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Research Article

PREVALENCE OF GASTROINTESTINAL HELMINTH PARASITES IN LIVESTOCK OF KAVREPALANCHOK

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ABSTRACT

The study was carried out in Mandandeupur Municipality, Kavrepalanchok from December 2018 to May 2019. A total of 131 fecal samples of livestock were collected and examined under a microscope by using direct smear and sedimentation technique. Overall, 65.65% of samples were found positive with various types of gastrointestinal helminth parasites. Samples were collected from cows, buffaloes, and goats. Among the samples collected, the highest prevalence (76.47%) was observed among the cows and the least was found among buffaloes (57.14%) but was found statistically insignificant ($p>0.05$). The study revealed a prevalence of nematodes (74.47%), cestodes (7.70%) and trematodes (3.10%). The prevalence of *Strongylus* sp. was found highest (35.88%) and the prevalence of *Cooperia* sp., *Hymenolepsis* sp., *Enterobius* sp. and *Fasciola* sp. were found similar (0.8%). In sex wise study, both males and females of livestock were found about equally infected. In the same way, the prevalence of gastrointestinal helminths was found about similar in both the winter and summer seasons. In age wise prevalence, the adult was more infected (68.27%) with gastrointestinal helminth parasites than the young (55.55%) which was statistically insignificant ($p>0.05$). In the present study, single infection was found highest (47.29%) and multiple infections were found least (2.29%). The samples collected from non-dewormed livestock were found highly (71%) positive for gastrointestinal helminths. The relation between deworming and prevalence was statistically significant ($p<0.05$). Only 37.25% of farmers maintain the cleanliness of the shed by removing feces from the animal shed every day and only 23.53% of farmers know about the mode of transmission of gastrointestinal helminths in livestock.

Keywords: Cestodes, host, livestock, nematodes, trematodes.

INTRODUCTION

Agriculture is the major sector of Nepalese economy which provides employment opportunities to 66% of the total population and contributes about 33% in the Gross Domestic Product (GDP). That's why; development of agricultural sector is the key for the development of national economy (MoAD, 2015). Livestock are domesticated animals raised to produce milk, meat, eggs, wool, labor, etc. Livestock farming is an important agricultural sub-sector in Nepal used for encouraging and pulling people into cultivation, and the dung of animals is used to enrich the soil fertility (SASEC-Portal, 2016). Livestock plays a significant role in the Nepalese economy contributing around 11% to the national GDP (MoLD, 2017). The demand for livestock products is predicted to double in the next 20 years due to rapid increase in the world population, urbanization, and economic growth (IFAD, 2009).

The livestock are attacked by various kinds of ecto- and endo-parasites which cause economic losses to the farmer. Gastrointestinal parasite infections of ruminant livestock are a worldwide problem for both small and large-scale farmers. Parasites are more abundant in nature, small ruminant in the tropical/subtropical regions of the world experience much greater ravages from internal parasitic diseases than those in the temperate region (Waller, 1997). Many studies show that the gastrointestinal parasite infections of ruminant livestock are mostly caused by nematodes, cestodes, and trematodes (Ntonifer *et al*., 2013). Helminths parasites cause the negative effect in breeding of farm animals; they damage the host, either directly or indirectly. Economic losses are caused by gastrointestinal parasite in a variety of ways; like lowered fertility, reduced work capacity, involuntary culling, a reduction in food intake and lower weight gains, lower milk production, higher treatment cost, and mortality in heavily parasitized animals (Lebbie *et al.,* 1994). The grazing habits also have a significant influence on the prevalence and intensity of gastrointestinal nematodes (Keyyu & Kassuku, 2005). Productivity of livestock is found to be very low in

Nepal and the major cause of it is the parasitic infestation in livestock (DLS, 2015).

Despite its economic importance, the livestock has been given the least importance and ignored by the researchers. The livestock harbor several endoparasites because of unavailability of veterinary care and ignorance of the farmers about diseases. Among different endoparasites, gastrointestinal parasites are a major problem in the livestock and these cause heavy economic losses mainly by severe weight loss, poor meat, and milk production. There is no documentation elsewhere about the prevalence of gastrointestinal parasites of livestock in this area. Thus, the present study identified the occurrence of parasites that can be useful tool for effective deworming schedule, treatment and developing control strategies.

MATERIALS AND METHODS

Study Area

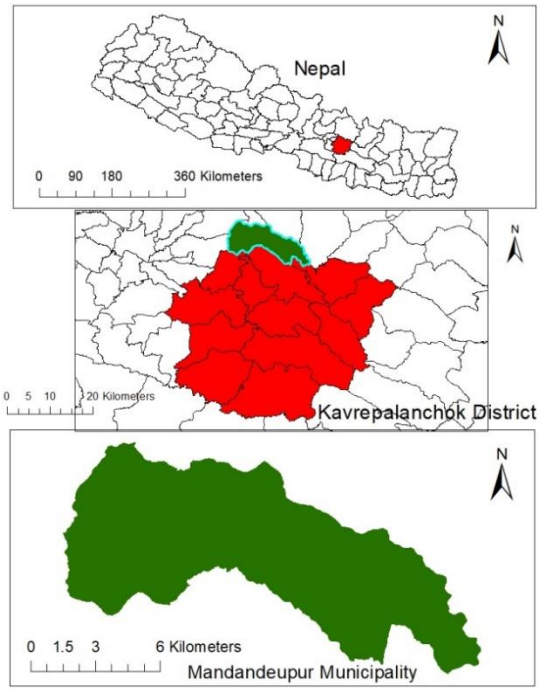

Figure 1. Map of the study area showing its location in the map of Nepal (upper), Kavrepalanchok district (middle) and Mandandeupur Municipality (lower)

The sample collection was done from December 2018 to May 2019 in Mandandeupur Municipality (MDM), Kavrepalanchok. Kavrepalanchok district is one of the parts of Bagmati Provinces of Nepal (Fig. 1). It covers an area of 1,396 km^{2}and total number of households is 80,720 with a population of 381,937. It lies on the elevation of 27°37'N 85°33'E (CBS, 2014). Many people of Mandandeupur Municipality are engaged in farming and rearing cattle like goats, cows, buffaloes, sheep, and pigs. More than 80% of this municipality is engaged in the agriculture sector (MDM, 2018). So, agriculture and animal husbandry are the major source of livelihood of people of this municipality.

Fecal samples collection

Fecal samples were collected from December 2018 to May 2019. Samples were collected from the land in and around the shed just after defecation in December-January in winter season and April-May in summer season simply by hands by wearing gloves. A total of 131 fecal samples (17 from cow, 35 from buffaloes and 79 from goats) were collected from the study. Each sample was taken in small glass containers with lid and labeled with date, age, sex and date of anthelminthic treatment were recorded. About 10% of $KMnO_4$ or 2-3% of formalin was added into the container for the preservation if immediate examination was not done.

Sample examination and identification of gastrointestinal helminths parasites

After collection, the samples were carried to the Central Veterinary Laboratory, Tripureshwor and microscopic examination was done for the detection and identification of eggs of gastrointestinal helminth parasites by using direct smear (Parija *et al.*, 2003) and sedimentation method (MAAF, 1986). All helminths were identified to the level of genus or above by morphological characteristics following Foreyt (2001) and Baker (2007). The results was considered as positive when at least one parasite egg is present (Lorenzini *et al.*, 2007). Parasite stages recovered was identified by using standard morphological criteria (Soulsby, 1968). Infections with more than one species of helminth parasite (poly-parasitism) were referred to as mixed infection.

Direct smear method

In direct smear method, the sample was dissolved in normal saline and a drop of solution was taken on the slide with the help of dropper then was examined under microscope.

Sedimentation method

In the sedimentation method, the sample was crushed with the help of mortar and pestle. The crushed sample was dissolved in normal saline solution. Then the sample was filtered with the help of tea filter in the beaker. Then 1 ml of filtered sample and 14 ml of NaCl solution in a centrifuging tube of 15 mal land centrifuged at 1000 rpm for 5 minutes. The tube was taken out and the solution was left undisturbed for

about 15 minutes. After 15 minutes supernatant was carefully removed with the help of a pipette without disturbing the sediment. After that, the deposited material was taken out with the help of pipette and placed on the slide with Lugol's solution and was examined under microscope.

Questionnaire survey

Different structured questionnaires were prepared, pretested, and validated. Brief information about the research work was provided to the farmers and then questionnaires were administered to the senior farmer of the study area from each house. The questionnaires were done to find out the knowledge attitude practices (KAP) in relation to the parasitic infections of farmers. It was also used to find out the condition and time of deworming of their live stocks.

Analysis of results

Results obtained from microscopic examinations and questionnaires were entered in the MS Excel 2010. Pearson's Chi-square test was done to determine the association of the explanatory variables with the prevalence of parasites by using R-studio version 3.6.3.

RESULTS

Prevalence of gastrointestinal helminths parasites

A total of 131 fecal samples (17 from cow, 35 from buffaloes and 79 from goats) were collected from the study area and examined. Among them, 65.65% (86/131) samples were found positive with various types of gastrointestinal helminths parasites (Fig. 2).

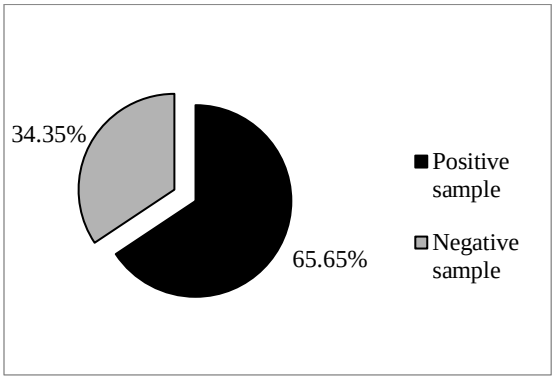

Figure 2. Prevalence of gastrointestinal helminths parasites in livestock

Prevalence of gastrointestinal helminths parasites in different groups of livestock

Among 131 samples collected, 17, 35 and 79 were from cows, buffaloes, and goats respectively. The samples collected from cows were found highly positive (76.47%) for the gastrointestinal helminth parasites (Fig. 3) which was found statistically insignificant (P>0.05).

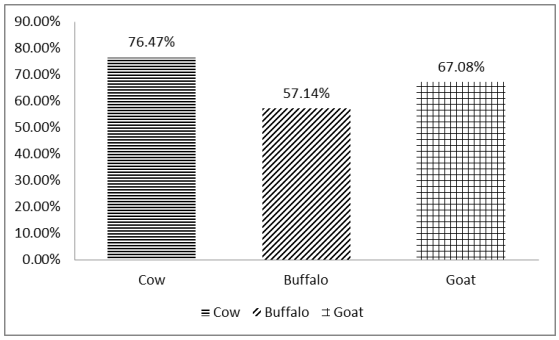

Figure 3. Prevalence of gastrointestinal helminths parasites in different groups of livestock

Prevalence of specific gastrointestinal helminths parasites

Altogether 13 genera of gastrointestinal helminths parasites were found. Among them Nematoda infection was highest (74.25%), followed by Cestoda (7.7%) and Trematoda (3.1%). The highest prevalence rate of *Strongylus* sp. was found i.e., 35.88% followed by *Trichuris* sp. (12.98%) and lowest infection were of *Cooperia* sp., *Hymenolepsis* sp., *Enterobius* sp. and *Fasciola* sp. i.e 0.8% (Table 1).

Table 1. Prevalence of specific gastrointestinal helminths parasites

S.N.	Class	Genera of helminths	Prevalence (n=131) No. (%)
1.	Trematoda	*Fasciola* sp.	1(0.8%)
		Paramphistomum sp.	3(2.3%)
2.	Cestoda	*Taenia* sp.	9(6.9%)
		Hymenolepsis sp.	1(0.8%)
3.	Nematoda	*Strongylus* sp.	47(35.88%)
		Toxocara sp.	13(9.92%)
		Ascaris sp.	6(4.58%)
		Ancylostoma sp.	4(3.1%)
		Cooperia sp.	1(0.8%)
		Trichostrongylus sp.	4(3.1%)
		Enterobius sp.	1(0.8%)
		Capillaria sp.	4(3.1%)
		Trichuris sp.	17(12.98%)

Prevalence of specific gastrointestinal helminth parasites in different groups of livestock

Among 13 different genera of parasites, *Strongylus* sp. (58.82%), *Toxocara* sp. (29.41%), *Taenia* sp. (11.76%) *Capillaria* sp. (11.76%) and *Trichostrongylus* sp. (5.88%) were found highest in cows. *Ascaris* sp. (11.43%) was found highest in buffaloes, but *Trichuris* sp. (17.72%) was found highest in goats. The infection of *Fasciola* sp. and *Enterobius* sp. were only recorded from buffaloes. In the same way, the infection of *Hymenolepis*

sp., *Ancylostoma* sp. and *Cooperia* sp. were only recorded from goats (Table 2).

Table 2. Prevalence of specific gastrointestinal helminths parasites in different group livestock

S.N	Genera of helminths	Different groups of livestock with prevalence percentage in		
		Cows (n=17) No. (%)	Buffaloes (n=35) No. (%)	Goats (n=79) No. (%)
1.	*Fasciola* sp.	-	1(2.85%)	-
2.	*Paramphistomum* sp.	1(5.88%)	1(2.85%)	1(1.26%)
3.	*Taenia* sp.	2(11.76%)	4(11.43%)	3(3.79%)
4.	*Hymenolepis* sp.	-	-	1(1.26%)
5.	*Strongylus* sp.	10(58.82%)	6(17.1%)	31(39.24%)
6.	*Toxocara* sp.	5(29.41%)	2(5.71%)	6(7.59%)
7.	*Ascaris* sp.	-	4(11.43%)	2(2.53%)
8.	*Ancylostoma* sp.	-	-	4(5.06%)
9.	*Cooperia* sp.	-	-	1(1.26%)
10.	*Trichostrongylus* sp.	1(5.88%)	-	3(3.79%)
11.	*Enterobius* sp.	-	1(2.85%)	-
12.	*Capillaria* sp.	2(11.76%)	1(2.85%)	1(1.26%)
13.	*Trichuris* sp.	-	3(8.57%)	14(17.72%)

Seasonal prevalence of gastro-intestinal helminths parasites

A total of 63 fecal samples were collected in winter season and 68 samples were collected in summer season from study area and examined. The livestock were found about equally infected in both the seasons (Fig. 4).

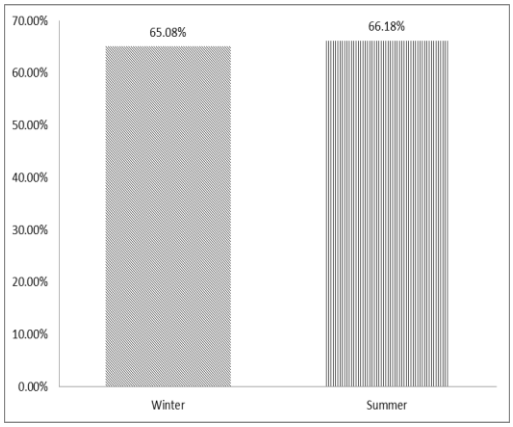

Figure 4. Seasonal prevalence of gastrointestinal helminths parasites

Sex wise prevalence of gastrointestinal helminths parasites

Among 131 of collected samples, 28 were from male and 103 were from female livestock. In the present study both males and females of livestock were found about equally infected by gastrointestinal helminths parasites (Fig. 5).

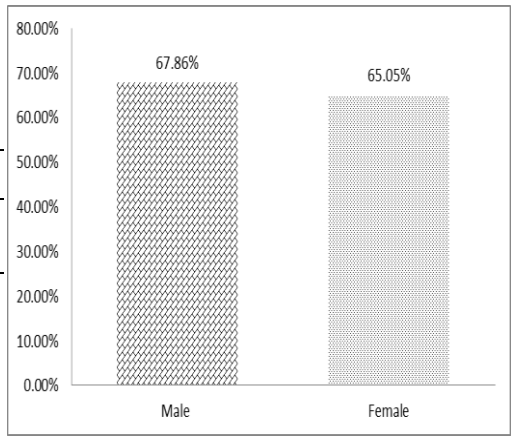

Figure 5. Sex wise prevalence of gastrointestinal helminths parasites

Prevalence of gastrointestinal helminths parasites among dewormed and non-dewormed livestock within six months

During the study, fecal samples from 131 livestock were collected, among them 31 livestock were found dewormed within six months and 100 were not dewormed within six months. The samples collected from non-dewormed livestock were found highly positive for the gastrointestinal helminth parasites (Fig. 6). The deworming within six months and prevalence of gastrointestinal helminths parasites were found statistically significant ($P<0.05$).

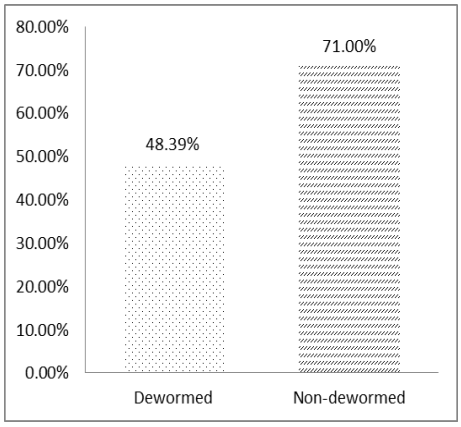

Figure 6. Prevalence of gastrointestinal helminths parasites among dewormed and non-dewormed livestock

Concurrency of gastrointestinal helminths parasites in different groups of livestock

Single infection was found highest (48.09%) and multiple infections were least (2.29%) in the studied population of livestock, same results were found for buffaloes and goats but in cows double infection was found higher (Table 3).

Table 3. Concurrency of gastrointestinal helminths parasites in different groups of livestock

S.N	Cattle	Single infection	Double infection	Multiple infection
1.	Cows (n=17)	5(29.41%)	8(47.06%)	-
2.	Buffaloes (n=35)	17(48.57%)	3(8.57%)	-
3.	Goats (n=79)	41(51.89%)	9(11.39%)	3(3.79%)
Total (n=131)		63(48.09%)	20(15.27%)	3(2.29%)

Age wise prevalence of gastrointestinal helminths parasites

The livestock were divided into young and adult on the basis of age. The animals below one year were considered young and above one year were considered adults. The prevalence of gastrointestinal helminths parasites was found higher (68.27%) in the adult (Table 4) but the relationship between the age of livestock and prevalence of gastrointestinal helminths parasites were found insignificant ($p>0.05$).

Table 4. Age wise prevalence of gastrointestinal helminth parasites

S.N.	Age	Prevalence No. (%)
1.	Young (n=27)	15 (55.55%)
5	Adult (n=104)	71(68.27%)

Knowledge of owner (farmer) and cleanliness of shed

Altogether 51 farmers (livestock owners) were interviewed during research. Among them only 23.53% (12/51) farmers know about the mode of transmission of gastrointestinal helminths parasites in livestock and 76.47% farmers were found unaware about the mode of transmission of gastrointestinal helminths parasites. In the same way, the majority (62.75%) of livestock owners did not remove feces from shed every day. Only 37.25% (19/51) of livestock owners remove feces from animal sheds every day to keep the shed clean.

DISCUSSION

The present study was carried out to determine the prevalence of gastrointestinal helminth parasites of livestock. In the present study, the overall prevalence of gastrointestinal helminth parasites was found to be 65.65%. This result was similar to research worked by Ntonifor *et al.* (2013) in ruminants in Jakiri, Bui division, Northwest region of Cameroon (66.9%), 63.4% prevalence in Tangail, Bangladesh by Rahman *et al.,* (2017). However, it was lower than the research conducted by Owhoeli *et al.* (2014) and Tung *et al.* (2012). The variation in the findings with the previous reports might be due to the difference in number of fecal samples examined, geo-climatic conditions such as temperature, humidity etc.

The highest prevalence of gastrointestinal helminths was recorded in cows (76.47%) followed by goat (67.08%) and buffaloes (57.14%) in the study. But Raza *et al.* (2007) showed 52% infection in goats, and 47% infections in buffaloes. The higher prevalence in buffaloes and goats may be due to differences in feeding habits and habitats of each species.

Two genera of Trematode (*Fasciola* sp. and *Paramphistomum* sp.), two genera of Cestoda (*Taenia* sp. and *Hymenolepsis* sp.) and nine genera of Nematoda (*Strongylus* sp., *Toxocara* sp., *Ascaris* sp., *Ancylostoma* sp., *Cooperia* sp., *Trichostrongylus* sp., *Enterobius* sp., *Capillaria* sp. and *Trichuris* sp.) were observed in the present study. The result of the current study indicated prevalence of 13 different genera of gastrointestinal helminths. They were *Strongylus* (35.88%), *Trichuris* (12.98%), *Toxocara* (9.92%), *Taenia* (6.9%), *Ascaris* (4.58%), *Ancylostoma* (3.1%), *Trichostrongylus* (3.1%), *Capillaria* (3.1%), *Paramphistomum* (2.3%), *Cooperia* (0.8%), *Enterobius* (0.8%), *Fasciola* (0.8%) and *Hymenolepsis* (0.8%). In the result, the prevalence rate of *Strongylus* sp. was higher than other genera in all livestock. The highest prevalence rate of *Strongyles* sp. was also reported by Laha *et al.* (2013) and Hamid *et al.* (2016). The prevalence of *Strongylus* sp. in cow and buffaloes was 37.96% in the present study which is similar to 35.41% of Udaipur district, India (Swarnakar *et al.,* 2015). The present study showed a higher prevalence of nematodes (74.25%). It was supported by Bedasa *et al.* (2016) and Huang and Lai (2014).

The rate of infection of gastrointestinal helminths parasites was found higher in male (67.86%) than females (65.05%).This finding was in agreements with the Marskole *et al.* (2016) who reported 83.33% in male and 70.83% in females, Olanike *et al.* (2015) reported 40.85% in male while 35% in female of goats in Ibadan, Southwest, Nigeria. The higher percentage of infection in male cannot be explained but it might be due to neglected attitude of farmers towards the management of male animals.

The present study showed a greater prevalence of gastrointestinal helminths in dry season (66.18%) than the winter season (65.08%). Among 131 fecal samples collected in the study period, a maximum, i.e., 100 were from non-dewormed livestock and the remaining 31 samples were from dewormed livestock within six months. We found the non-dewormed livestock were in the more threat to gastrointestinal helminths i.e., 71% v/s 48.39%. In the livestock of present study area single infection of gastrointestinal helminths was found more common (48.09%). The result was supported by Marskole *et al.* (2016) who found 45.84% of single infection in livestock.

CONCLUSIONS

This is the first coprological, microscopy-based study in the Mandandeupur Municipality of Kavrepalanchok district. We found most of the livestock were infected with at least one gastrointestinal helminths parasite. The season and sex of livestock were not significant for the prevalence of gastrointestinal helminths parasite but periodic deworming (specially within the period of six months), prompt removal of feces from animal shed, and improving owner's education on gastrointestinal helminths transmission, play great role to limit the risk of livestock infections by helminths parasite. So, the Strategic parasitic control programs should be designed, farmers should be given awareness by developing programme and sanitary measures should be strictly employed to minimize the gastrointestinal helminths parasite.

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AUTHOR CONTRIBUTIONS

ST designed the research, collected data, performed laboratory work, analyzed the data, and wrote the paper. PRS designed the research, collected data, performed laboratory work, supervised the research work. Both authors reviewed and approved the final manuscript for publication.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

REFERENCES

Amarante, A.D. (2011). Why is it important to correctly identified *Haemonchus* species? *Revista Brasileria de Parasitologia Veterinaria*, **20**(4):263-268.

Bedasa, C., Getachow, M., Duguma, A., & Abera, S. (2016). Status of helminths parasites of cattles in dairy farms of Holleta Agricultural Research Center, Central Ethiopia. *Journal of Veterinary Science and Technology*, *7*(5):1-5.

CBS. (2014). Nepal Population and Housing Census. Central Bureau of Statistics, Kathmandu, Nepal.

CBS. (2015). Local unit population and household data of Kavrepalanchok. Central Bureau of Statistics, Kathmandu, Nepal.

Elashmawy, W., & Abdelrahman, M.A.M. (2013). *Toxocara vitulorum* in faeces, serum and milk of buffaloes in Giza governorate. *International Journal of Livestock Research*, *3*(2): 89-99.

Guo, Z., Gonzalez, J.F., Hernandez, J.N., McNeilly, T.N., Corripio-Miyar, Y., Frew, D., Morrison, T., Yu, P., & Li, R.W. (2016). Possible mechanisms to host resistance to *Haemonchus contortus* infection in sheep breeds native to the Canary Islands. *Scientific Reports*, 6, 26200.

Hamid, P.H., Kristianingrum, Y.P., Prastowo, J., & Ribeiro da Silva, L.M. (2016). Gastrointestinal parasites of cattle in Central Java. *American Journal of Animal and Veterinary Sciences*, *11*(3), 119-124.

Huang, C.C., & Lai, C.H. (2014). Investigation of gastrointestinal parasites of dairy cattle around Taiwan. *Journal of Microbiology Immunology*, *47*(1), 70-74.

IFAD. (2009). Livestock thematic papers, Rome, Italy. International Fund for Agriculture Development. http://www.fao.org/fileadmin/templates/agpho me/image/iclsd/documents/wk3_c5_rota.pdf. Accessed on 13 May 2019.

Keyyu, J.D., & Kassuku, A.A. (2005). Epidemiology of gastrointestinal nematodes in the cattle on traditional, small-scale dairy and large dairy farms in Iringa districts, Tanzania. *Veterinary Parasitology*, *127*(3-4): 285-294.

Laha, R., Das, M., & Goswami, A. (2013). Gastrointestinal parasitic infections in organized cattle farms of Meghalaya. *Veterinary World*, *6*(2), 109-112.

Lebbie, S.H.B., Rey, B., & Irungu, E.K. (Eds.) (1994). Small ruminants research and development in Africa. Proceeding of the Second Biennial Conference of the African Small Ruminant Research Network, ILCA: 1-5.

LLA. (2017). Local Level Authorities (Metropolitan, Sub-Metropolitan, Municipality, Rural Municipality). Retrieved June 5, 2019 from

http://www.rapnepal.com/sites/default/files/report-publication/local_govt_of_75_districts23mar2017.

Lorenzini, G., Tasca, T., & De Carli, G.A. (2007). Prevalence of intestinal parasites in dogs and cats under veterinary care in Porto Alegre, Rio Grande do Sul, Brazil. *Brazilian Journal of Veterinary Research and Animal Science, 44*(2), 137-145.

Mahato, S.N., Harrison, L.J.S., & Hammond, J.A. (2000). Overview of fascioliasis-an economically important disease of livestock in Nepal. Strategies for feed management in areas endemic for fascioliasis: *Fasciolosis 2000 - Nepal*, 13-17.

Marcin, J. (2016). Parasitic infections. Retrieved May 25, 2019 from http://www.healthline.com/health/parasitic-infections. Accessed on 25 May 2019.

Marskole, P., Verma, Y., Dixit, A.K., & Swamy, M. (2016). Prevalence and burden of gastrointestinal parasites in cattle and buffaloes in Jabalpur, India. *Veterinary World*, *9*(11), 1214-1217.

MDM. (2018). Municipality profile. Mandan Deupur Municipality, Kavrepalanchok, Provinces 3.

MOAD. (2015). Statistical information on Nepalese Agriculture. Ministry of Agriculture Development Monitoring, Evaluation and Statistics Division Agri Statistics Section, Singadurbar, Kathmandu, Nepal.

MOLD. (2017). Livestock statistics of Nepal. Ministry of Livestock Development, Planning, Monitoring and Evaluation Division. Singadurbar, Kathmandu Nepal.

Mukhia, G. (2007). *A study on intestinal helminth parasites of buffaloes brought to Satungal (Kathmandu) for slaughter purpose*. M.Sc. thesis, Central Department of Zoology, Tribhuvan University, Nepal

Nordquist, C. (2018). What's to know about parasites? Medical News Today. http://www.medicalnewstoday.com/articles/220302.php. Accessed on 15 February 2019.

Ntonifor, H.N., Shei, S.J., Ndaleh, N.W., & Mbunkur, G.N. (2013). Epidemiological studies of gastrointestinal parasitic infections in ruminants in Jakiri, Bui Division, North West Region of Cameroon. *Journal of Veterinary Medicine and Animal Health*, *5*(12), 344-352.

Olanike, A.O., Olayide, A.J., Oludunsin, F.O., Racheal, A.O., & Japhet, D.W. (2015). Prevalence of gastrointestinal parasites of goats in Ibadan, Southwest, Nigeria. *World Journal of Agricultural Research*, *3*(2), 49-51.

Owhoeli, O., Elele, K., & Gboeloh, L.B. (2014). Prevalence of gastrointestinal helminths in exotic and indigenous goats slaughtered in selected Abattoirs in Port Harcourt, South-South, Nigeria. *Chinese Journal of Biology*, 435913, https://doi.org/10.1155/2014/435913.

Pfukenyi, D.M., & Mukaratirwa, S. (2013). A review of the epidemiology and control of gastrointestinal nematode infections in cattle in Zimbabwe. *Onderstepoort Journal of Veterinary Research*, *80*(1), 1-12.

Prokopic, J. (1987). Parasites of domestic animals and their lifecycles in ecosystems influenced by man. Agricultural Development and Environmental Research: American and Czechoslovak.

Rahman, M.A., Labony, S.S., Dey, A.R., & Alam, M.Z. (2017). An epidemiological investigation of gastrointestinal parasites of small ruminants in Tangail, Bangladesh. *Journal of Bangladesh Agriculture University*, *15(*2), 255-259.

Raza, M.A., Iqbal, Z., Jabbar, A., & Yaseen M. (2007). Point prevalence of gastrointestinal helminthiasis in ruminants in Southern Punjab, Pakistan. *Journal of Helminthology*, *81*, 323-328.

SASEC Portal. (2016). How to grow, harvest food cash crop, livestock farming. South Asian Sub-Regional Economic Cooperation. Retrieved December 12, 2018 from http://www.saserctn.edu.np.

Soulsby, E.J.L. (1968). *Helminths, arthropods and protozoa of domesticated animals*. Baillière Tindall & Cassell Ltd.

Swarnakar, G., Bhardawaj, B., Sanger, B., & Roat, K. (2015). Prevalence of gastrointestinal parasites in cow and buffalo of Udaipur district, India. *International Journal of Current Microbiology and Applied Sciences*, *4*(6), 897-902.

Tembely, S., & Baker, R.L. (1997). The epidemiology of nematode infections in sheep in a cool tropical environment. *Veterinary Parasitology*, *70*(1-3), 129-141.

Tung, K.C., Huang, C.C., Pan, C.H., Yang, C.H., & Lai, C.H. (2012). Prevalence of gastrointestinal parasites in yellow cattle between Taiwan and its off shores Island. *Thai Journal of Veterinary Medicine*, *42*(2), 219-224.

Waller, P.J. (1997). Nematode parasite control of livestock in the tropics/subtropics: the need for novel approaches. *International Journal for Parasitology*, *27*(10), 1193-1201.