cysts in buffaloes by organs**

The *Taenia* cysts observed were mostly located in the food pipe of the slaughtered animal. 24.00% of the buffaloes observed had infection only in the food pipe region, 2.00% had both food pipe and tongue infection while 1.50% had both food pipe and muscle infection.

**Table 11:** PREVALENCE OF *Taenia* CYSTS IN BUFFALOES BY ORGANS

| Month | Total no. of animals observed | POSITIVE WITH *Taenia* CYST | | | |
|---|---|---|---|---|---|
| | | **Food pipe only (%)** | **Both food pipe and tongue (%)** | **Both food pipe and muscle (%)** | **Total (%)** |
| **Winter** | 100 | 23 (23.00%) | 3 (3.00%) | 1 (1.00%) | 27 (27.00%) |
| **Summer** | 100 | 25 (25.00%) | 1 (1.00%) | 2 (2.00%) | 28 (28.00%) |
| **Total** | **200** | **48 (24.00%)** | **4 (2.00%)** | **3 (1.50%)** | **55 (27.50%)** |

## G. MEASUREMENT OF ECOLOGICAL FACTORS

Buffaloes for the slaughtering purposes are mainly brought from the Terai of Nepal and Utter Pradesh and Bihar of India. Rice is a dominant crop in these areas so rice husks are the important part of buffaloes' diet. The prevalences of different diseases in buffalo could be related to the food it feeds on. Hay piles are one of the suitable sites for dogs to play, rest and sleep. So have all chance of being contaminated with dog feces and buffaloes become infected when they feed on the hay containing the eggs bearing infective oncospheres larva of *Echinococcus granulosus* in the dog feces. Similarly the intermediate host of *Fasciola* i.e. lymnaeid snails are usually found in the moist region. They are often found in the paddy fields. Cercaria of *Fasciola* after being liberated from the snails' body, encyst on the nearby vegetations which therefore mainly includes the paddy. So there is every possibilities of hay containing the infective metacercariae which when ingested by the buffalos, they become infected. Buffaloes become infected with cyst of *Taenia saginata* (*Cysticercus bovis*) by ingesting vegetation contaminated with eggs or gravid proglottid of *Taenia saginata* shed on the feces of definitive host i.e. human. So, contamination of vegetation or hay with human feces increases the prevalences of cysticercosis among buffaloes.

## H. MEASUREMENT OF SOCIO-CULTURAL AND RELIGIOUS FACTORS

Majority of people in Kirtipur are Newars. The ethnic group is renowned for its culture and tradition. They have lots of feasts and festivals to celebrate and in each of these occasions, varieties of dishes prepared from the meat serve as an important part. Kachila' (raw meat), and 'Chhengu' (raw skin attached with flesh), are among the varieties of meat dishes. They are raw meats, so have got zoonotic significances. The survey found that, in Kirtipur, each day, an average of 25 buffaloes is slaughtered. However the number was found increased upto 30 to 35 during festivals due to more demand of meat. Similarly during Ekadashi and Aaunshi, the number was found reduced as the tradition prohibits the consumption of meat in these days. More calves were found slaughtered during Saturdays and holidays. The reason for this is that during holidays Newars, the ethnic people of the study area prefer to eat the cuisine prepared from buffaloes' skin called 'Chhengu'. As the calves' skin is softer than the adults and olds, they are slaughtered more often to meet the demand of 'Chhengu'.

## I. MEASUREMENT OF LEGAL FACTORS

Though 'The Slaughter House and Meat Inspection Act 1998' has come to legislation, not a single example of its implementation has been found during the study. The butches and meat sellers said that no one has ever come for meat inspection. They themselves also revealed that the condition of slaughtering places and meat shops could have been much better had there been regular meat inspection. The law strictly demands the requirement of license for carrying out the slaughtering and meat selling activities. It demands certain basic requirements in the slaughtering places and meat shops. It prohibits the slaughter of diseased animals, females, etc but due to absence of ante-mortem inspection of animals, inspection of slaughter place and meat shops, and post-mortem inspection of carcass, all above mentioned activities which are supposed be illegal have been carried out without any threats. The urgent requirement of the implementation of 'The Slaughter House and Meat Inspection Act 1998' is the foremost and uttermost demand of the study.

# VI

## DISCUSSION AND CONCLUSION

Meat, one of the delicious and nutritious dishes, is an indispensable food consumed by most of the people. It is rich in protein, containing all of the essential amino acids, and in most cases, is a good source of zinc, vitamin B12, selenium, phosphorus, niacin, vitamin B6, iron and riboflavin (http://www.beef.org/uDocs/whatyoumisswithoutmeat638.pdf). In the 1990s the average consumption of meat was 12 kg/ head per year for sub-Saharan Africa, 18 kg/head per year for Asia and 45 kg/head per year for Latin America (FAO, 1998) compared to an average of 76 kg/head per year in developed countries. Although a number of factors affect the long-term estimates for per capita demand for livestock products, the scenario predicted for changes in consumption patterns based on economic development has been considered (Bouwman, 1997) and the per capita demand (kg/year) for all the developing countries will increase from 17 kg in 1989/91 to 25 kg in 2010 and to 30 kg in 2025 (Kondaiah and Anjaneyulu, 2003). The demand for meat in context to Nepal is also found increasing. A survey done by Himal magazine in 2004 showed that an average Nepali consumes 10 kg of meat a year but 10 years from then; per capita consumption of meat is expected to reach 26 kg a year. It is considered that buff has a strong potential for meeting this requirement for increased per capita consumption. The water buffalo offers promise as a major source of meat, and the production of buffaloes solely for meat is now expanding.

As the demand of meat is ever-increasing, the importance and significance of it in meat borne diseases can’t be ignored. Meat and other meat products contribute significantly to high incidence of food borne diseases and zoonotic diseases. Meat, like any food, can also transmit certain diseases, but undercooked meat is especially susceptible.

Observation of slaughter places and questionnaires of butchers, reveal the poor infrastructure to facilitate the slaughter and marketing of meat. The butchers were found unaware of the meat borne diseases (67.85%) and environmental effect (64.28%) due to slaughtering places.

The sanitary conditions and facilities in the slaughtering places and in the meat shops were found primitive. They were found visited by dogs. Most of the butchers and meat sellers’ lacked the knowledge of meat borne diseases and were even found selling the meat containing the parasites thus highly enhancing the chances of human infection by the parasites.

Through the study it was known that both butchers and meat sellers have not obtained proper trainings in meat business. They entered into this business by learning from older persons. Most of them use primitive types of tools which damage the hides, due to poor flying and waste large part of the products like blood, bones and glands and cause loss of meat.

During survey, all the butchers as well as meat sellers were asked if there is any inspection of pre and post mortems meat inspection and slaughter house examination by any authorities of the government institution but all of them denied of such inspection and examination.

Lack of slaughter house, lack of proper infrastructure in the slaughtering places and meat shops, absence of knowledge about meat borne diseases, shortage of adequately trained personnel, improper slaughtering, handling and selling of meat and the most importantly the lack of meat inspection and examination which though is in the law (The Slaughterhouse And Meat Inspection Act 1998: Annex 3 ) have definitely bound to increase the prevalences of different pathogens and parasites, some of them being much zoonotically significant as well.

Echinococcosis, fascioliasis and cysticercosis are three important zoonotic diseases claiming lives of so many buffaloes, condemning carcass of worth thousand of billions and infecting millions of people around the world. They have huge economic as well as zoonotic significances.

The main aim of the study was to find out the prevalence of echinococcosis, fascioliasis and taeniasis in buffaloes slaughtered for meat in the Kirtipur municipality, one of the urban areas nearby the capital city of the country. The carcass of 200 slaughtered buffaloes was observed from 12 slaughtering places during the study, 100 each during the winter and the summer.

Through the questionnaires and observations it was found that, among the slaughtered animals, females outnumbered the males. Out of the 200 slaughtered buffaloes observed during the survey.113 (56.50%) were females and 87 (43.5%) were males. This is against the law and fact that, slaughtering of females is prohibited in Nepal. So most of the butchers used to lie the consumers about the slaughtered animal as consumers prefer not to buy the meat of female buffaloes.

The study also found out that the old animals are slaughtered more often than the adults and the calves. Among 200 slaughtered animals observed, 95 (47.50%) were the old animals. 51 (25.50%) were adults and the rest 54 (27.00%) were calves. Loss of productivity in old animals makes them cheaper to buy, as revealed by the butchers and this seemed to be the main reason behind their greater slaughtering. The study found an interesting thing that more calves were slaughtered during Saturdays and holidays. The reason for this is that during holidays Newars, the ethnic people of the study area prefer to eat the cuisine prepared from buffaloes' skin called 'Chhengu'. As the calves' skin is softer than the adults and olds, they are slaughtered more often to meet the demand of 'Chhengu'.

The study found the overall prevalence of echinococcosis in slaughtered buffaloes to be 19.50%. The prevalence was 25.00% during the winter and 14.00% during the summer. The difference was found to be significant ($\chi^2_{0.05}$, 1d.f. =3.851). Females (23.89%) were found more infected with *Echinococcus* than males (13.79%) but the difference in the sex-wise prevalence of *Echinococcus* was not found significant ($\chi^2_{0.05}$, 1d.f. =3.19). The study also showed that old animals (30.25%) were found more infected with *Echinococcus* than calves (11.11%) and adults (7.84%). Difference in prevalence of *Echinococcus* according to age was found significant ($\chi^2_{0.05}$, 2d.f. =14.19).

The study conducted by Khatri (2003) on the prevalence of *Echinococcus* by examining the carcasses of 450 slaughtered buffalos in Kavrepalanchok, Nepal found 73 (16.22%) buffaloes positive for the cyst of *Echinococcus*. Maharjan (1996) studied 535 slaughtered buffaloes in western part of Kathmandu, Nepal and found 21% buffaloes positive for hydatid cyst. He too found infection of hydatidosis in females (26.00%) slightly higher than in males (25.00%). Similarly, Joshi (1991) found 5% (153/3065) prevalence in Kathmandu, Nepal. Khan *et al*., (2006) at Bikaner slaughter house in Rajasthan, India found an over all prevalence of 34.5% in buffaloes with an infection rate of 40.9% in males & 44.1% in females. In adult buffaloes (above 2 years) the prevalence of hydatid disease was recorded as 43.6% against 11.1% of buffalo of below 2 years; Rinaldi *et al*., (2006), found 10.5% (76/722) prevalence in southern Italy, etc.

Altogether 100 hydatid cysts were found in 39 animals (an average of 2.56 cysts per animal) and out of them 14 (35.89%) animals had single infection (10 buffaloes during winter and 4 during summer) while 25 (64.10%) had multiple infection (15 buffaloes during winter and 10 during summer).

Out of 100 hydatid cysts observed from 39 infected animals (an average of 2.56 cysts per animal), most of them, in fact 94 (94.00%) of them were found fertile while only 6 (6.00%) was found sterile. In similar type of study, Rinaldi *et al*., (2006) found 10 (13.2%) fertile cysts out of the 76 positive buffaloes in southern Italy; Manandhar *et al*., (2006) found 58.5% fertile and 41.5% sterile cysts in a total of 53 infected buffaloes in Kathmandu valley.

The finding out of more multiple infections in compare to single infection and more fertile cysts in compare to sterile cysts indicates greater condemnation of the carcass and greater economic as well as public health significances.

Liver and lungs of the animals were found most susceptible organs as the hydatid cyst were mostly confined in them. 76.00% of the cysts observed were from that of lungs while 23.00% were recovered from liver and 1.00% from spleen. Such distribution of hydatid cysts was also observed by Shrestha *et al.*, (2006) who found the occurrence of hydatid cysts as 6.4% in lungs, 2.4% in livers and 1.8% in both, livers and lungs; Maharjan (1996) found lungs 11% were more infected than liver 5% and both liver and lungs found infected was 4%; Rinaldi *et al*., (2008) collected a total of 363 cysts from 45 infected animals: 239 in the liver and 124 in the lungs; Mehrabani *et al*., (1999) found 4% of liver and 8% of lungs of buffaloes were infected with hydatid cysts among 25 slaughtered buffaloes observed.

Regarding fascioliasis, the overall prevalence in slaughtered buffaloes was found to be 28.50%. The prevalence of fascioliasis during winter (35.00%) was higher in compare to summer (22.00%) which was significant ($\chi^2_{0.05}$, 1d.f. =4.14). Females were found more infected with fascioliasis. 38.05% of the females had fascioliasis as compared to 16.09% males. The difference in sex-wise prevalence of fascioliasis was also found significant ($\chi^2_{0.05,}$ 1d.f. =11.63). Also old animals (35.78%) were found more infected with fascioliasis than calves (14.81%) and adults (29.41%). This difference was found significant as well ($\chi^2_{0.05}$, 2d.f. =7.45).

The prevalence of fascioliasis in buffaloes was also observed by Parajuli (1996), 83.00% in Surkhet; Shrestha *et al*., (1992), 20% to 87.5% in Dhankuta; Singh *et al*., (1992-1993), 48.57% in Chitwan; Mahato (1993), 57.9% in the hills and 4.3% in the Terai of Nepal; Adhikari *et al*., (2003), 61% in Kathmandu; Nguyen *et al* (1999), 46.67% in Vietnam; Oliveria (2002), 75% at the Cajati abattoir of Vale Do Riberia, Sao Paulo, Brazil; Marques *et al*., (2003), 20% in Viamao, southern Brazil.

The prevalence to fascioliasis in buffaloes was found more during winter than in summer. Seasonal or month wise prevalence of fascioliasis in buffaloes is also studied by Singh and Mahato (1992) who showed that the higher incidence of liverfluke occurred during the month of Sept. through Nov. and again Jan. Similarly, Pandey (2001) found increase in *Fasciola* infection from June to December, decrease in Feb., and again rise in April, the prevalence being highest during December.

The age-wise prevalence showed that old animals (35.78%) were infected more than the calves (14.81%) and (29.41%) adults. This finding is in agreement with Mahato (1993), Ghimire and Karki (1996), Regmi *et al*., (1999) and Pandey (2001). Ghimire and Karki (1996) found higher prevalence of fascioliasis in old animals (94.30%) compared to heifers (54.16%) and calves (34.60%) in rural Kathmandu. Mahato (1993) found increase in prevalence of fascioliasis with increase age group i.e. < l, 1-2, 3-4, 5-6, 7-8, 9-10 and 11 > was 17.6%, 43.1%, 57.9%, 55.6%, 67.8% and 70.3% respectively in eastern Nepal. Regmi *et al*., (1999) found 63.83% prevalence of fascioliasis below age group three and 69.16% prevalence above age group three in Syangja. Pandey (2001) found the highest prevalence of fascioliasis in old buffaloes (65.30%) followed by 56.80%, 48.78%, 35.29% and 14.25% in the age group of 7-8, 5-6, 3-4 and 0-2 years respectively.

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.*

During research a total of 57 positive cases of fascioliasis were reported, 35 (61.40%) during winter and 22 (38.59%) during summer. 27 (47.36%) slaughtered animals were infected with only *Fasciola hepatica*, 23 (40.35%) with only *Fasciola gigantica* and 7 (12.28%) animals with both *F. hepatica* and *F. gigantica.* It showed that prevalence of *Fasciola hepatica* (59.65%) was slightly greater when compared to *Fasciola gigantica* (52.63%) among the slaughtered animals.

Nguyen *et al*., (1999) studied livers of 955 buffaloes. The buffaloes infected with *Fasciola gigantica* were found 14.14% and both *Fasciola hepatica* and *Fasciola gigantica* were found 32.04%. The mean numbers of flukes in the infected organ were 78. Asharaf *et al*., (2004) collected 928 adult liver flukes from 13 infected livers of cattle, in Rasht and Bandar-Anzali slaughterhouses in Iran, 91.1% were diagnosed as *F. gigantica* and 8.9% as *F. hepatica*.

During the study, the slaughtered animals were also observed for the cyst of *Taenia saginata* (*Cysticercus bovis*). Regarding cysticercosis, the overall prevalence in slaughtered buffaloes was found to be 27.50% (55/200). 27 positive cases of *Cysticercus* were reported out of 100 animals observed during winter and 28 animals were found to have *Taenia* cysts out of 100 observed during summer. Difference in the prevalence of cysticercosis according to season was not found significant ($\chi^2_{0.05,}$ 1d.f. =0.024). The study found, cysticercosis was more prevalent in females (34.51%) than in males (18.39%) which was significant ($\chi^2_{0.05,}$ 1d.f. =6.39). Again old animals (41.05%) were found infected with the cyst of *Taenia saginata* more often than the calves (9.26%) and adults (21.56%). The difference in age-wise prevalence of *Cysticercus* was also found significant ($\chi^2_{0.05}$, 2d.f. =18.66).

The prevalence of cyst of *Taenia saginata* was also studied by Hardy *et al*., (1999) who observed a total of 6,434,093 slaughtered cattle, buffaloes and pigs over a period of 4 years (1994-1997) in Egypt and found 0.14% in buffaloes to have cysticercosis. *C. bovis* is found in between 1 and 40% of cattle in Kenya, Uganda, Sudan, Tanzania, Nigeria, Botswana, Zimbabwe and South Africa by Giesecke, 1997. Bovine cysticercosis is found in 9.0% of animals slaughtered in Botswana (OIE, 2001). Rodríguez-Hidalgo *et al*., (2003) on post mortem inspection of animals in Equador found 3 out of 806 (0.37%) carcasses had *T. saginata* metacestodes. Wanjala *et al*., (2003) on carcass inspection of naturally and artificially infested cattle detected cysticerci in 12 out of 24 animals (50%) in artificially infested calves. In animals with natural infestations, meat inspection revealed a prevalence rate of 48% (12 out of 25 animals). Again Wanjala *et al*., (2005) recovered 671 cysticerci in naturally infested animals, of which 361 (53.80%) were alive and 310 (46.20%) were dead. Opara *et al*., (2006) on examination of various organs of 25,800 cattle in 10 major abattoirs of southeastern Nigeria showed that 6750 (26.2%) were infected with *Cysticercus bovis*. Out of 11,720 male cattle, examined, 3215 (27.4%) had cysts of *C. bovis* while 160 (13.6%) of the 1180 female animals investigated were infected. There was an inverse relationship between the ages of the animals and prevalence of infection with *C. bovis*. Abunna *et al*., (2008) examined a total of 400 carcasses of cattle in Ethiopia, of which 105 (26.25%) were found infected with *T. saginata* metacestodes. He found the prevalence varied significantly between local and crossbred animals but not varied between sex, age groups and origin of the animals.

During the study 55 animals were found positive for *Taenia* cysts. 48 (24.00%) had infection only in the food pipe. In 4 (2.00%) animals *Cysticercus bovis* was reported from both food pipe and tongue while in 3 (1.50%) animals, it was reported from both food pipe and muscles. The muscles include neck muscle and shoulder muscle.

Wanjala *et al*., (2003) in Kenyan cattle observed *Cysticercus bovis* in 12 out of 24 studied. Of these animals, 9 (36%) had cysticerci in the heart, 4 (16%) in the Masculus triceps brachii (shoulder muscles) and 3 (12%) in the tongue. In natural infestations, most cysticerci were found in the heart (2.98%), tongue (1.79%) and Masculus triceps brachii muscles (1.04%). Wanjala *et al*., in 2005 again studied the distribution of *Taenia* cyst in 671 positive cases in Kenya. In carcasses of naturally infested animals, the order was from fore limbs (24.74%), hind limbs (23.85%), liver (12.22%), chest (9.24%), heart (8.79%), lumbar (6.56%), pelvis (3.58%), tongue (3.28%), lungs (2.98%), neck and back (2.38%), head (1.49%), diaphragm (0.75%), kidneys (0.15%) to rumen (0.00%). Abunna *et al* (2008) found the anatomical distribution pattern of *Taenia* cyst as follows: 65 (29.2%) heart, 56 (25.3%) shoulder muscle, 59 (26.7%) masseter, 23 (10.4%) tongue, 12 (5.4%) diaphragm, 3 (1.4%) liver, 2 (0.9%) lung and 1 (0.5%) kidney samples.

From the result obtained it was found that the prevalence of diseases were more among females in comparison to males and again more in old animals in comparison to the adult or young.

Higher prevalence in old animals might be due to loss in resistance associated with old age and also might be due to carrying residual infection from previous years. Swarup and Pachauri (1987) in India suggested that the higher prevalence in older female animals is due to relaxation of resistance at parturition or during lactation.

Regarding seasonal prevalence, higher prevalence of echinococcosis was obtained during winter (25.00%) in comparison to summer (14.00%). Higher prevalence during winter might be associated with different things. Dog and buffalo relationship and the food of the buffaloes seem to play a vital role for higher winter prevalence. Buffaloes are mainly feed with rice straw, tree fodders and grass form the rice field as rice is the major crop in countries like Nepal and India. Rice is harvested during winter in theses countries so availability of rice straw is much during winter. The farmers and butchers themselves are found storing these rice straw in the ground floor of their houses or nearby their house. Dogs are often found playing and sleeping to refrain from chills during winter in these deposits of rice stray and during these, the rice stray might easily be contaminated with the fecal material of the dog which might contain eggs bearing infective oncospheres larva. Such rice straw (food material) when get eaten by buffalos, they become infective. This might certainly be one of the reasons for higher prevalence of *Echinococcus* during winter .Further studies are needed in this subject matter.

The study found higher prevalence of fascioliasis during winter (35.00%) as compared to summer (22.00%). Reason for this may again be associated with the type of food buffaloes are provided with during the winter and summer. During winter, buffaloes are mainly feed with rice straw as rice are harvested mainly during winter and grass from the rice fields; and during summer, their food mainly consists of maize stover, maize husks, millet etc. Encysted cercariae i.e. metacercariae which is the infective stage of *Fasciola* spp. to buffaloes (Definitive host) are plentiful in the paddy fields as Lymnaeid snails their intermediate host and source of cercaria are found in them. When these rice straws or grass from the paddy fields containing the infective metacercariae is ingested, buffaloes become infective.

Study on seasonal prevalence of *Taenia* cyst; found that the prevalence was slightly higher during summer (28.00%) in compare to the winter (27.00%). The intermediate hosts like buffaloes become infected by ingesting vegetation contaminated with eggs or gravid proglottid shed on the feces of definitive host i.e. human. Fecal contamination of vegetation (food of buffaloes) by vector or vehicle is more during summer than in winter which might be the cause of higher prevalence of *Taenia* cyst infection in buffaloes during the summer.

The findings of the field research reveal the prevalence of echinococcosis, fascioliasis and taeniasis in the slaughtered buffaloes and the situation has been aggravated by the unhygienic condition of the slaughtering places and meat shops, lack of infrastructure and facilities in them, lack of meat inspection programme and unawareness of the meat borne diseases. The study demands an urgent need of meat inspection.

# VII

## RECOMMENDATIONS

From the outcome of the study performed, following recommendations have been drawn.

1. Slaughter house, at least a mini abattoir should be established in each ward depending the consumption of the meat.
2. Slaughtering practices should be made humane.
3. Slaughter shed should be constructed.
4. Infrastructure to facilitate the slaughter and marketing of meat should be established.
5. Meat marketing system is unhygienic and lacks quality. It should be improved.
6. The butchers and meat sellers should be trained and should be made aware about meat borne diseases.
7. Information regarding meat borne diseases and zoonotic diseases should be introduced in the text book of primary and secondary level as a compulsory subject.
8. The Slaughter House and Meat Inspection Law which has been approved in 1998 by the then HMG should be strictly considered and implemented.

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ANNEX- 1

## DETAILS ABOUT:

### 1/ Echinococcosis

Echinococcosis or Cystic Echinococcosis (CE) is caused by the larval stages (hydatid cysts) of *Echinococcus granulosus* and is known as one of the most important parasitic infection in livestock in the world (Capuano *et al*., 2006). It can establish itself in many different hosts, including humans, and is regarded as one of the most widespread zoonoses (Craig *et al*., 2007).

Echinococcosis is a cosmopolitan parasitic disease caused by adult or larval stages of tapeworms belonging to the genus *Echinococcus*, Rudolphi, 1801. Within the genus *Echinococcus* four species are presently recognized, namely *E. granulosus, E. multilocularis, E. oligarthrus* and *E. vogeli*. In addition, a new sibling species, *E. shiquicus*, has recently been reported from Tibet (Xiao *et al.*, 2005; Nakao *et al.*, 2007).

### Morphology

The adult worm is about 5 to 10 mm long (Ralph *et al*., 1995). It has a scolex, a neck and strobila. The scolex has four suckers and a rostellum with hooks, the latter being tightly inserted into the crypts of Lieberkuhn in the gut mucosa. The mature strobila has only 3 to 4 segments and when gravid, these or shed eggs are expelled in the feces (Smyth, 1996).

### Life cycle and transmission

*Echinococcus* species have an indirect life cycle, and must develop in both an intermediate and a definitive host (College of Veterinary Medicine, Iowa State University, 2005). The parasite differs from other Taeniid in having a relatively low specificity in the larval stage while having a great reproductive potential (Thompson, 1979). The definitive hosts of *E. granulosus* are almost invariably canid carnivores like dogs, wolves and jackals (http://homepage.usask.ca/~shb292/hydatid.pdf). Sheep appear to be the most common intermediate hosts in most areas of the world, but in some regions, other domestic ungulates, including goats, cattle, swine, buffalo, horses, and camels, serve as hosts. (Schantz, 1982; Rausch, 1986).

The adult tapeworm is found in different parts of the small intestine of the definitive host. It is hermaphrodite and has ability of self-fertilization (Soulsby, 1982). There is wide variation on number of eggs produced per proglottid as it may range from 100 to 1500 (Thompson, 1995). The eggs have a sticky coat that will adhere to an animal’s fur and other objects. Flies can also act as mechanical vectors. In addition, the shed proglottids may perform rhythmic contractions that help to disperse the eggs widely on pastures. Under ideal conditions, *E. granulosus* eggs remain viable for several months in pastures or gardens and on household fomites. They survive best under moist conditions and in moderate temperatures. Viable eggs have been found in water and damp sand for 3weeks at 30°C, 225 days at 6°C and 32 days at 10-21°C. The eggs survive for only short periods of time if they are exposed to direct sunlight and dry conditions (College of Veterinary Medicine, Iowa State University, 2005). When ingested by the susceptible intermediate mammalian host, the eggs hatch immediately into infective oncospheres larvae that penetrate into the lymphatic or vascular system and carried to various organs, especially the liver or lungs and possibly other organs (Ralph *et al* 1995). At these organs, the larva or metacestode becomes spherical and fluid- filled ‘hydatid’ cyst, which is characteristically unilocular (Schantz, 1982). This fluid filled cavity is surrounded by a germinal layer internally and a tough elastic acellular laminated layer externally. The latter is supported by fibrous capsule of host origin. Increase in size of this single chambered cyst occurs by concentric enlargement (Thompson, 1995). Capsule is produced by the asexual multiplication of the cyst germinal layer. These brood capsules in turn produce multiple protoscolices by polyembryony (Schantz, 1982). Sometimes, several cysts may come closer to each other and fuse to form group or cluster of small cysts of different size (Thompson, 1995). Formation of daughter cysts is common in some hosts like man, where the size of the cyst is usually large (Soulsby, 1982), containing large volume of fluid and protoscolices (Schantz, 1982). Secondary hydatid cyst may be produced from the protoscolices if the cyst within the intermediate host bursts (Thompson, 1979). Not all hydatid cysts are fertile enough to produce brood capsules and protoscolices, and this depends upon host species and site of development (Thompson, 1979; Soulsby, 1982). The rate of growth of the cyst is variable, but generally increase in diameter occurs by about 1 to 5 cm per year, depending on factors yet unresolved, and protoscolex formation may require more than one year (Schantz, 1982).

Definitive hosts pick infection by eating hydatid cysts containing viable protoscolices. Protoscolices are then released from the cyst by the masticatory activities of the host. Enzymatic actions of the stomach also facilitate this excystment (Smyth, cited in Thompson, 1979). After ingestion, the protoscolices evaginate, attach to the intestinal mucosa, and develop into adult stages in 32 to 80 days.

### Significance

**In animals**: The adult parasite is considered to be rather harmless to the definitive host, except when it occurs in large numbers and may cause severe enteritis (Soulsby, 1982). The parasite however produces considerable ill effects in the intermediate host. Torgerson and Budke (2003) have reviewed these clinical aspects. Larval cysts may cause problems in host tissue because of the continual growth and expansion of the cyst. The structure of the wall of the cysts forms a tissue/host barrier enabling tissues of the host to “wall” off the cysts itself, preventing further spread. Subsequent compression of tissues, such as the lung, may cause debilitation due to the animal’s reduced ability to breathe if a sufficient number of cysts are involved. It seems that economic impact resulting from the disease is rather more important than the disease itself. The economic losses are mainly due to the carcass condemnation in meat animals (Schantz, 1982), as well as decreased production (Torgerson and Budke, 2003). Examples of reduced production due to Echinococcosis are like reduced feed conservation ratio, decreased meat production, impaired reproductive efficiency and downgrading of wool and hide from them (Polydorou, Ramazanov, cited in Torgerson and Budke, 2003).

**In human**: Humans are not capable of harboring adult *Echinococcus* tapeworms and so cannot become infected either by handling or eating hydatid cysts. He, like other intermediate hosts becomes infected when eggs that have been shed in the faeces of the definitive host are ingested. In the beginning phases of infection, there are virtually no clinical symptoms. When produced, after a highly variable incubation period, symptoms are diverse with varying degrees of severity that are never suggestive of Echinococcosis (Schantz, 1982). Symptoms may become apparent if the cyst ruptures or exerts a mass effect (McManus *et al.,* 2003). The symptoms are determined by organ of localization, size of the cyst and their condition (Schantz, 1982). The organ most commonly involved is the liver (50-70%), followed by lungs (20-30%) and other organs (like the spleen, kidney, heart, bones, central nervous system etc.) in less than 10% of the cases (Schantz, 1982; Torgerson and Budke, 2003). Infection is mostly acquired during the childhood in patients in which the disease is diagnosed between 10 to 50 years of age (Schantz, 1982). In some parts of the world, prevalence rate is relatively higher in children and women as they are in frequent contact with dogs (Macpherson and Craig, 2000); however, overall prevalence is similar in both sexes (McManus *et al*. 2003). Mortality and case fatality rate has been recorded to be around 0.2 per 100000 population and 2.2% respectively (McManus *et al*., 2003).

## Prevention and Control

Together, animal control programs and personal protection prevent echinococcosis. The primary objective of control programme in most settings is to prevent dogs from feeding on infected intermediate hosts. For *E. granulosus*, control measures, include supervision of livestocks slaughtering, sage disposal of infected viscera, dog control and health education. Mass treatment of dogs with praziquantel may be indicated in hyperendemic area.

Personal protection requires education of people at risk and implementation of measures that prevent exposure to Echinococcus eggs. Handwashing, particularly for children, should be emphasized

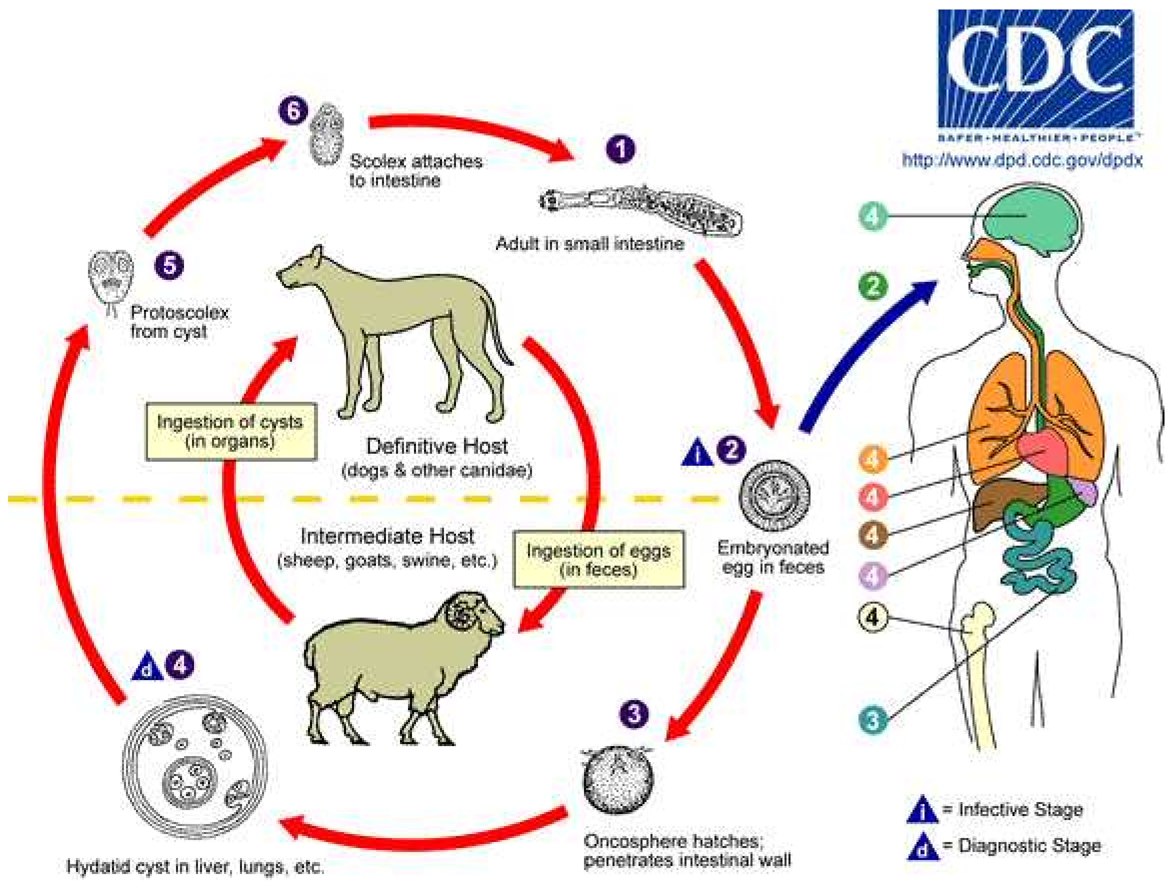


Image Source:
http://www.dpd.cdc.gov/dpdx/images/ParasiteImages/Echinoccoccosis/Echinococcus_LifeCycle

**Life cycle of *Echinococcus granulosus***

## Treatment

Praziquantel (5 mg/kg of body weight) administered once orally or IM completely eliminates all juvenile and adult Echinococcus tapeworms from the intestines of dogs and other definitive hosts. Larval echinococcosis in intermediate hosts responds to benzimidazole carbamate compounds. Mebendazole and albendazole administered for 1 month have been shown to kill most hydatid cysts in infected sheep; however, the cost of such treatment limits its applicability.

Surgery is the recommended treatment for human disease caused by E granulosus and E multiloculans; however, advances in medicinal treatment may offer alternatives to patients with irresectable disease and those who cannot tolerate surgery. Treatment with mebendazole has met with varied success, but results of recent studies of treatment using albendazole are more encouraging. This medication may soon be the preferred alternative to surgical intervention in patients for whom surgery is not an option.

**2/ Fascioliasis**

Fascioliasis is infection caused by one of two liver flukes, either *Fasciola hepatica* or *Fasciola gigantica* (Mas-coma, 2007). It is a zoonotic disease for which humans act as an accidental host during the life cycle of the parasite (Price *et al*., 1993).

*Fasciola* is a well known parasite of herbivorous animals. It has a worldwide distribution in the animal reservoir host. A large variety of animals, such as sheep, goats, cattle, buffalo, horses and rabbits show infection rates that may reach 90% in some areas. Infection of the human host was very sporadic until the last two decades when clinical cases and outbreaks were reported. It is now taking an important emerging foodborne trematode infection of increasing concern (Cheng *et al*., 1990). *F. hepatica* is widespread in Europe and in the higher altitude districts of India. *Lymnea truncatula*, a mud snail, is involved as the intermediate host for this species in these areas. *F. gigantica* is widely prevalent in the Indian sub-continent and Southeast Asia. *Lymnea rufescens*, an aquatic snail, acts as an intermediate host in the Indian sub continent (FAO, 1977). The estimated number of people infected is 2.4 million in 61 countries. The number at risk is more than 180 million throughout the world. The largest numbers of infected people have been reported from Bolivia, China, Ecuador, Egypt, France, Islamic Republic of Iran, Peru and Portugal (WHO, 1995).

**Morphology**

***Fasciola hepatica***

*Fasciola hepatica* is large, broad fluke 20 to 50 mm by 6 to 13mm. Its anterior end is cone-shaped and the posterior end is bluntly rounded. The tegument contains spines. Oral and ventral suckers are adjacent in the short, cone-shaped area. There is a prominent pharynx, a short esophagus and 2 highly branched ceca that extend to the posterior end of the fluke. Two highly branched testis lie to in the second and third quarters of the body. The single branched ovary is on the right side and pretesticular. Vitellaria are in the midbody below the acetabulum (Meyers *et al*., 2000).

***Fasciola gigantica***

Adult *Fasciola gigantica* are larger than adult Fasciola hepatica (24 to 76mm by 5 to 13mm). The average length/width ratio of *F. gigantica* is 4.39 to 5.20, while that of *F. hepatica* is 1.88 to 2.32. *F. gigantica* also differs from *F. hepatica* in having a shorter cephalic cone, a larger acetabulum and more anteriorly oriented testis. The average distance between the posterior border of the body and the posterior testis is longer in *F. gigantica* (14.9mm; range: 6to 19mm) than *F. hepatica* (7.78mm; range: 3 to 13 mm) and the ovary and ceca are more branched (Sahba *et al*., 1972).

## Life cycle and transmission

*Fasciola hepatica* and *F. gigantica* have similar aquatic diheteroxenous life cycles. Humans are infected by ingesting encysted metacercariae on raw vegetation and probably also floating infective metacercariae in contaminated water (Smithers, 1982). Sheep, goats, cattle, horses donkeys, mules, camels, buffalo, deer, wild sheep, pigs, marsupials, rabbit hare and other rodents and monkeys serve as definitive hosts for both *F. hepatica* and *F. gigantica* (Boray, 1982). Adult *Fasciola* spp. deposit immature eggs that pass in feces. Eggs become embryonated in water. Eggs release miracidia, which invade a suitable snail intermediate host, including many species of the genus *Lymnae.* After penetrating a snail host, miracidia transform into elliptical secular sporocysts. Sporocysts produce mother rediae, which produce daughter rediae, and finally cercariae in about 6 to 7 weeks. Snail release motile cercariae into fresh water, where some find water plant to land on. These cercariae shed their tails, encyst and transform into metacercariae, and become infective within 24 hours (Mas Coma *et al*., 2000). Mammals acquire the infection by eating vegetation containing metacercariae. Humans can become infected by ingesting metacercariae-containing freshwater plants especially watercress. After ingestion, the metacercariae excyst in the duodenum and migrate through the intestinal wall, the peritoneal cavity, and the liver parenchyma into the biliary ducts, where they develop into adults (http://www.dpd.cdc.gov/DPDX/ Fascioliasis). The entire life cycle takes 14 to 23 weeks (Lapage, 1968).

## Significance

Of all the body's organs, Fascioliasis does the most damage to the liver, hence the term "common liverfluke infection". Following ingestion of the larvae, a symptomless incubation phase starts, which lasts for a few days up to a few months. When symptoms do appear, they occur in the following patterns:

**Acute Phase** The acute phase of infection is rarely seen in humans and occurs only when a large number of metacercariae are ingested at once. Fever, tender hepatomegaly, and abdominal pain are the most frequent symptoms of this stage of infection although vomiting, diarrhoea, urticaria (hives), anemia, etc may also be present.

The above characteristics of the acute phase are caused by the migration of the *F. hepatica* larvae throughout the liver parenchyma. The larvae penetrate the liver capsule and begin to produce the above symptoms 4-7 days after ingestion. Migration and thus the acute phase continue for 6-8 weeks until the larvae mature and settle in the bile ducts.

**Chronic Phase** The symptoms of chronic infection are much more common in human populations and include biliary cholic, abdominal pain, tender hepatomegaly, and jaundice. In children, severe anemia is a common result of infection and is the greatest source of disability from infection in this age group. These symptoms reflect the biliary obstruction and inflammation caused by the presence of the large adult worms and their metabolic waste in the bile ducts. Inflammation of the bile ducts eventually leads to fibrosis and a condition called "pipestem liver", a term describing the white appearance of the biliary ducts after fibrosis. The final outcome of severe infections is portal cirrhosis and even death (www.stanford.edu/class/humbio103/parasites2001/fascioliasis/Fasciola.htm#epidemiology)

It is of interest to note that if raw bovine liver harboring Fasciola is eaten by humans, young flukes may become attached to the buccal or pharyngeal membranes causing pain, irritation, hoarseness and coughing. This condition is known as 'halzoun' (Cheng, 2006).

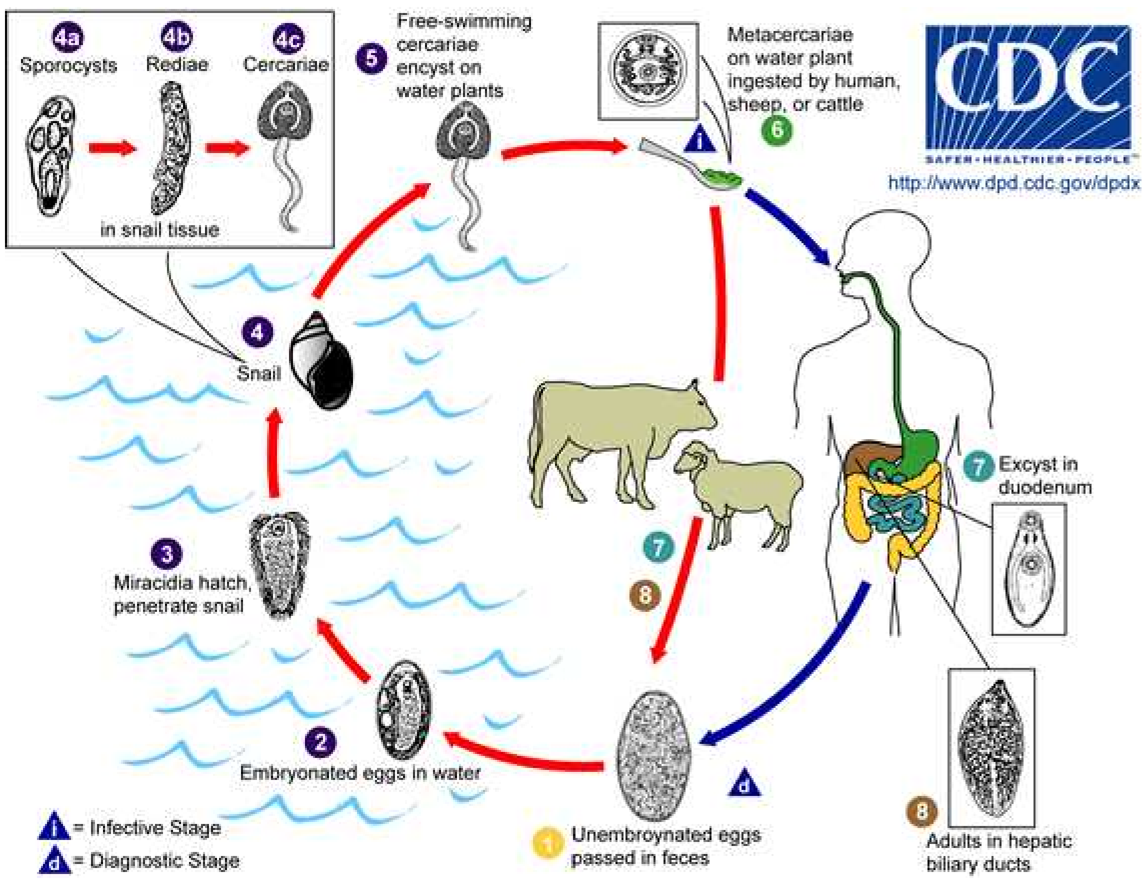


Image Source: http://www.dpd.cdc.gov/dpdx/images/ParasiteImages/Fascioliasis/Fasciola_LifeCycle

**Life cycle of *Fasciola***

**Public Health and Prevention Strategies:**

The presence of infection in a population is dependent upon and exacerbated by four factors:

- the presence of a substantial reservoir
- the presence of the intermediate host, the Lymanaea snails
- the opportunity for water source contamination by human and non-human hosts
- dietary practices that include the consumption of raw, untreated aquatic vegetation

Therefore, the most effective public health measures need to address several, if not all, of these factors.

**Education:** Behaviour changes have the potential to be the most effective and cost efficient approaches to disease control and thus, education is an essential aspect of any public health effort. The primary message of *Fasciola hepatica* campaigns is to keep domestic animal herds separate from the growing sites of aquatic. This limits the risk of contaminating the vegetation and thus decreases both human infection and the animal reservoir.

Teaching the washing of vegetables in either 6% vinegar or potassium permanganate for 5 to 10 minutes, which destroys the encysted metacercariae, is another useful educational effort. This approach has proven more acceptable to communities than past attempts to entirely halt the consumption of raw vegetables.

**Molluscicides:** The most frequently used public health intervention is the application of molluscicides to decrease the population of *Lymnaea* snails, the intermediate hosts of *Fasciola hepatica.*

**Chemotherapy:** Chemotherapy has been used for years in animal populations to decrease the animal reservoir and reduce agricultural losses. Until recently, however, bithionol was the only treatment available for fascioliasis and its cost, high doses, and the extended length of treatment effectively prohibited its use for large-scale campaigns.

**Treatment**

Treatment for fascioliasis has an 80-100% success rate.

In many countries, a 5-10 day course of oral bithionol at 30 mg/kg body weight is not only the preferred treatment but the only one available. It is highly effective. Triclabendazole, an antihelmintic agent, has recently been proven to provide substantial human benefit at much lower doses than bithionol. In 1990, the WHO and pharmaceutical company, Ciba-Geigy, partnered to conduct clinical trials of triclabendazole and found that 1-2 oral doses at 10 mg/kg body weight administered in a single 24 hour period results in virtually no side effects and has a success rate approaching 100%. Along with pharmaceutical therapy, surgery may be necessary in very extreme cases to clear the biliary tract.

**3/Taeniasis**

An infection due to an adult *Taenia*, in man or animals, is referred to as taeniasis. (Smyth, 1996). 3 *Taenia* spp. are known to infect human that include *T. saginata*, *T. saginata*- Taiwanese, and *T. solium*. The natural intermediate hosts are cattle and buffaloes for T. *saginata* and pigs for *T. saginata*- Taiwanese, and *T. solium.* (Naefie *et al*., 2000).

***Taenia saginata***

*Taenia saginata* also known as beef tapeworm is a worldwide zoonotic cestode whose epidemiology is ethnically and culturally determined with estimates of approximately 50 million cases of infestation worldwide with 50,000 people dying from this problem annually. (WHO, 1996). Both adult and larvae forms hazardously affect health of their respective hosts, either directly or indirectly accompanied with severe secondary infections, particularly in human hosts. The occurrence of the larvae (*Cysticercus bovis*) in cattle musculature cause bovine cysticercosis while the adult worms in human small intestines cause taeniasis. (Neva et *al*., 1994).

**Morphology**

Adults are ribbon-like, flattened, segmented, hermaphroditic flatworms 5 to 10 m long, consisting of scolex, neck, and immature, mature, and ripe segments in linear sequence. (http://gsbs.utmb.edu/microbook/). Most *T. saginata* are 3 to 8 m long, but ranges upto 25 m. There are often over 1000 proglottids. The scolex is quadrate, 1 to 2 mm in diameter, and has 4 suckers. The apex of the scolex is concave and superficially pigmented, and has no rostellum or hooklets. Gravid proglottids are longer than broad (18 to 20 mm by 5 to 7 mm) and have 15 to 20 lateral uterine branches per side. Terminal proglottids are motile and usually appear single in feces. A gravid proglottid may contain over 100,000 eggs. (Naefie *et al*., 2000).

**Life cycle**

Human is the only definitive host for *T. saginata*. The adult tapeworms remain attach to the small intestine by their scolex. (http://www.dpd.cdc.gov/DPDX/ Taeniasis). Infected human usually have a single adult worm however, because tapeworms are hermaphrodite, they release gravid proglottids into the stool. (Naefie *et al*., 2000). The adults produce proglottids which mature, become gravid, detach from the tapeworm, and migrate to the anus or are passed in the stool (approximately 6 per day). The eggs contained in the gravid proglottids are released after the proglottids are passed with the feces. *T. saginata* may produce up to 100,000 eggs per proglottid. The eggs can survive for days to months in the environment. (http://www.dpd.cdc.gov/DPDX/ Taeniasis).

The intermediate host, cattle becomes infected by ingesting vegetation contaminated with eggs or gravid proglottid. (http://www.doctorndtv.com/Taeniasis). In the animals' intestine, eggs hatch releasing oncospheres which invade the intestinal wall, reach the blood stream and encyst in muscle, viscera and other tissues. The encysted form is called a cysticercus. A cysticercus can survive for several years in the animal. (Naefie *et al*., 2000). The cysticercus is a pea-sized, fluid-filled cyst, which develops in the muscles of the intermediate host. It is approximately 7.5 - 10mm wide by 4 - 6 mm in length. (http://gsbs.utmb.edu/microbook).

Humans become infected by ingesting partially cooked, smoked, or pickled beef, although raw beef (steak tartare) is the commonest bearer of infection, as witnessed by the frequency of taeniasis in countries such as Ethiopia and Argentina where raw or undercooked beef is often eaten (http://gsbs.utmb.edu/microbook). Upon reaching the small intestine, the scolex everts, attaches to the mucosa, and develops into an adult over 2 months time which then can survive for years (http://www.doctorndtv.com/Taeniasis).

The life cycle and transmission of the parasite occur most commonly in environments characterized by poor sanitation, primitive livestock husbandry practices, and inadequate meat inspection, management and control policies (Mann, 1983).

**Significance**

Both adult and larvae forms hazardously affect health of their respective hosts, either directly or indirectly accompanied with severe secondary infections, particularly in human hosts (Neva *et al*., 1994).

**In animal**: The occurrence of the larvae (*Cysticercus bovis*) in cattle musculature cause bovine cysticercosis. (Neva *et al*., 1994). In cattle, heavy infestation by the larvae may cause myocarditis or heart failure. (Gracey *et al*., 1992). Rather than the disease itself in the cattle, the economic losses occurring from the condemned and downgraded carcasses due to treatment of carcasses before human consumption are substantial (Onyango-Abuje *et al*., 1996). For instance, in Kenya, Botswana and Great Britain, such losses were estimated at, £1.0 million, £0.5 million (Grindle, 1978) and £1.2 million (Gracey, 1992) annually, respectively. For the African continent, an annual loss was reported to be US$ 1.8 billion (Mann, 1983) under an overall infestation rate of 7%. In South America, where an overall infestation rate was estimated at 2.0%, bovine together with porcine cysticercosis caused an annual loss of US$ 428 million (Fan, 1997).

**In human**: The adult worms in human small intestines cause taeniasis. In humans, the infestation is accompanied with mild symptoms ranging from nausea, abdominal discomfort, epigastric pain, diarrhea, vitamin deficiency, excessive appetite or loss of appetite, weakness and loss of weight to digestive disturbances and intestinal blockage (Mann, 1983).

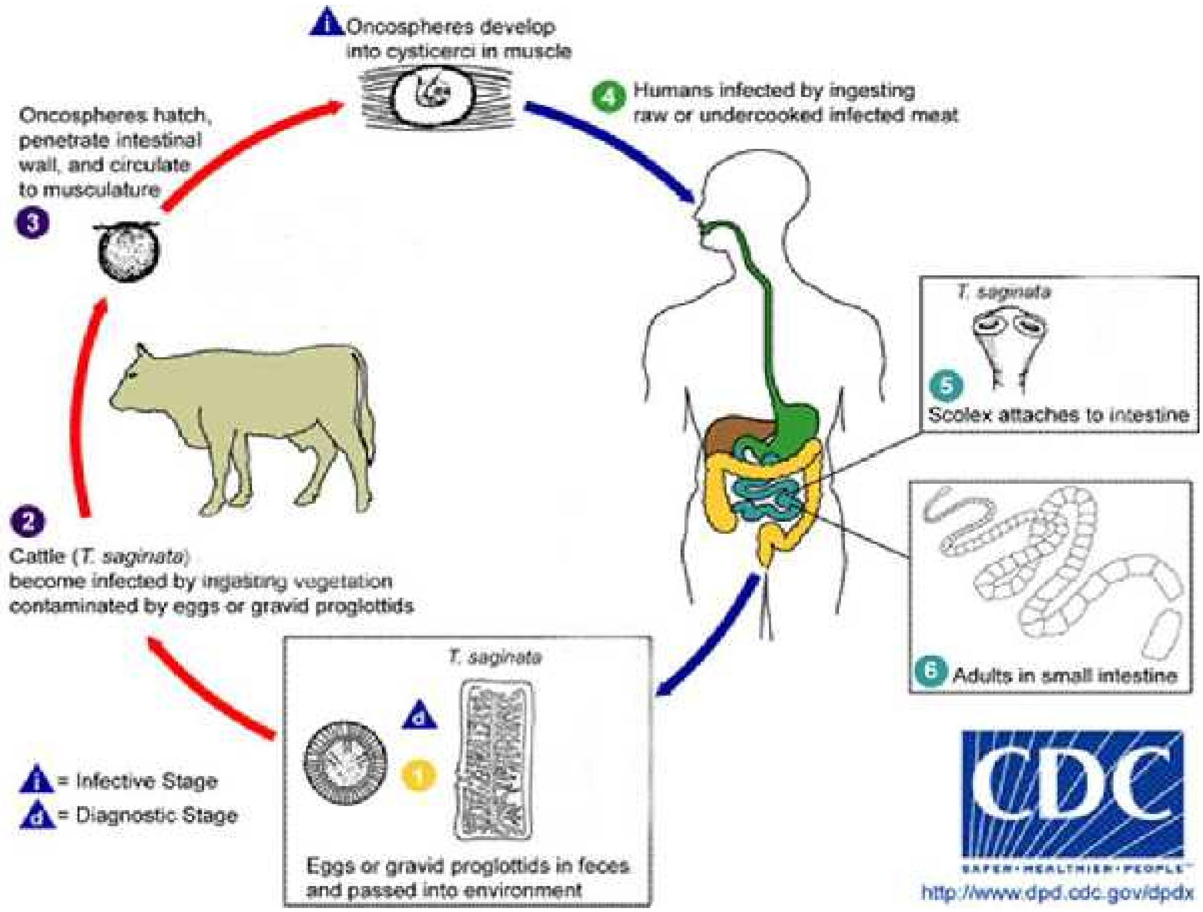


Image Source:
http://www.dpd.cdc.gov/dpdx/images/ParasiteImages/Taeniasis/Taeniasaginata_LifeCycle

**Life cycle of *Taenia saginata***

## Prevention and Control

Inspection of beef for cysticerci is the best preventive measure. Beef must be thoroughly cooked in endemic areas—to at least 56°C throughout the meat, which may be difficult to accomplish with large cuts of fatty meat, particularly pork. Freezing at 10°C for 10 days usually is lethal to *Taenia cysticerci*, but they can withstand 70 days at 0°C.

Treatment is readily available for the intestinal adult worms. Niclosamide, is a nonabsorbed oxidative phosphorylation inhibitor that kills the scolex and anterior segments on contact, after which the worm is expelled. Praziquantel, a synthetic isoquinoline-pyrazine derivative, is an equally effective and relatively nontoxic cesticidal compound. Since the scolex is usually but not always destroyed, and a new worm can regenerate if the scolex and a minute portion of the neck survive, the patient should be observed for several months, as egg-bearing segments can reappear in 10-12 weeks

# ANNEX-2

## Questionnaires

### Questionnaire for butchers

1. Name:
2. Address:
3. What type of animal do you slaughter?
   a/buffalo b/goat c/pig d/chicken e/fish
4. How do you slaughter the animal?
   a/stunning b/electric shock c/euthanasia d/other
5. What is the total number of animal you slaughter each day?
   a/1 b/2 c/3 d/4 e/more than 4
6. Where do you bring the animal from?
   a/local place(name of the place) b/outside the valley
7. How do you transport the animal?
   a/on foot b/by truck c/other if any
8. Do you have shed for the animal (buffalo) before slaughter?
   a/yes b/no
   if no, where do you keep them? ……………………………………
9. What do you do with …..?
   a/hide and skin b/bones c/blood d/gall bladder
10. Where do you dispose the waste of the slaughtered animal?
    a/street site b/river site c/drainage system d/container e/other
11. Do you sell the meat yourself or give to others?
    a/oneself b/give to others
    if others, give it inside or outside the Kirtipur?
    a/inside b/outside
12. Where do you bring the water from?
    a/well b/tap c/river d/other
13. Do you have slaughter house?
    a/yes b/no
    if yes,
    i/ slaughter place with shed a/yes b/no
    ii/slaughter place with concrete floor a/yes b/no
    iii/slaughter place with water supply a/yes b/no
    iv/slaughter place with electricity supply a/yes b/no
    v/ slaughter place with offal disposal a/yes b/no
    vi/slaughter place with drainage a/yes b/no
    vii/slaughter place with meat storing facilities a/yes b/no
    if no,

i/why didn't you make the slaughter house?

a/no money b/no place c/other

ii/if somebody makes slaughter house do you join with him?

a/yes b/no

14. Have you got any training on meat business?

    a/yes b/no

15. Has municipality or other ever come to check your meat?

    a/yes b/no

16. Do you have any idea about meat borne diseases?

    a/yes b/no

17. Do you have knowledge of environment pollution due to the wastes from your slaughtering place?

    a/yes b/no

**Questionnaire for meat sellers**

1. Name:
2. Address:
3. What type of meat do you sell?
   a/buffalo meat(buff) b/mutton c/pork d/chicken
   e/fish
4. Do you have adequate facilities at your shop for meat marketing?
   a/yes b/no
   if yes,
   what type of facilities do you have?
   i/housing a/permanent b/temporary shed c/road side d/hut
   ii/water supply provision A/yes B/no
   if yes, what type of water do you use?
   a/well b/tap c/river d/other
   iii/electricity a/yes b/no
   iv/fly proof a/yes b/no
   v/cold storage facilities a/yes b/no
   vi/dog proof a/yes b/no
   vii/offal/waste disposal container A/yes B/no
   if no, where do you dispose them?
   a/street side b/road side c/drainage system d/other
   viii/clothing of meat seller
   a/appron b/cap c/gloves d/gumboot e/none
5. Where do you get the meat from?
   a/from the butcher b/slaughter oneself
6. How do you get the meat?
   a/on vehicle b/via manpower
7. Have you seen any cysts (water pockets)/parasites on the meat?
   a/yes b/no
8. Do you have any idea about meat borne diseases?
   a/yes b/no

**Questionnaire for consumers**

1. Name:
2. Address:
3. What type of meat you most buy?
   a/buffalo meat(buff) b/mutton c/pork d/chicken e/fish
4. How often do you eat meat?
   a/once a week b/twice a week c/once a month d/twice a month
   e/in a long gap f/other
5. Have you seen any cysts (water pockets) in the meat you buy?
   a/yes b/no
6. Have you your family member ever been sick after having meat?
   a/yes b/no
7. Are you satisfied with the meat hygiene and sanitation?
   a/yes b/no
8. Do you have any idea about meat borne diseases?
   a/yes b/no

# ANNEX-3

## Animal Slaughterhouse and

## Meat Inspection Act 2055' (A translation)

### Preamble

To safeguard the health and welfare of public and to prohibit adulteration in meat and meat products, to prevent any fraud which lowers the wholesomeness quality and adequacy of meat, it is imperative to establish slaughterhouse and arrangement for meat inspection.

Therefore, on the 26th year of accession **of His Majesty the King Birendra Bir Bikram Shah Dev**, the Parliament has enacted this Act.

### 1. Short title and commencement

1. This Act shall be called "Slaughterhouse and Meat Inspection Act, 2055".
2. This Act shall come into force in prescribed area on a prescribed date which His Majesty Government may notify it in the Nepal Gazette, to specify it.

### 2. Definition

1. "Animal" means castrated or un-castrated goat, sheep, pig, wild boar, chyangra goat, buffalo, bull, rabbit or the females above which are fit for meat other than cow and ox and this word also includes poultry, ducks, pigeon or other species kept for meat purpose.
2. "Meat" means meat of the animals which is fit for human consumption.
3. "Meat inspector" means persons appointed or as prescribed under Article 6.
4. "Meat supervisors" mean persons as prescribed under Article 7.
5. "Meat sellers" mean persons who sell the meat professionally.
6. "Prescribed or as prescribed" means prescribed or as prescribed on the regulation made under this Act.

### 3. Prohibit to established slaughterhouse and selling of meat without license

Nobody shall establish slaughterhouse or sell the meat without obtaining license under this Act.

### 4. Establishment of slaughterhouse

1. His Majesty Government may establish the slaughterhouse in any area of the country by the notification in Nepal Gazette.
2. What so ever is written in Sub-Article (1) His Majesty's Government may give permission to non-government sector as well to establish the slaughterhouse.
3. The term and conditions and specification to establish the slaughterhouse under Article (1) or (2) shall be as prescribed.

**5. Application for license**

1. Persons interested to establish a slaughterhouse or selling of meat shall obtain license as prescribed.
2. To obtain the license under Sub-Article (1), a fee is to be paid as prescribed.

**6. Appointment of meat inspector**

1. His Majesty's Government may nominate/appoint a person as a meat inspector to examine animals of meat, who is at least graduate in veterinary science.
2. Other rights and duties of meat inspector will be as prescribed, in addition to those mentioned in this Act.

**7. Nomination of meat supervisor**

1. His Majesty's Government may nominate a meat supervisor to be any civil servant who is at least graduate in veterinary science for supervision of slaughterhouse management and as meat supervisor.
2. His Majesty's Government may nominate the meat supervisor as meat inspector in case if there is no meat inspector.
3. Other functions, duties and rights of meat supervisor shall be as prescribed.

**8. Inspections of animals before slaughtering (anti-mortem inspection)**

1. Animals to be slaughtered should be produced for inspection and anti-mortem exanimation before meat supervisor, at slaughterhouse, and in the area where slaughterhouse is not yet constructed such animals should be inspected at the site prescribed by the meat supervisor. Procedure for examination of animals will be as prescribed.
2. After inspection under Sub- Article (1) animal found suitable for slaughter may be permitted for slaughter with marking the animal by meat inspector.
3. Upon inspection under Sub- Article (1) if animal is found diseased, such animal should be prohibited for slaughter.

**9. Slaughtering of animals in slaughterhouse**

1. Animal fit for slaughtering under Article (8) shall be slaughtered in the slaughterhouse.
2. Whatever is written in Sub-Article (1) if there is no slaughterhouse in those areas, animal shall be slaughter at the place and time as prescribed by the meat supervisor.

**10. Meat examination of the slaughtered animal**

1. Meat inspector should inspect the meat of the slaughtered animal under Article 9, as prescribed.
2. If meat inspectors find any disease in meat of slaughtered animal upon inspection under Sub-Article (1) such meat may be prohibited for selling partially or completely by meat inspector.

**11. Prohibition on sale of carcass**

1. Sale of meat of animal other than mentioned in section (A) of Article 2 shall not be allowed.
2. Meat of dead animal due to disease or any other cause shall not be allowed for sale.
3. Sale of meat with skin shall not be allowed.

But this article shall not be applied for selling meat of birds, pigs, wild pigs and in other species identifying organs or portions like heat and legs with skins.

**12. Marketing of stamping on carcass**

1. Meat inspector shall affix clearly visible marking of stamp as prescribed during the certification of meat for sale.
2. No meat shall be sold without the marks or stamps retired under Sub-Article (1).

**13. Adulterated meat shall not allowed to sale**

1. Adulteration of carcass with another species of animal or deceiving the species of animal while selling meat shall not be allowed.
2. Adulteration of meat with any substance that alters the normal quality or taste or weight shall not be permitted for sale.

**14. Fee to be paid**

Inspection of animal or mat under this Act., fee shall be levied as prescribed.

**15. Authority to enter**

Meat inspector or meat supervisor may enter in slaughterhouse or butcher's shop and may take sample of meat or inspection of animal or carcass. To help on this work will be the duty of all concerned.

**16. No objection**

Whatever is contained in this Act, there will be no objection on slaughter of animal for household purposes the relevant Articles of this Act shall not be effective.

**17. Penalty and punishment**

1. Person who contrivance Sub-Article (1) or (3) of Article 8, Article 9, Sub-Article (2) of Article 10, Sub-Article (3) of Article 11 or Sub-Article (2) of Article 12 shall be punished with a fine of maximum of Rupees one thousand.
2. Persons who contrivance Article 3, Sub-Article (1) or (2) of Article 11 or Article 13 shall be punished with a maximum fine of Rupees of five hundred.

**18. Delegation of authority**

Authority vested on His Majesty's Government under this Act may be delegated with limitation to other bodies as required.

**19. His Majesty's Government shall be plaintiff**

His Majesty's Government shall be plaintiff on case under this Act.

**20. Investigation of crime and defence**

1. Meat investigator shall investigate the case under this Act and register the case after completing the investigation; he shall file the case to judiciary powered officer.
2. During the registration of the case under Sub- Article (1) investigation personnel may take advice with government lawyer.

**21. Judicial authority**

The judicial authority for cases and hearing appeal related to this Act should be vested on prescribed officer.

**22. Shall be according to the prevailing law**

Whatever mentioned in this Act shall be decided accordingly, while in other matter it will be as per the prevailing law.

**23. Authority to frame rules**

For the implementation of purpose of this Act. His Majesty's Government shall have authority to make the necessary rules.

**24. Repeal**

Whatever is written in Muliki Ain (Act) under Chaupaya (four footed animal) on paragraph number 3 and 16 has been repealed.