

**PREVALENCE OF GASTROINTESTINAL PARASITES OF  
DOMESTICATED KALIJ PHEASANT (*Lophura leucomelanos*  
LATHAM, 1790) IN CHUNIKHEL, BUDHANILKANTHA  
MUNICIPALITY, KATHMANDU, NEPAL**



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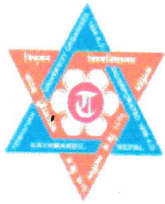
## DECLARATION

I hereby declare that the work presented in this thesis entitled “**PREVALENCE OF GASTROINTESTINAL PARASITES OF DOMESTICATED KALIJ PHEASANT (*Lophura leucomelanos* LATHAM, 1790) IN CHUNIKHEL, BUDHANILKANTHA MUNICIPALITY, KATHMANDU, NEPAL**” has been done by myself and has not been submitted elsewhere for the award of any degree. All the sources of information have been specially acknowledged by reference to the author (s) or institution (s).

Date 2023/05/14

  
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### RECOMMENDATION

This is to recommend that the thesis entitled “**PREVALENCE OF GASTROINTESTINAL PARASITES OF DOMESTICATED KALIJ PHEASANT (*Lophura leucomelanos* LATHAM, 1790) IN CHUNIKHEL, BUDHANILKANTHA MUNICIPALITY, KATHMANDU, NEPAL**” has been carried out by **Anita Karki** for the partial fulfillment of Master’s Degree of Science in Zoology with a special paper ‘**Parasitology**’. This is her original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institution.

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**LETTER OF APPROVAL**

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**CERTIFICATE OF ACCEPTANCE**

This thesis work submitted by **Anita Karki** entitled “**PREVALENCE OF GASTROINTESTINAL PARASITES OF DOMESTICATED KALIJ PHEASANT (*Lophura leucomelanos* LATHAM, 1790) IN CHUNIKHEL, BUDHANILKANTHA MUNICIPALITY, KATHMANDU, NEPAL**” has been accepted as a partial fulfillment for the requirements of Master’s Degree of Science in Zoology with special paper Parasitology.

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## LIST OF ABBREVIATIONS

<b>Abbreviated form</b>	<b>Details of abbreviation</b>
GI	Gastrointestinal
NaCl	Sodium Chloride
viz	Namely
RPM	Rotation per Minute
µm	Micrometer
VDC	Village Development Committee
IBM	International Business Machine
SPSS	Statistical Package for the Social Sciences
i.e.	that is
P value	Probability value
$\chi^2$	Chi square
df	Degree of freedom

## ABSTRACT

The Kalij Pheasant belongs to the family Phasianidae. Kalij pheasant is a South and Southeast Asian bird. It is found in Pakistan, India, Nepal, and western Thailand. The present study was conducted for the prevalence of gastrointestinal parasites of Kalij Pheasant in Chunikhel, Budhanilkantha Municipality, Kathmandu, Nepal. Total 200 fecal samples were collected by random sampling method from October 2022 to December 2022. The examination of fecal samples was done by direct microscopic examination, floatation technique and sedimentation technique whereas Microsoft Excel 2016 was used for data analysis. Out of 200 fecal samples examined, 110 fecal samples were positive with 55% prevalence of parasitic infection. Total five gastrointestinal parasites were identified including one protozoan: *Eimeria* spp. (13%) and four helminths (42%): *Capillaria* spp. (19%), *Ascaridia* spp. (11%), *Heterakis* spp. (7%) and *Raillietina* spp. (5%). The prevalence rate of helminths (42%) was higher than protozoan parasite (13%). Statistically, the difference in prevalence of intestinal parasitic infection among study area was found to be insignificant ( $\chi^2=8.81$ ,  $df=4$ ,  $p>0.05$ ). Single infection was found to be higher than mixed infection. The heavy intensity of *Eimeria* spp. was seen in three samples, moderate infection of *Eimeria* spp. was seen in eight samples and *Capillaria* spp. was seen in two samples. The study indicated that Kalij Pheasant of Chunikhel, Budhanilkantha Municipality, Kathmandu were susceptible to gastrointestinal parasites due to improper management of waste products and improper handle of fecal samples. In order to minimize the GI infestation in Kalij, droppings should be cleaned up regularly and the surrounding area should be kept clean.

# 1. INTRODUCTION

## 1.1 Background

The most frequent and significant economic losses in aviculture are caused by gastrointestinal parasites with direct or indirect life cycles, specifically *Eimeria* spp., *Ascaridia galli*, *Heterakis gallinarum* and *Capillaria* spp. Kalij Pheasants (*Lophura leucomelana*) are native to the western foothills of the Himalayas in northern India and Nepal (Bohl, 1971). These Gallo -pheasants were introduced into Hawaii in 1962 at the Puu Waawaa Ranch on the island of Hawaii (Lewin, 1971) from game farms in Michigan and Texas. Kalij pheasants became so abundant that in 1977 they were declared a legal game species. Pheasant is considered an invasive species They are grouped under the order Galliformes in the family Phasianidae, the pheasant family, which include various birds like jungle fowl, peacock, quail, pheasant etc. are included in it. Large ground-dwelling birds known as pheasants are found across Nepal, from lowland to high alpine regions. In Nepal, eight species of pheasants have been identified, including the captivating "Danphe," the nation's national bird. According to the 1973 National Parks and Wildlife Conservation Act, three protected species are listed: Cheer Pheasant (Cheer), Danphe (Himalayan Monal), and Munal (Satyr Tragopan). Pheasant can be included in poultry too. Pheasants are often referred as pets for various purposes. Poultry is one of the most intensively reared of the domesticated species and one of the most developed and profitable animal production enterprises (FAO, 1987). Poultry production is divided into two main different productive systems: intensive/indoor and free-range/outdoor (Permin and Hanssen, 1998). Based on the number of animals, poultry represent the largest domestic animal stock in the world (Gilbert *et al.*, 2015). Poultry include all species of domestic birds used for meat and egg production (Al-Nasser *et al.*, 2007). Poultry sector plays an important role in the national and socio-economic development of the country contributing nearly \$2.2 billion annually to the national economy (Mohanty and Rajendran, 2003). Poultry meat and egg production have shown a considerable increase worldwide since 1970. The increase in the size of the poultry industry has been faster than other food-producing animal industries. The trade volume of poultry products has also increased parallel to the rapid growth of global poultry meat and egg production (Windhorst, 2006). These include chicken, ducks, turkey, guinea fowl, goose, quail, pheasant and peafowl (Al-

Nasser *et al.*, 2007; Adejinmi and Oka, 2011). The most commonly kept poultry are the domestic chicken (*Gallus gallus domesticus*) (Jegade *et al.*, 2015). It is clear that the poultry business not only contributes significantly to the nation's food security but also offers employment to a sizable portion of the global population.

## **1.2 Parasitic infections of poultry**

Animals may exhibit greater natural resistance to parasite infection when they are in their natural habitat. However parasitic infections are among the most common sanitary problems affecting birds in captivity, especially those in high density populations (Otegbade and Morenikeji, 2014). The parasitic infections are chronic in nature, causing anorexia, malnutrition related diseases, which makes the birds immunocompromised (Steiner and Davis, 1981). Specific infectious and parasitic diseases of poultry are economically important and a threat to public health (Sambo *et al.*, 2015). However, the reported prevalence of infectious and parasitic diseases varies significantly across the country (Luu *et al.*, 2013). The common internal parasitic infections occur in poultry include gastrointestinal helminths (cestodes, nematodes and trematodes) and *Eimeria* species that cause considerable damage and great economic losses to the poultry industry due to malnutrition, decreased feed conversion ratio, weight loss, lowered egg production and death in young birds (Puttalakshamma, *et al.*, 2008). Nematodes constitute the most important group of helminth parasites of poultry both in number of species and the extent of damage they cause the main genera include *Capillaria*, *Heterakis*, and *Ascaridia* (Jordan and Pattison, 1996). *Ascaridia galli* has been incriminated as the most common and most important parasite of poultry (Pam *et al.*, 2006; Luka and Ndams, 2007). *Raillietina tetragonal* and *Raillietina echinobothrida* are parasites in the small intestines of birds (including chicken, turkey, quail and pheasant) and these infections have been spread worldwide (Vattanodorn *et al.*, 1984). Furthermore, parasites can make the flock less resistant to diseases and exacerbate existing disease conditions (Gary and Richard, 2012; Katoch *et al.*, 2012). Coccidiosis induced by *Eimeria* species infection is an important parasitic disease of poultry.

### **1.3 Objectives**

#### **1.3.1 General objective**

- To study the prevalence of gastrointestinal parasites of Kalij Pheasant in Chunikhel, Budhanilkantha Municipality, Kathmandu, Nepal.

#### **1.3.2 Specific Objectives**

- To study the concurrency and intensity of GI parasites of Kalij.
- To compare GI parasites between different farms of Chunikhel, Budhanilkantha Municipality, Kathmandu, Nepal.
- To study the prevalence of GI parasites with respect to age and sex of Kalij

### **1.4 Justification of the study**

Many infections, including protozoans and helminths, can be spread by birds either directly or indirectly. There have no any studies being carried out regarding gastrointestinal parasites of Kalij at Chunikhel, Budhanilkantha Municipality, Kathmandu, Nepal. I am the first person to conduct a research study on this topic in Nepal. Chunikhel poultry farming is new in Nepal. So, it is important to know about the factors that affect them in the farming among them one of the factors is parasites. Study on prevalence of parasites of Kalij Pheasant in Chunikhel, Budhanilkantha Municipality was lacking. This study's goal is to give a brief overview of the main parasites that are common in Pheasants and to fulfil the knowledge gap. This will be beneficial for learning about parasitic infection in various Pheasants, which will enable the development of knowledge about the overall prevalence of GI parasites in Pheasants. This research will be helpful in developing strategies to effectively combat gastrointestinal parasites. The recent study can help new scholars and investors expand their understanding.

## 2. LITERATURE REVIEW

Poultry farming is the main method of generating meat and eggs for the market. The poultry animals, however, are infected with intestinal parasites. Most social birds, both migratory and non-migratory, can transmit a number of pathogens, including parasites, which can lead to serious illnesses in people, other animal species, and birds. Unlike free-range scavenging birds which are in direct contact with parasite vectors, soil and feces, on the other hand lack of hygiene, direct contact with humans, captivity conditions and the physical environment (rainfall, humidity and ambient temperature) provides optimum conditions to maintain parasites populations (Alves *et al.*, 2008). There are some published articles regarding the gastro intestinal parasites of different poultry birds but in case of gastro-intestinal parasites of Kalij there is not much information available. The majority of birds kept as domestic pets in rural areas are chickens and pigeons. Many articles related to chickens and poultry are published but there are a very few articles related to Kalij (Pheasants) or a very little research work has been carried out regarding parasitic infections. So, to fulfill the lack of literature, some articles regarding gastro-intestinal parasitic infection of some poultry birds including broiler, free ranging, avian, domestic, local and exotic breeds have been described here, some of the important literature relevant with the present work has been reviewed.

Pinto *et al.* (2008) in Brazil reported 72.5% prevalence in *Meleagris gallopavo* (Galliformes, Phasianidae). In the same manner, 102 fighting cocks (*Gallus gallus domesticus*) were tested in Coro, Falcon State, Venezuela, by Cazorla *et al.* in 2013 where protozoa or helminths were present in 38 roosters (37.3%) in which *Strongyloides* spp. (20.6%), *Capillaria* spp. (16.7%), *Choanotaenia* spp. (12.8%) and *Heterakis* spp. (6.9%) were the most prevalent enteric parasites. Colombian researchers Alvarez J. *et al.* (2015) reported 63.54% of *Eimeria* spp. (35.93%), *Ascaridia galli* (31.25%), *Heterakis gallinarum* (21.87%), and *Syngamus trachea* (4.68%). The prevalence of roundworms was higher than that of tapeworms i.e., 63.5% and 27.58% respectively.

*Eimeria* spp. oocysts were reported by Santilli *et al.* (2012) in Tuscany, Italy, in 59 of 119 samples (51.3%) and 33 of 129 samples (25.6%). In order to determine the degree of intestinal helminth infection in the birds, Rzaad *et al.* (2015) imported pheasants (32)

into Poland where nematodes like *Capillaria phasianina*, cestodes like *Railietina Friedberg Eri*, and one trematode like *Brachylaima* spp. were found in partridges and found that pheasants have a parasite prevalence that is 70.4% higher than that of partridges, which is 50.0%.

In a semi-arid region of north-eastern Nigeria, Ibrahim *et al.* (2006) conducted study on 100 total feces samples from ostriches, 50 of which were collected from the animals in their natural habitat and 50 from captive ones. By using the concentration approach, the single protozoan parasite *Eimeria* spp. as well as various helminth parasites such *Ascaridia* spp., *Strongyloides* spp. and *Capillaria* spp. were found. On average, 44 (88%) and 36 (72%) captive and free-living ostriches had gastrointestinal parasites, respectively. In a study by Opara *et al.* (2010), 32 animals, 18 males and 14 females from 16 different species were evaluated. An analysis of the feces found a 76.6% overall frequency. The number of GIT parasites in the male and female zoo animals was 74 (62.7%) and 44 (37.2%), respectively. Paul *et al.* (2015) found eight different nematode species in Nigeria. The two nematode species discovered were *Ascaridia galli* 514 (85.67%) and *Trichostrongylus tenus* 18 (3.00%). Rufai *et al.* (2017) collected a total of 250 layers in domestic and exotic breeds in Osun state, Nigeria and found that 62% of birds had parasite infections where the detected parasites like *Ascaridia galli*, coccidian, *Heterakis gallinarum* (cecal worm), *Syngamus trachea* (gapeworms), *Capillaria annulata* (thread worm), and tape worm were found among the helminths, *Ascaridia galli* was the most common species (17.2%). In Ghana Asumang *et al.* (2019) *Ascaridia galli* is listed as being the most common i.e., 65 (32.5%), *Heterakis gallinarum* 38 (19.0%), and *Capillaria* spp. 29 (14.5%) are a few of the nematodes. Similarly, study conducted by Adeola *et al.* (2022) in University of Ilorin Nigeria where the prevalence of gastrointestinal parasites was determined with Ostrich having the greatest rate of infection.

Likewise, Patel *et al.* (2000) using the sedimentation and flotation technique on a total of 106 fecal samples from captive birds. Of these, 48% were found to be parasite positive. Helminth parasites *Ascaridia* spp. and *Capillaria* spp. were recorded in 20.75% and 13.20%, respectively. When Radfar *et al.* (2011) conducted a survey on pigeons in Iran and found the nematodes like *Ascaridia colombae* (16.66%) and *Hadjelia truncata* (1.96%), while the cestodes like *Cotugnia digonopora* (13.79%), *Raillietina magninumida* (18.62%), and *Raillietina achinobothridia* (32.35%).

According to Musa *et al.* (2012) in Dhaka, trematode and cestode infections were found in 100% of the female ducks, but only in 60% of the male ducks. When 58 poultry farms were examined, Kumar *et al.* (2013) reported that *Ascaridia galli* (3.45%), *Heterakis gallinarum* (1.72%), *Syngamus trachea* (5.17%), *Capillaria* spp. (1.72%), *Raillietina* spp. (1.72%), *Trichostrongylus tenuis* (1.72%), and *Strongyloides avium* (1.72) were all positive for *Eimeria* species. According to Moussawi *et al.* (2016), a turkey from Al-Nasiryah city, Iraq, was determined to be infected with seven *Heterakis gallinarum*. According to Ybanez *et al.* (2018) in Philippines, the parasites with the highest prevalence were *Ascaridia* spp. (41.2%), *Heterakis* spp. (59.3%), *Capillaria* spp. (10.7%), *Eimeria* spp. (43.2%), and others. *Strongyloides* spp. (74.1%). In the Pakistani districts of Gujranwala and Jhang, 613 captive birds from 19 species were discovered by Tauseef *et al.* (2019), 54.32% prevalence of trematodes, protozoa, nematodes, and cestodes. *Ascaridia* spp. (33.93%), *Capillaria* spp. (11.41%), *Eimeria* spp. (67.87%), and *Hymenolepsis* spp. (6.61%), respectively. Ali *et al.* (2020) in Saudi Arabia conducted a survey on feral pigeons were found to have cestodes of *Raillietina* spp. (*Cyclophyllidea: Davaineidae*) and nematodes of *Ascaridia* spp. (*Ascaridida: Ascaridiidae*), with prevalence of 10.71% and 3.57%, respectively. According to Sarker *et al.* (2022), 50 captive peafowls were present in Bangladesh, of which 10 (41.67%) had both coccidiosis and ascariasis. In the high-altitude Padmaja Naidu Himalayan Zoological Park in the Darjeeling hills, researchers Pariyar *et al.* (2021) investigated the prevalence of gastrointestinal parasites in a variety of captive mammals and pheasants. 222 (23.39%) were found to be parasite infected. They discovered that the most prevalent parasites were *Toxocara* spp., *Eimeria* spp., *Isospora* spp., and *Ascarid* species.

Similar to this, Goldova *et al.* (2006) found gastrointestinal parasites in restricted systems in pheasants. By using a qualitative flotation approach, a total of 1030 fecal samples were collected and tested for the presence of gastrointestinal parasites. With a 48.2% prevalence, 497 samples were found to be positive for intestinal parasites. There were five different nematode species found, including *Ascaridia* spp. (10.5%), *Heterakis* spp. (31.7%), *Syngamus trachea* (45.7%), and *Trichostrongylus tenuis* (2.1%).

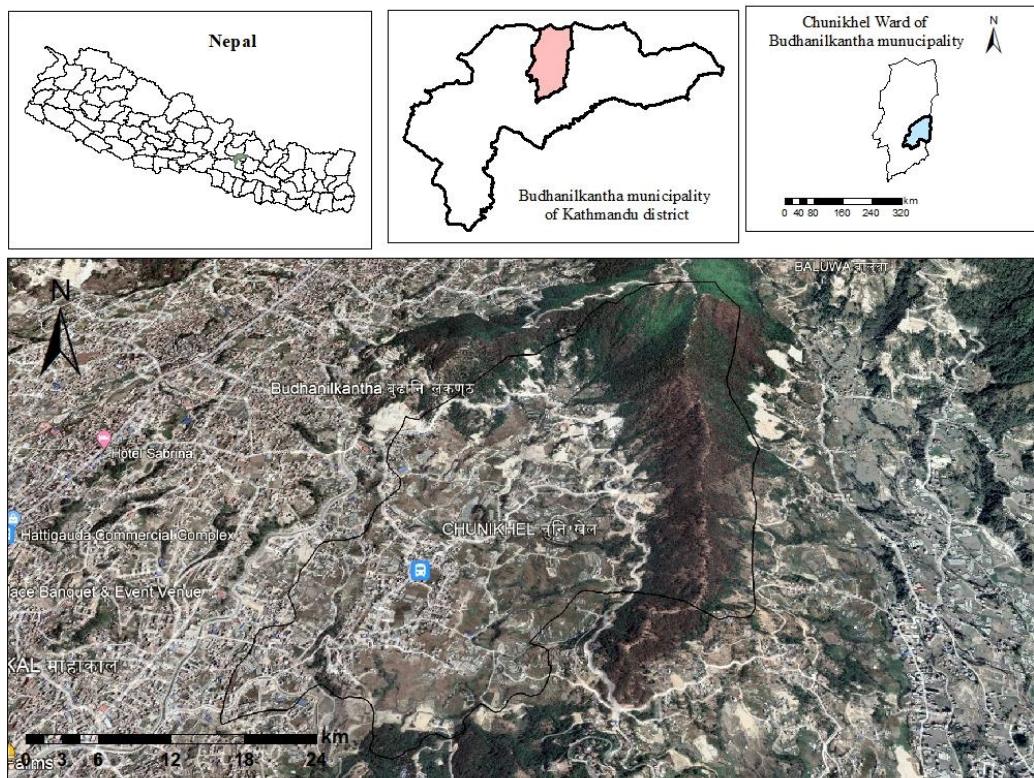
Different studies on gastrointestinal parasites in birds are conducted in Nepal. But in Kalij it is less This study reviews the papers that are relevant to it.

According to Subedi *et al.* (2014), chicken from the Lalitpur district was susceptible to four unidentified species, one cestode species, and five nematode species. The most common species were *Heterakis gallinarum* (22.4%), several *Capillaria* species (16%), *Ascaridia galli* (10.4%), unidentified species (4.8%), and *Raillietina tetragona* (4%). In order to explore the prevalence of gastrointestinal parasites in emus, Maharjan *et al.* (2018) in Rupandehi, where 65 percent of the 100 feces samples tested positive for gastrointestinal parasites. In terms of prevalence, *Eimeria* spp. (30%) outnumbered *Entamoeba* spp. (10%) among protozoan parasites. The most common helminth parasite was *Ascaris* species (15%), which was followed by *Dromaestrogylus* species (10%), *Davainea* species (9%), *Raillietina* spp. (5%), and *Heterakis* species (5%). 120 samples of pigeon excrement from three temples in the Pokhara Valley were submitted, according to (Gurung, 2016). In 83 of the 120 fecal samples examined, parasite infection was determined to be prevalent (69.16%). Six genera of helminths and 23 protozoan coccidia (19.16%) were discovered during the investigation. 120 fecal samples were obtained by Shrestha *et al.* (2020) where 98 of these samples, or 81.67%, were parasite- positive. The highest rate of positivity was for nematodes (74.49%; 73/98), then for cestodes (52.04%; 51/9) and protozoans (41.84%; 41/98). The results of Dhakal *et al.* (2022) in central Nepal in household and temple pigeons (*Columba livia*) showed a prevalence rate of 87.1% for 16 parasite species, consisting of 8 protozoan and 8 helminth faunae.

### 3. MATERIALS AND METHODS

#### 3.1 Study area

The study area Chunikhel is located in the northern part of Kathmandu which is a part of Budhanilkantha Municipality in Kathmandu District in Bagmati province of central Nepal. Chunikhel is a village and former Village Development Committee. It has 15 VDC in total. Chunikhel is gate for entering Shivapuri National Park. The five farms are within a short 25-30 minutes' drive apart. People of this Chunikhel ward are mostly engaged in agriculture. The biggest amount of Kalij, or about 800-1000, is found in Kumar and Bikram farms, followed by Dolma farm with 100, Bhuwani farm with 200-300, and Khalitman farm with the same amount. All farms of Kalij eat primarily cereals, cauliflower leaves, and maize. They primarily have ringneck and golden Kalij species. They are handed a bucket of cold water. For drinking water, they do not treat it. Only the Kumar farm kept the younger and older Kalij apart, while the other farms kept them all together.



**Figure 1:** Map showing study area; Chunilkhel, Budhanilkantha Municipality, Kathmandu, Nepal

### **3.2 Materials**

During the research, the materials used have been listed below:

#### **3.2.1 Materials for field**

- I. Measuring tape
- II. Sterile vials
- III. Gloves
- IV. Camera
- V. Mask

#### **3.2.2 Materials for laboratory**

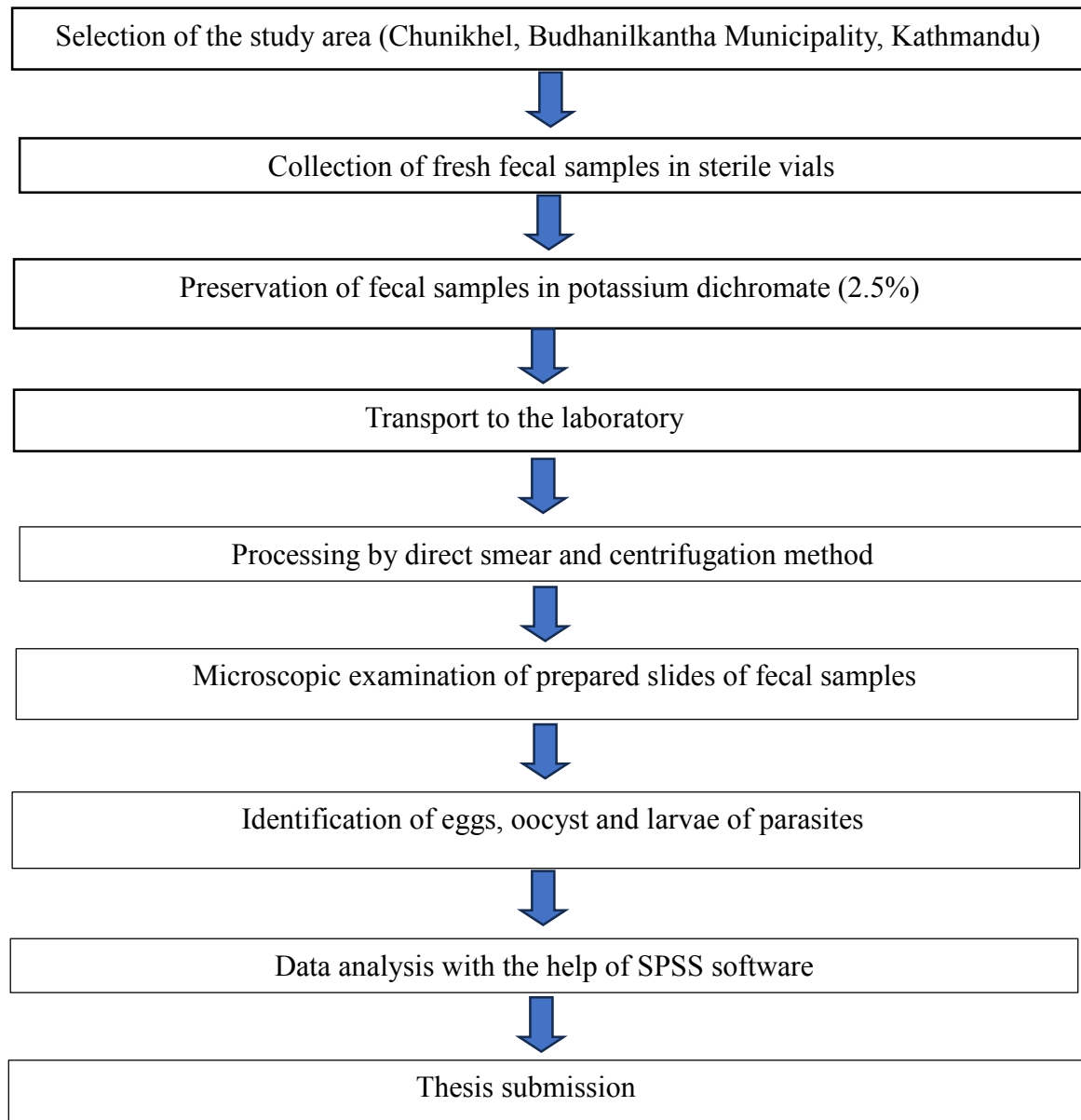
- I. Centrifuge machine (REMI)
- II. Electric microscope (SWIFT)
- III. Stage micrometer and ocular micrometer (Ubuy)

#### **3.2.3 Chemicals**

- I. 2.5% Potassium dichromate ( $K_2Cr_2O_7$ )
- II. Distilled water
- III. 0.9% NaCl/Saline solution
- IV. Methylene blue
- V. Lugol's Iodine solution
- VI. Giemsa
- VII. Concentrated NaCl (40%)

### 3.3 Methods

#### 3.3.1 Study design



**Figure 2:** Flow chart showing study design

### **3.3.2 Study period**

The study was carried out from October 2022 to May 2023.

### **3.3.3 Sample size**

To study the gastrointestinal parasites of Kalij, a total of 200 samples were collected from five different farms at different times in Chunikhel, Budhanilkantha Municipality, Kathmandu, Nepal.

### **3.3.4 Sample collection and preservation**

With the help of the caretaker, approximately 10-15 grams of faeces were collected in clean, sterile vial with the help of a spatula wearing gloves and mask soon after defecating from various locations throughout the farms each morning and evening. On the first day, newspaper or polythene was placed on the ground to collect fecal samples. On the second day, a wooden applicator was used to transfer all of the faeces that had been collected on the newspapers or polyethene into a sterile vial that contained potassium dichromate ((K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>)) solution (2.5%). The samples were taken after defecation. A marking was given to Kalij for not repeating themselves. To ascertain the gender of Kalij, morphological traits were used. All the samples collected were labeled properly. The same collection process was repeated for all collected fecal samples. Vials were kept airtight after that the materials were then brought to Central Referral Veterinary Hospital and later transported to Central Department of Zoology

## **3.4 Laboratory examination**

Fecal samples were preserved and transported, and then all samples were examined at the Central Referral Veterinary Hospital in Tripureshwor, Kathmandu and measurement was carried out at the Central Department of Zoology at TU. The fecal samples were examined under microscope for trophozoite, cysts, oocysts, eggs and larvae of gastrointestinal by stained smear preparation and concentration method viz. floatation and sedimentation techniques (Soulsby, 2012).

### **3.4.1 Direct smear method**

On a clean glass slide, two grams of fecal samples were emulsified in a drop of Lugol's iodine solution before being covered with a fresh cover slip. The samples were crushed with the help of a mortar. A small drop of iodine was dropped in the slide. Then the

sample was kept over iodine and a smear was prepared. The prepared smear was observed under a microscope at different magnifications, 10X and 40X (Soulsby, 2012).

### **3.4.2 Concentration technique**

Eggs, cysts and trophozoite are often in such low number in fecal, that they are difficult to be detected in direct smears or mounts. Therefore, these procedures were performed which include floatation and sedimentation techniques (Soulsby, 2012).

#### **3.4.2.1 Floatation method**

By using this method, the eggs are guaranteed to float in the floatation liquid, making it easier to identify the nematode and cestode eggs as well as the protozoan cysts that are present in the faeces of Kalij (Pheasants). This technique is used widely for the detection of nematode and cestode eggs. As eggs of cestode and nematodes seem to be very small in size and light so the technique makes sure eggs float in floatation liquid. 3gm of fecal sample were taken in a beaker and added 15ml of saturated sodium chloride solution then sample was grinded lightly with the help of spatula and filtered the solution by tea strainer. The filtrate solution was poured into a centrifuge tube of 15ml and tube was filtered with more sodium chloride solution and centrifuged at 2000 rpm for 5 minutes. After centrifugation more saturated sodium chloride was added to develop convex surface at the top of the tube and 1-2 drop of methyl blue (to stain) was added and a cover slip was placed for 5 minutes and then cover slip was removed and place on a slide and examined at various magnifications 10X and 40X.

#### **3.4.2.2 Sedimentation method**

This technique is used for detecting trematodes eggs. It provides better results as the eggs of trematodes are a bit heavier than any other eggs. Sediments of centrifuged content are taken for eggs detection. Saturated salt solution was removed gently from the test tube after examining the floatation portion and poured the sediment content into watch glass and stirred the content gently to mix it. 1-2 drop from mixture was taken to prepare another slide. The specimen was stained with iodine wet mounts solution. Two sides were prepared from one sample (one from floatation and one from sedimentation) were examined under 10X and 40X with objectives of microscopes to detect eggs of protozoan, helminths or cysts of gastrointestinal parasites (Soulsby, 2012).

### **3.4.3 Determination of concurrency and intensity**

#### **3.4.3.1 Concurrency**

The host harbors one or more parasites with low numbers; in such circumstances, the host does not develop sickness yet might continue to be a source of infection for an extended length of time. Single, double, triple and multiple infections of gastrointestinal parasites were classified. A single infection was defined as the presence of only one egg/cyst/larva of the parasite per field, whereas double, triple and multiple infections were characterized as the presence of two, three or more egg/cyst/larva of the parasite per field.

#### **3.4.3.2 Intensity**

The total amount of eggs/oocysts and larvae detected per field was used to calculate the intensity of parasite infection. The level of gastrointestinal parasite infection was divided into three categories: light infection, moderate infection, and heavy infection. The presence of less than two eggs/cysts/larva of the same species per field was used to assess light infection. In a similar manner the presence of 2-5 egg/cyst/larva, and 6 or more egg/cyst/larva of the same species per field characterized moderate, and heavy infections.

### **3.4.4 Eggs and cysts size measurement**

Using micrometry, the sizes of the eggs and cysts were determined. It was discovered that the calibration factor was 2.4  $\mu\text{m}$  for 40X of objective lens.

### **3.4.5 Identification of eggs cysts and larva**

Eggs, cysts/oocysts, and larva were identified utilizing a variety of recently published publications on the internet based on morphological characteristics (form, size, and color). (Cuomo *et al.*, 2009; Soulsby, 2012).

### **3.4.6 Interview format**

The data were gathered via a semi-structured questionnaire. A one-on-one interview took place.

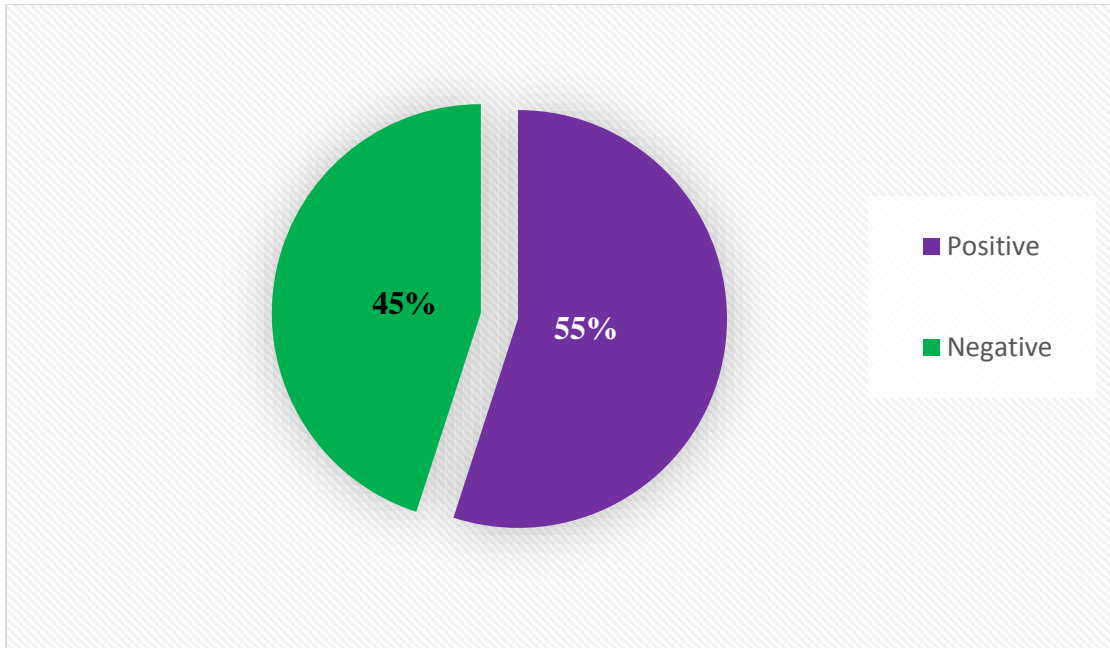
### **3.5 Data analysis**

The data were recorded based on a laboratory examination. The recorded data were analyzed using Microsoft Excel 2016 for analysis. Additionally, pie charts and bar diagrams were also used. Data were statistically analyzed using Chi-square test performed by “**IBM SPSS Statistics 25**” software package. In all cases 95% confidence interval (CI) and  $P < 0.05$  was considered for statistically significant difference. Percentage was used to calculate prevalence. Chi-square test was used for statistical analysis of data to measure farms wise prevalence, age wise prevalence and sex wise prevalence. Chi-square test was used to compare observed results with expected results and to find the association between two variables.

## 4. RESULTS

### 4.1 General prevalence of GI parasites

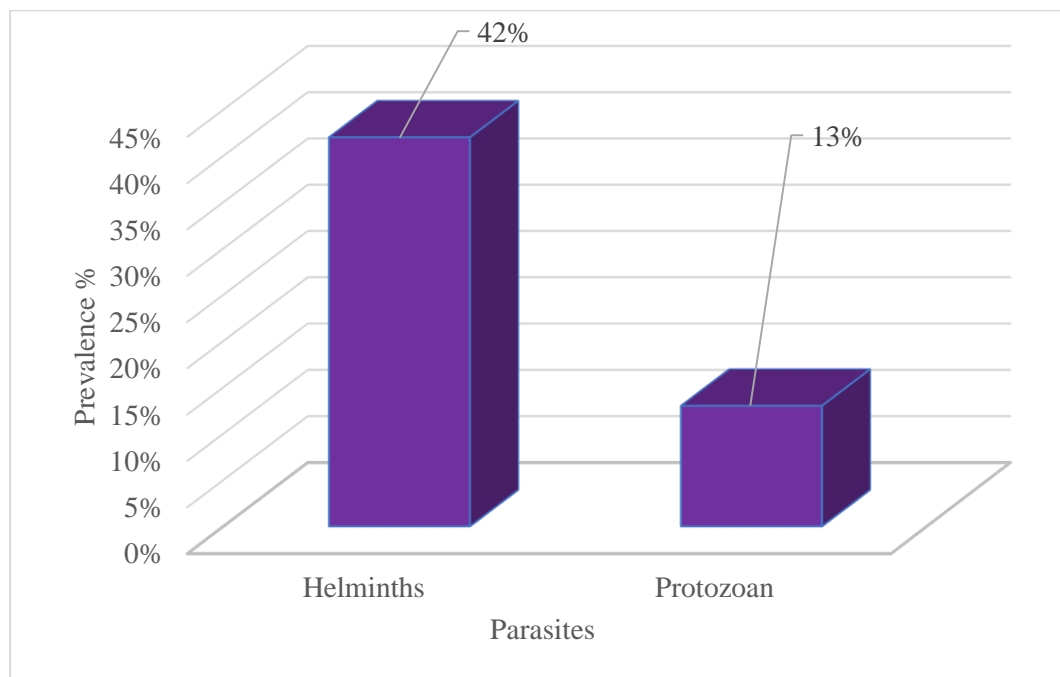
Out of 200 tested fecal samples from five different farms, 110 (55%) were found to be positive for one or more particular GI parasites.



**Figure 3:** Pie chart showing general prevalence of GI parasites in Kalij

#### 4.2 Prevalence of protozoan and helminths parasites

Out of 200 fecal samples, 84 were found to be positive for helminths, while 26 were found to be positive for protozoan parasites. Five parasites have been detected via fecal examination, and only one protozoan species i.e., *Eimeria* spp. have been recorded in 26 (13%) samples. The highest number of helminth species among the four was *Capillaria* spp. with 38(19%), followed by *Ascaridia* spp. with 22(11%), *Heterakis* spp. with 14 (7%), and *Raitellina* spp. 10(5%).



**Figure 4:** Prevalence of different helminths and protozoan parasites

### 4.3 Prevalence of specific GI parasites of Kalij

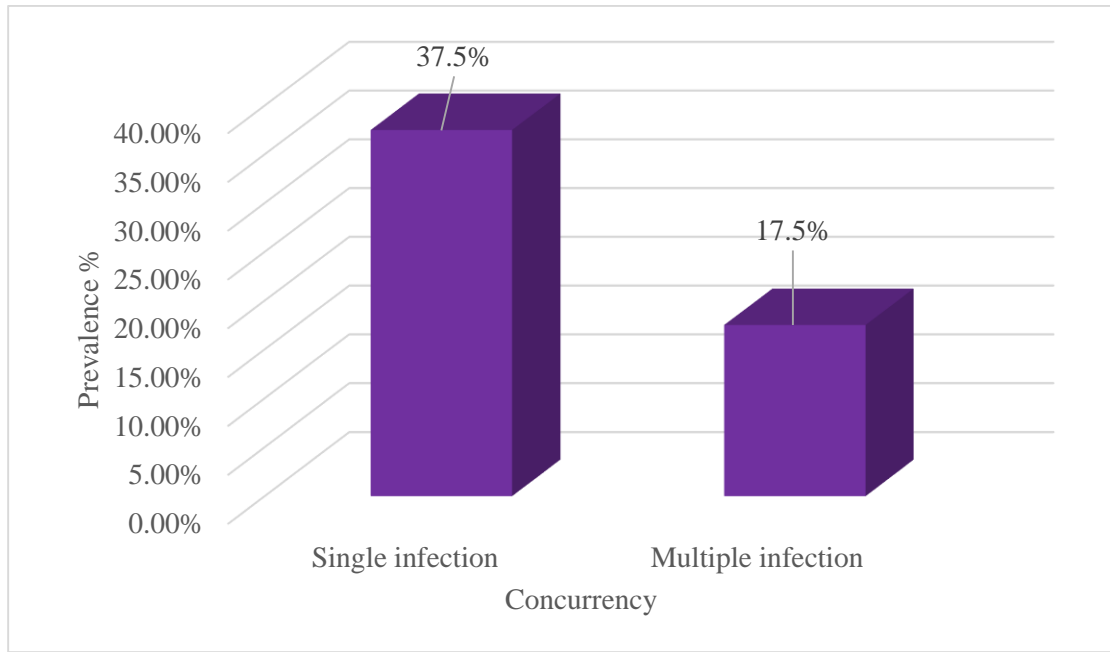
13% of samples collected from Kalij were found to be positive for *Eimeria* spp. Only two groups of helminths i.e., nematodes and cestodes were observed in Kalij samples. Kalij were found to be infected with three species of nematodes and one species of cestode i.e., 37% and 5% respectively. Among nematode parasites, *Capillaria* species were found to have high prevalence than that of *Ascaridia* spp. Likewise, *Heterakis* spp. was found to be least prevalent in Kalij with 7%. Among cestode parasite only one species was recorded i.e., *Raillietina* spp. with prevalence of 5%.

**Table 1:** Prevalence of specific GI parasites

Class	Species	No. of infected	Prevalence rate
Protozoa	<i>Eimeria</i> spp.	26	13%
Nematodes	<i>Heterakis</i> spp.	14	7%
	<i>Ascaridia</i> spp.	22	11%
	<i>Capillaria</i> spp.	38	19%
Cestode	<i>Raillietina</i> spp.	10	5%

#### 4.4 Concurrency of GI parasites of Kalij

Concurrency of parasitic infection in Kalij revealed single infection i.e., 75 samples (37.5%) while multiple infection occurred in 35 samples (17.5%).



**Figure 5:** Concurrency of parasitic infection in Kalij

#### 4.5 Intensity of GI parasites

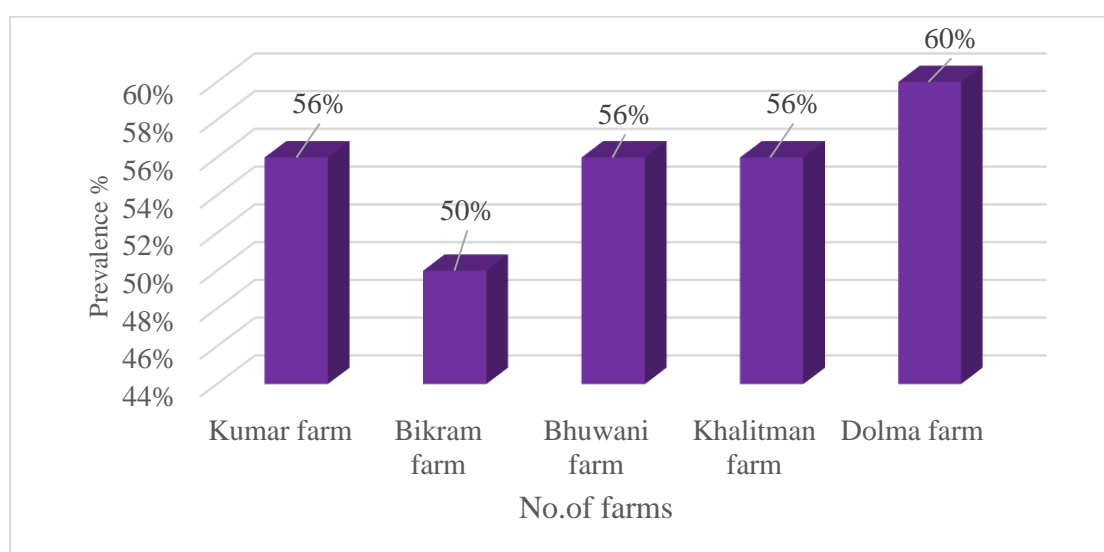
Most of the parasites of Kalij revealed with light parasitic infections. Three samples of *Eimeria* spp. showed signs of heavy infection (1.5%). Two samples of *Capillaria* spp. and seven samples of *Eimeria* spp. showed moderate infections (1%) and (3.5%) respectively. In all positive samples, mild and light infections were observed.

**Table 2:** Intensity of GI parasites of Kalij

Class	Parasites	Light (+)	Mild (++)	Moderate (+++)	Heavy (++++)
Protozoa	<i>Eimeria</i> spp.	11(5.5%)	5(2.5%)	7(3.5%)	3(1.5%)
Nematodes	<i>Heterakis</i> spp.	10(5%)	4(2%)	-	-
	<i>Ascaridia</i> spp.	17(8.5%)	5(2.5%)	-	-
	<i>Capillaria</i> spp.	30(15%)	6(3%)	2(1%)	-
Cestode	<i>Raillietina</i> spp.	7(3.5%)	3(1.5%)	-	-

#### 4.6 Farms wise prevalence

Out of 5 farms, 150 samples from three farms (Kumar's farm, Bikram's farm and Bhuwani's farm) were taken for examination while 50 samples from two farms (Khalitman's farm and Dolma's farm) were taken. The farm with highest prevalence of GI parasites were found in Kumar's farm and Bhuwani's farm i.e., 28/50(56%), followed by Bikram's farm i.e., 25/50(25%), Dolma's farm 15/25(60%) and Khalitman's farm 14/25(56%). Since, the farms were close to one another, they were compared. Statistically, the difference in prevalence of GI parasitic infection amongst farms was found to be insignificant ( $\chi^2= 8.81$ ,  $df=4$ ,  $p>0.05$ ).



**Figure 6:** Bar graph showing prevalence of GI parasites in different farms

#### 4.7 Species wise prevalence of different farms

Bikram's farm had a high prevalence rate of *Eimeria* spp. i.e., 18% compared to Dolma's farm and Bhuwani's farm, which had low prevalence rates of 8% and 10%, respectively. Similar to this, Bhuwani's farm had the lowest prevalence rate of *Heterakis* spp. while Khalitman's farm had the highest. The percentage of *Ascaridia* spp. was highest (14%) in Kumar's farm and lowest (8%) in Bikram's farm. While Bikram's farm had the lowest prevalence of *Capillaria* spp. and Bhuwani's farm had the highest. Dolma's farm and Bikram's farm had the highest rates of cestode prevalence i.e., *Raillietina* spp.

**Table 3:** Species wise prevalence of different farms

S. N	Protozoa	No. of farms				
		Farm 1(Kumar's Farm) N=50	Farm 2(Bikram's Farm) N=50	Farm 3(Bhuwani's Farm) N=50	Farm 4(Khalitman's Farm) N=25	Farm 5(Dolma's Farm) N=25
1	<i>Eimeria</i> spp. (26)	6(12%)	9(18%)	5(10%)	4(16%)	2(8%)

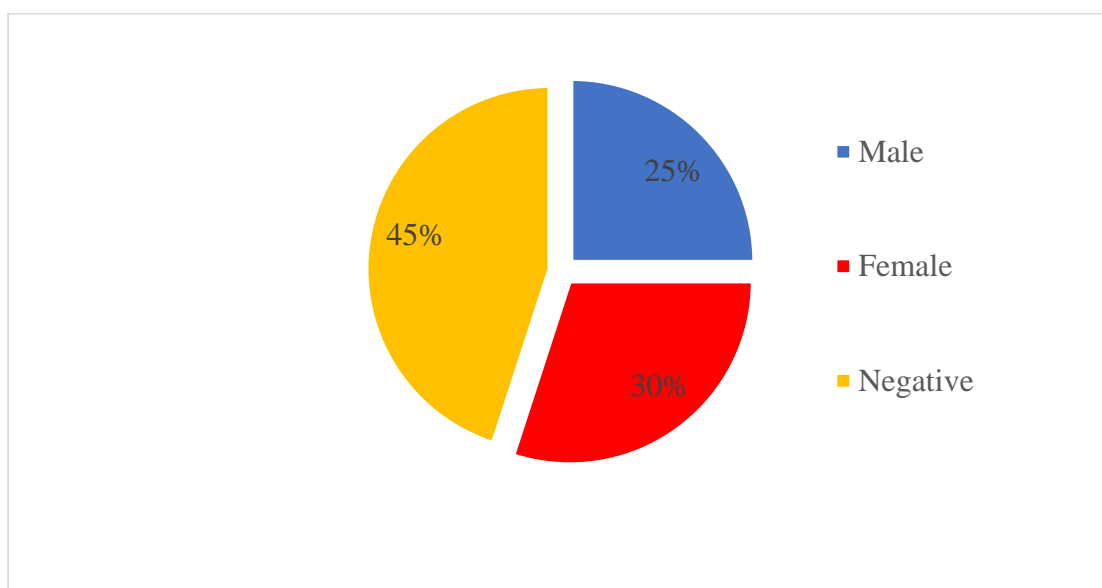
#### Nematodes

2	<i>Heterakis</i> spp. (14)	4(8%)	3(6%)	2(4%)	4(16%)	1(4%)
3	<i>Ascaridia</i> spp. (22)	7(14%)	4(8%)	6(12%)	2(8%)	3(12%)
4	<i>Capillaria</i> spp. (38)	10(20%)	5(10%)	13(26%)	3(12%)	7(28%)

#### Cestode

5	<i>Raillietina</i> spp. (10)	1(2%)	4(8%)	2(4%)	1(4%)	2(8%)
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#### 4.8 General prevalence of male and female



**Figure 7:** Pie chart showing general prevalence of male and female

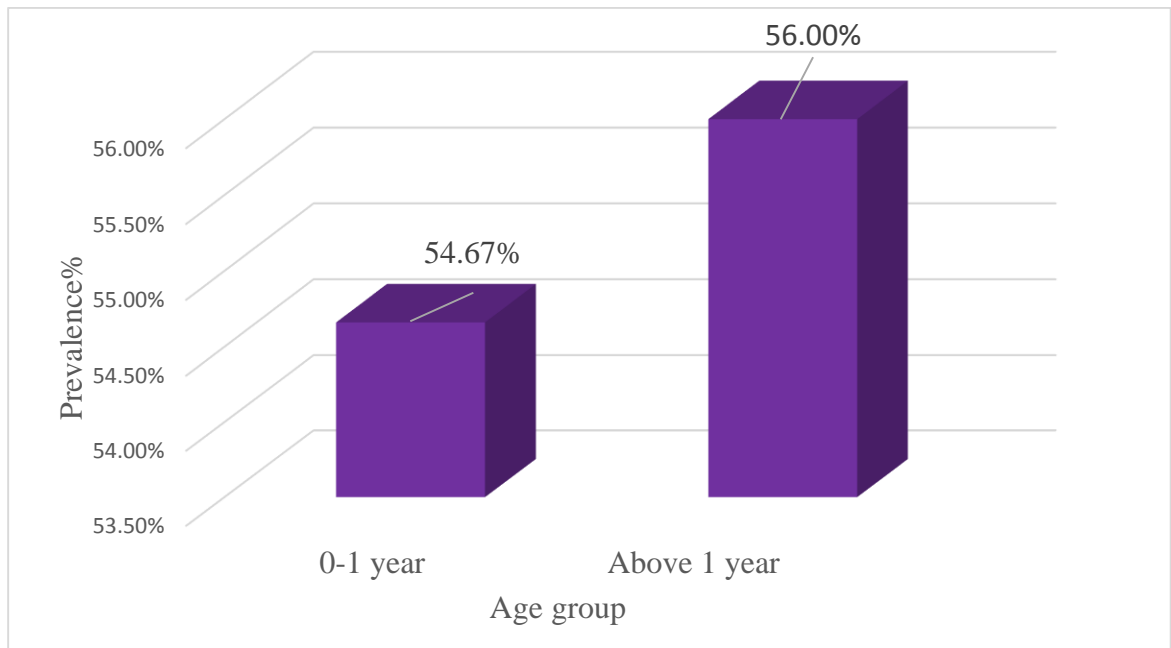
Out of 200 total samples, 80 samples were obtained from males in which 50 samples were found to be infected whereas 120 samples were taken from females in which 60 samples were found to be infected i.e., 25% from males and 30% from females respectively. Sex wise prevalence was higher in male with a prevalence rate of 62.5% whereas in female it was 50% (shown in table 4). Statistically, the distribution of parasitic infections in male and female was found to be insignificant ( $\chi^2= 0.90$ ,  $df=1$ ,  $p>0.05$ ).

**Table 4:** Sex wise infection of male and female

Gender	Total no. of samples examined	Total no. of samples infected	Prevalence rate
Male	80	50	62.5%
Female	120	60	50%

#### 4.9 Age wise prevalence

The 150 samples under 1 year from four different farms showed the highest prevalence rate of 54.67% i.e., in 82 samples as compared to samples older than 1 year, which showed a prevalence rate of 56% i.e., 28 out of 50 samples. Statistically, the distribution of parasitic infections in age group was found to be insignificant ( $\chi^2=26.50$ ,  $df=1$ ,  $p>0.05$ ).



**Figure 8:** Bar graph showing age wise prevalence

With 19.33% %, *Capillaria* spp. had the highest prevalence in the 0–1 year range, and in the 1+ year range 18%. The highest prevalence of cestode *Raillietina* spp. and nematodes *Ascaridia* spp. and *Capillaria* spp. and the highest prevalence of protozoa *Eimeria* spp. was seen in the 0–1-year group.

**Table 5:** Species wise prevalence of age

S. N	Protozoa	Age	
		0-1 year N=150	Above 1 year N=50
1.	<i>Eimeria</i> spp. (26)	20(13.33%)	6(12%)

#### Nematodes

2.	<i>Heterakis</i> spp. (14)	6(4%)	8(16%)
3.	<i>Ascaridia</i> spp. (22)	19(12.66%)	3(6%)
4.	<i>Capillaria</i> spp. (38)	29(19.33%)	9(18%)

#### Cestode

5.	<i>Raillietina</i> spp. (10)	8(5.33%)	2(4%)
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## 5. DISCUSSIONS

The non-migratory Kalij Pheasant is primarily found in South Asia. These omnivorous birds eat grains, leaves, insects, tiny snakes, bamboo seeds, and other things. The Kalij pheasant's gastrointestinal parasites have not been well studied, thus it was compared to other poultry birds. Generally, ectoparasites and endoparasites can both harm birds. The mechanical vectors including flea, rats, cockroaches, and beetles can easily spread gastrointestinal parasites from one infection source to another. *Syngamus trachea*, *Raillietina* spp., *Choanotaenia*, and *Taenia* spp., *Ascaridia* spp., *Eimeria* spp., *Heterakis* spp., *Capillaria* spp., *Coccidia* oocysts spp. are the main endoparasites reported in poultry.

The various fecal qualitative techniques, including the direct smear method and concentration techniques (flotation and sedimentation method), were also used in earlier studies (Ibrahim *et al.*, 2006; Borghare *et al.*, 2009; Santilli and Bagliacca, 2011).

The present research was done to study the GI parasites of Kalij Pheasant at five different farms of Budhanilkantha Municipality, Kathmandu. The prevalence rate of gastrointestinal parasites was found to be 55% overall in the current study, which was comparable to the prevalence rates of 54.32% in the prior study by Tauseef *et al.* (2019), 48.2% in the prior study by Godiva *et al.* (2006) and 48% in the prior study by Patel *et al.* (2000). The prevalence of common GI parasites in the current investigation was comparable to previous studies (Sukupayo 2018, Alexandra *et al.*, 2016, Adang *et al.*, 2008) for 59.6%, 53.24%, and 52.17%, respectively. In the same manner, comparable results from the current study, which revealed a prevalence rate of 19% for *Capillaria* spp. and 7% for *Heterakis* spp. were found in 102 fighting cocks (*Gallus gallus domesticus*) tested in Coro, Falcon State, Venezuela, by Cazorla *et al.* in 2013 which showed *Capillaria* spp. (16.7%) and *Heterakis* spp. (6.9%). In different climatic environments the prevalence of parasite was same. This might be due to the same feeding habits and occurrence of same intermediate host.

One protozoan and four helminth parasites were identified during this study utilizing the direct smear and concentration techniques. *Eimeria* spp. was the only solitary protozoan parasite identified in this study, similar outcomes were also attained in earlier studies by (Ibrahim *et al.*, 2006; Eslami *et al.*, 2007). According to Moussawi *et al.*

(2016), it was discovered that a turkey from Al-Nasiryah city, Iraq, had seven *Heterakis gallinarum* infections corresponding to the latest study.

The prevalence rate of protozoa in the current study was higher than that in the studies that came before it by 10.40%, 6%, and 4.1% (Prathipa *et al.*, 2013; Varadharajan A and Kandasamy, 2000; Papini *et al.*, 2012) respectively. In the current study, contacts with roving birds, a poor management system, and tainted food and water from the excrement of sick confined birds may be to blame for the high prevalence rate of *Eimeria* spp.

In a survey conducted by Asumang *et al.* (2019) in Ghana, *Capillaria* spp. (14.5%) exhibited slightly lower prevalence rates than in the current study. In their 2011 study by Radfar *et al.* on pigeons in Iran, they recorded nematodes like *Ascaridia* spp. (16.66%) and *Raillietina* spp. (18.62%), which is greater than the current study's *Ascaridia* spp. (11%) and *Raillietina* spp. (5%). According to Musa *et al.* (2012) in Dhaka, infections were found in 100% of the female ducks, but only in 60% of the male ducks. Whereas in the present study, infections were found in 50% of the female and 62.5% of the male.

*Ascaridia* spp. (41.2%) had the highest incidence in Philippines, according to Ybanez *et al.* (2018), however *Capillaria* spp. had the highest prevalence (19%) in the present study, which is rather low. The prevalence rate in the current study was lower than the prevalence rate in the previous one, which was 70.4%, and 62% in birds (Rzad *et al.*, 2015; Rufai *et al.*, 2017). This might be due to the variable sample sizes, methodologies employed, management practices, sanitary conditions, anthelmintic treatments, and sampling season.

The prevalence rates of 19% *Capillaria* spp., 11% *Ascaridia* spp., and 5% *Raillietina* spp. in the current study were comparable to those found in earlier study (Subedi *et al.*, 2014) for *Capillaria* species (16%), *Ascaridia galli* (10.4%), and *Raillietina tetragona* (4%). According to Maharjan *et al.* (2018) in Rupandehi, 65% *Ascaris* species (15%), *Raillietina* species (5%), and *Heterakis* species (5%), were the three most prevalent helminths parasites i.e., comparable to the present study, which revealed a similar prevalence rate. In contrast to Shrestha *et al.* (2020), the prevalence of the current study was rather low; 98 of these samples, or 81.67%, were parasite-positive, nematodes had the highest rate of positives since they were present at the same prevalence in the

present study. In the current study, the prevalence rates of parasites were found to be 55% lower than those in another publication on pigeons from Nepal (Gurung, 2016) which had a prevalence of (69.16%) and the results of Dhakal *et al.* (2022) in central Nepal in household and temple pigeons (*Columba livia*) showed a prevalence rate of 87.1%. It might also be as a result of nest and pen overcrowding. The presence of dumping grounds, dense forest, and people could be the cause of high prevalence than the present study.

## 6. CONCLUSION AND RECOMMENDATIONS

### 6.1 Conclusion

The main purpose of this study was to determine the prevalence of GI parasites of Kalij. The present analysis of fecal samples revealed 55% prevalence of gastrointestinal parasites in Chunikhel, Budhanilkantha Municipality. *Capillaria* spp. had greater prevalence rates (19%) than other gastrointestinal parasites whereas, *Railletina* spp. had a lower prevalence rate (5%) using direct smear method and concentration techniques. Age wise prevalence was slightly higher in above 1 year group. Infection prevalence was higher in male than in female.

Nematodes and cestode parasites were recorded but due to the absence of intermediate host and environmental condition, trematode was not found in this study. My study may be crucial in creating controls for gastrointestinal parasites in Kalij as no research has been done on this topic in Nepal.

### 6.2 Recommendations

- For the effective control of GI parasites, fecal examination should be performed.
- Anticoccidial medications, and coccidiosis vaccination programs should be implemented.
- Droppings should be cleaned up regularly and the surrounding area should be kept clean.
- Modern management techniques should be enhanced.

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## APPENDIX I (Photographs)

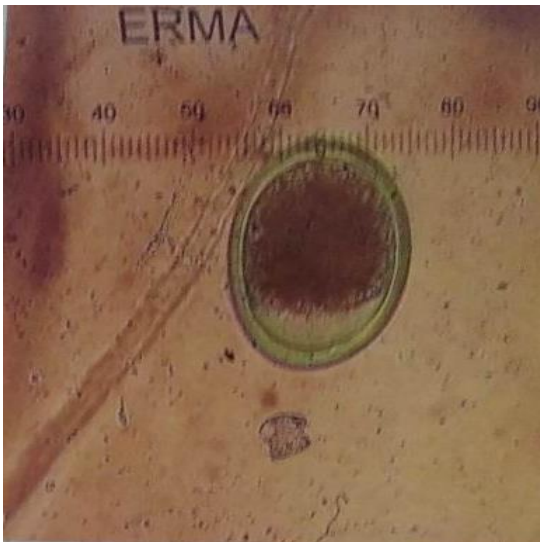
Eggs of parasites in Kalij Pheasant under 10X×40X electric microscope.



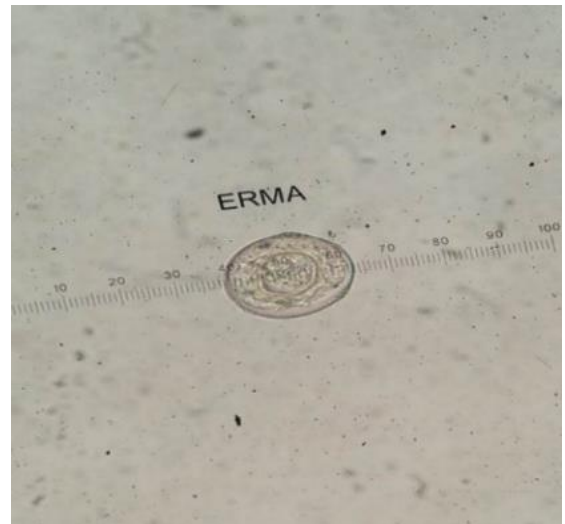
**Photo 1:** *Eimeria* spp. egg (25 × 22.5 μm)



**Photo 2:** *Capillaria* spp. egg (43.2 × 21.6 μm)



**Photo 3:** *Ascaridia* spp. egg (72 × 52.8 μm)



**Photo 4:** *Raillietina* spp. egg (48 × 48 μm)



**Photo 5:** *Heterakis* spp. egg (72 × 45.6 μm)

## APPENDIX II (Photographs)



**Photo 6:** A lady working in the farm



**Photo 7:** Kalij in their farm



**Photo 8:** Sample examination



**Photo 9:** Microscopic examination

### APPENDIX III (Questionnaire)

GI- parasites of Kalij Pheasant in Chunikhel, Budhanilkantha Municipality, Kathmandu, Nepal

Name of owner..... Address ..... Educational level.....

Age ..... Economic status..... Gender.....

1. Do you know have any knowledge about parasites?

A) Yes                      B) No

2. How many Kalij Pheasant are in this farm?

3. How many species of Kalij Pheasant are here?

4. Can you distinguish their age?

A) Yes                      B) No

5. If yes, which age of birds were more infected to parasites?

6. Can you distinguish their sex?

A) Yes                      B) No

7. What do you feed Kalij Pheasant?

8. From where feeding materials are supplied to Kalij Pheasant?

9. At what time do you provide food to them?

A) Morning      B) Day      C) Evening

10. What is the source of water given to the Kalij Pheasant?

A) Tap water    B) Well water    C) Tanker water    D) Others

11. Do you treat water for drinking?

A) Yes                      B) No

12. Are the grounds of Kalij cleaned every day? If at what time?

A) Yes                      B) No

13. Which chemical disinfectant are used to keep the grounds clean?

14. Where did the faecal waste disposal?

15. Is there proper management of drainage?

A) Yes            B) No

16. Is the health of those birds regularly monitored?

A) Yes            B) No

17. What kind of disease they suffer more frequently?

18. What is done in emergency case they get ill?

19. What are the management practices done to dead Kalij?

A) Buried            B) Post - mortem            C) Others

20. Did you provide antibiotics vaccine to Kalij?

A) Yes            B) No