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Nonigopal Shit
Regional Research Station, Terai Zone, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

Dilip Kumar Hajra
Department of Agronomy, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

Mrityunjay Mandal
Directorate of Animal Husbandry and Veterinary Services, ARD Deptt., Govt. of West Bengal, India

Rupsanatan Mandal
Regional Research Station, Terai Zone, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

Suprakash Pal
Regional Research Station, Terai Zone, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

Ashutosh Sarkar
Regional Research Station, Terai Zone, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

Correspondence
Nonigopal Shit
Regional Research Station, Terai Zone, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

Epidemiological studies for strategic control of gastrointestinal helminths in cattle population under Sub-Himalayan Terai Zone of West Bengal

Nonigopal Shit, Dilip Kumar Hajra, Mrityunjay Mandal, Rupsanatan Mandal, Suprakash Pal and Ashutosh Sarkar

Abstract
The present study was aimed to understand the epidemiological prevalence of the gastrointestinal parasitism in cattle population. A total 1620 faecal samples were collected from three eco-regions under different seasonal conditions. Faecalysis was performed following standard protocol. GI helminths, nematode (*Toxocara*, *Strongyloides*, Strongyle and *Trichuris*), cestode (*Moniezia*) and trematode (Paramphistomes and *Fasciola*) were examined based on morphology of eggs. The overall prevalence was recorded upto 60.68% when Paramphistomes and Strongyle represented the highest and lowest degree of infection. The location specific study confirmed the highest magnitude of nematode, cestode and trematode infection at AlipurduarII, Falakata and Mathabhanga respectively. Compared to others, the rainy season was most congenial to GI parasitism. Young animals (6-24months) were severely affected with highest cestode infection (3.14%) among different age groups. This study affirms host, parasite and environment relation which would be helpful in strategic control programme for better livestock production in the sub-Himalayan Terai Zone.

Keywords: Epidemiology, prevalence, GI parasitism, seasons, Terai Zone

1. Introduction
India's livestock sector is one of the largest in the world and assumed to be distributed more equitable compared to that of land. This sector has not only been catering nutritional security also playing crucial role in generating gainful employment among the landless, small and marginal farmers. Similar to environmental and other life risk cues, parasitism not only affects animal health also influences negative impact on the productive and reproductive performance, loss in body weight, digestive disturbances and emaciation for longer period [17, 18]. Moreover, along with the reduction in milk yield (1.2-2.5kg/cow/day), GI parasites exert severe effect on carcass quality, calving rate and heavy calf mortality [5, 11]. The multi-factorial stress, poor nutritional management and concurrent diseases may be associated with the release of hypo biotic larvae from the dormant state leading to the clinical helminthosis [1]. Accordingly, the rural livelihood of the Sub-Himalayan Terai Zone of West Bengal comprising of three main district (i.e. Cooch Behar, Alipurduar and Jalpaiguri) along with the part of Darjeeling districts (Siliguri) constitutes about 13.40% of the total state cattle population with a density of 730 per km^2 [4]. Statistically more than 9.15% breedable cross breed population over this zone substantiate a promising dairy entrepreneurship development for better livelihood. Despite the natural vegetation and wide-reached bio-diversity, the geological condition together with the low-lying areas, poor husbandry practices and chronic shortage of nutrients predispose to rapid multiplication and dissemination of parasites. So, parasitism, similar to environmental and other life risk cues, is now a challenge for this zone to demand sustainable livestock production and rural livelihood security. Evidently, the occurrence of flooding and rain-fed water bodies are the habitats for propagation of the snail, the intermediate hosts for trematodes, resulting causes higher rate of prevalence of Paramphistomes and *Fasciolla* spp. in the existing cattle population [21]. The common GI helminthes reduces protein and energy retention and disturb the essential mineral and water balance [7] resulting to low production, high cost of prevention and treatment and death of infected animals [22]. However, the prevalence of GI helminthes, the genera of helminth parasites involved, species and the severity of infection also vary considerably depending on local environmental conditions such as humidity,

temperature, rainfall, vegetation and management practices [24]. Further, the traditional husbandry practices including nomadic or pastoral mixed farming system, gradual shifting of the profession to the un-skilled professionals and indiscriminate uses of anthelmintics may lead not only the resistance also scroll down the production potential of the animals through parasitaemia.

In view of the above cues, the present study was undertaken to investigate the incidence of the GI helminths in the existing cattle and their seasonal distribution in this study zone for strategic prevention and control.

2. Materials and Methods

2.1 Ethical approval

The protocols involving the care and use of animals for these experiments were in accordance with the guideline of the revised framework of animals (Scientific Procedures) Act of 2002 of Government of India on Animal welfare. A non-invasive faecal collection was performed. Therefore, handling was minimal based on the guide for the care and use of agricultural animals in research [8].

2.2 Description of the study area

The Sub-Himalayan Terai Zone is the foot hills of the Eastern Himalaya and known as the chicken neck connecting the North-East states to the Indian sub-continent by road. This zone bears an international importance as virtually linked with Bangladesh (South) and being constituted with the districts of northern part of Cooch Behar, Alipurduar, Jalpaiguri and the plains of Darjeeling (Siliguri sub-division) lies between 22° 38' and 23° 38' north latitude and between 86° 36' and 87° 46' east longitude (GPS coordinates).

Considering the agro-climatic condition and cattle population, the study area was sketched into three geographical eco-regions i.e. Plain area (Cooch Behar I, Dinhata and Falakata), Riverine area (Mathabhanga, Dhupguri and Tufanganj) and Forest fringed area (Cooch Behar II, Alipurduar I and Alipurduar II). The weather forecast during different season were recorded (Table 1) and correlated with the percent prevalence of the GI helminths.

2.3 Study design

This diversified study area was outlined into three distinct geographical region i.e. Plain, Riverine and forest fringed for better understanding on the occurrence and diversity of the GI helminths. A preliminary survey on questionnaires was carried out prior to sample collection to sensitize interested farmers on the objectives of the study. Based on the basic information on the age/sex/breed of the animal, farm management practices and health conditions of the animals, the study was designed to realize the prevalence of the GI helminths in the existing cattle population.

2.4 Study subjects

This experiment was carried out in between February 2016 to January 2017. The prevalence of GI helminthes was studied into three main seasons *i.e.* Summer (February-May, 2016), Rainy (June-September, 2016) and Winter (October, 2016-January, 2017). A total of 1620 cattle (540/season) consisting of 1171 females (357/season) and 549 males (183/season) irrespective of age, breed and body condition were examined from nine different locations. The ages of the animals were determined by the response from animal owners against the questionnaires, prepared for the programme. The animals were classified into three groups calf (0-6 months), Young (6-24 months) and Adult (24 and above).

2.5 Sampling and faecaylysis

The minimum sample size (540/season) required for this study was determined from the formula devised by [26]. Faecal samples (5g approx.) were collected per-rectal in the plastic zipper pouch from different study locations. Samples were labeled accordingly and stored in ice chilled container to slow down the process of eggs development during transportation to the working laboratory (Animal science, Uttar Banga Krishi Viswavidyalaya). Immediately after naked eye scrutiny for different worms, samples were processed and examined for parasitic eggs and oocysts following direct smear, sedimentation and flotation methods as per standard techniques [13]. Samples, not processed on the same day, were preserved in 10% formaline for the subsequent examination in the next day. The positive cases were diagnosed based on the characteristic morphological features of the eggs of helminth parasites and cyst of protozoal parasites using low and high-power illuminations [23]. The results of faecal sample examination were then recorded according to age, season and sex of the animals.

2.6 Data management and analysis

Data generated during the course of study were organized and cleaned using Microsoft Excel 2007 (Microsoft Corporation, USA). The percent prevalence was computed based on d/n where d is the number of animals infected and n represents the total number of animals examined. The occurrence was determined using one-way analysis of variance, ANOVA (statistical software package) and means compared using Duncan's multiple range test [10].

3. Results and Discussion

The Terai is a belt of marshy grasslands, evergreen and deciduous forests at the base of the Himalaya range stretching southwards to about 38 km with a gentle slope from north to south. This region is turned into a general height of the land between 80 to 100m (Figure 1) with wide range of climatic variation round the year (Table 1).

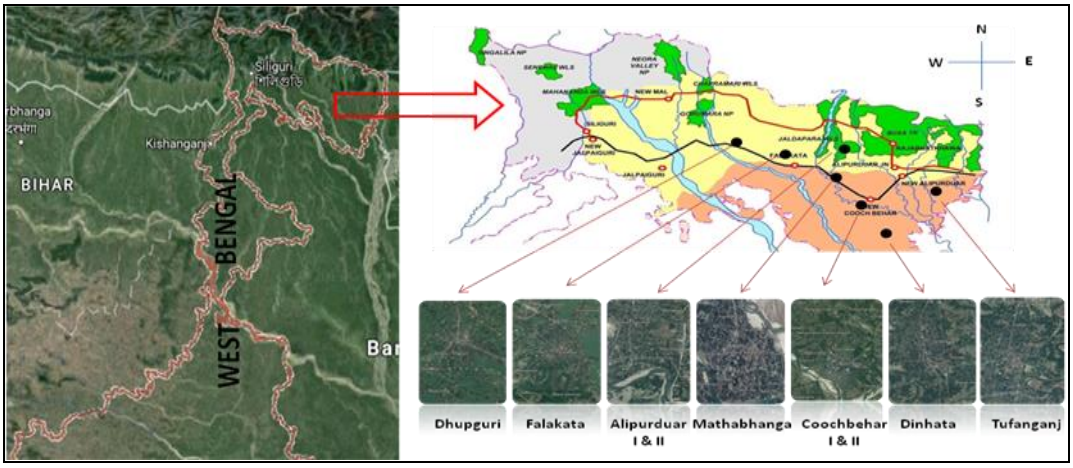


Fig 1: The GIS satellite map showing the geographical location of sub-Himalayan Terai Zone of West Bengal and the site for sample collection of this study

However, based on the agro-climatic sphere, the production and management of the livestock varies from free range to intensive rearing system which needs a comprehensive knowledge of epidemiology of the GI helminths for better farm management practices.

Table 1: Weather condition during the study period from February, 2016 to January, 2017 in the sub-Himalayan Terai Zone, West Bengal.

Seasons	Temperature		Humidity		Rainfall (mm)
	Max (ºC)	Min (ºC)	Max (%)	Min (%)	
Pre-kharif	30.32	18.33	78.84	69.21	03.57
Kharif	32.64	24.79	89.80	82.39	21.69
Rabi	29.03	15.03	80.63	76.65	01.23

Source: GKMS, UBKV unit

3.1 Overall prevalence of the GI helminths

Out of the total 1620 samples examined by direct smear followed by sedimentation and floatation methods, 983 were found positive with one or more parasitic ova or cyst, giving an overall prevalence of 60.68% (Figure 2). In the qualitative faecalysis, the helminth eggs were screened and based on their morphological features categorized into Nematoda (*Toxocara*, *Strongyloides*, Strongyle and *Trichuris*), Cestoda (*Moniezia*) and Trematoda (Paramphistomes and *Fasciola*). In the studied population, Paramphistomes and Strongyle were recorded the highest and lowest degree of prevalence (27.37% and 1.46%) respectively. The prevalence and distribution of GI parasites are largely governed by a combination of their ecological requirements for development and survival outside the host and farm management practice [19]. Higher prevalence of gastrointestinal parasitism in the studied population might be due to favorable agro-climatic condition and the frequent exposure to the same communal grazing land that caused contamination of the pasture.

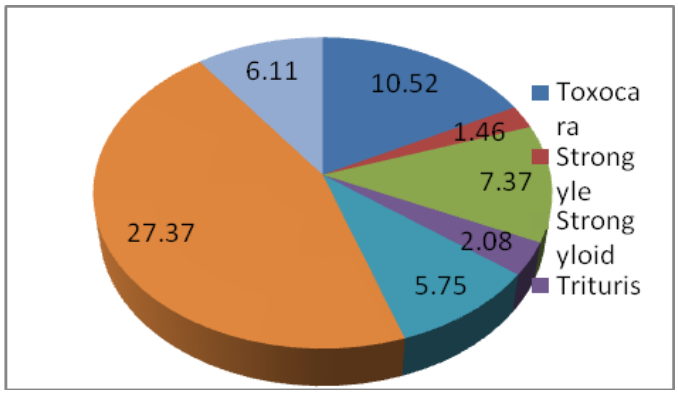


Fig 2

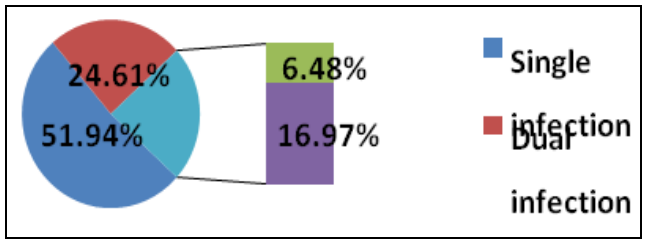


Fig 3

The pie diagram represents the overall percent prevalence of GI helminths (Figure 2) and proportion of GI parasitism (Figure 3) of cattle in sub-Himalayan Terai Zone of West Bengal

The occurrence of parasitic infection caused by one type of infective agent was noticeably higher (51.94%) than those of dual (24.61%) and triple (6.48%) concurrent infection (Figure 3). Among the cases, identified with single parasitic infection, the highest frequency was recorded for Paramphistomiasis (27.37%) whereas very few were positive (1.46%) for strongylosis.

3.2 Location wise prevalence of GI helminthes

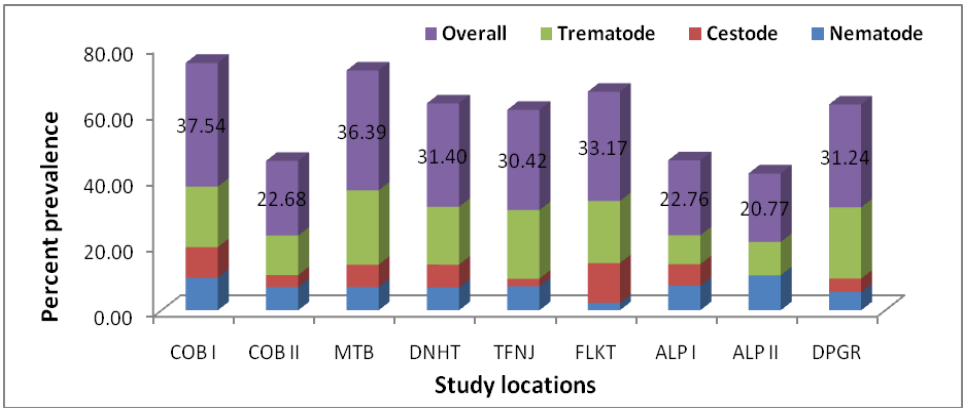
In the present study, the samples were collected from eight development blocks, representing three distinct geographical ecoregions i.e. plain, riverine belt and forest fringed. Amongst the studied locations, the highest overall prevalence of GI helminths was found in Cooch Behar I (COB I) although regional variation in the occurrence of the three types of helminthes was detected.

Table 2: Percent prevalence of gastrointestinal (GI) helminth parasites in the cattle population under different study locations of sub-Himalayan Terai Zone, West Bengal

9	Toxocara	Strongyle	Strongyloides	Trituris	Moniezia	Amphistome	Fasciola
COB I	10.86	07.44	17.09	04.23	9.25	32.54	04.23
COB II	06.46	04.32	10.79	06.68	3.62	23.17	00.83
MTB	14.21	00.00	06.73	07.23	6.81	36.86	08.22
DNHT	11.67	00.00	09.35	06.62	6.96	27.14	07.94
TFNJ	17.74	05.01	01.46	05.00	2.28	31.59	10.10
FLKT	02.30	00.00	00.00	06.46	12.14	27.81	09.88
ALP I	10.22	03.68	10.49	05.36	6.55	17.56	00.00
ALP II	15.75	10.70	05.66	10.38	0.00	16.93	03.37
DPGR	05.48	00.00	04.78	11.76	4.12	32.78	10.46

COB I-Cooch Behar I, COB II-Cooch Behar II, MTB-Mathabhanga, DNHT-Dinhata, TFNJ-Tufanganj, FLKT-Falakata, ALP I-Alipurduar I, ALP II-Alipurduar II, DPGR-Dhupguri

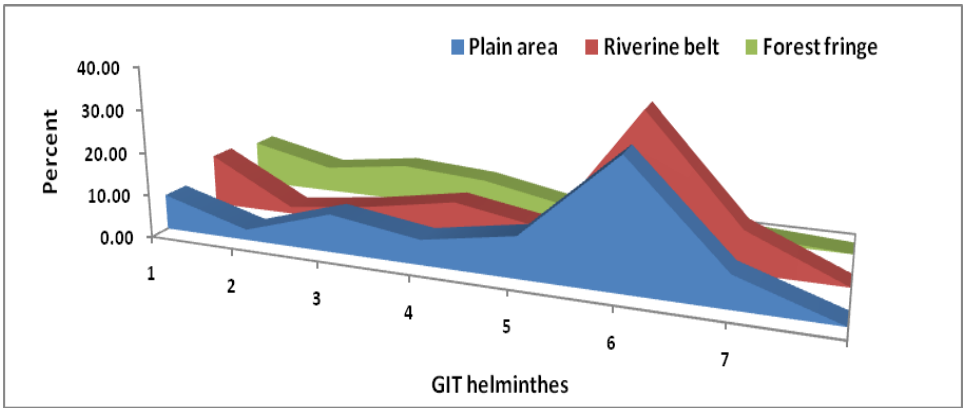
Comparatively, higher magnitude of infection of nematode, cestode and trematode was noticed in Alipurduar II (ALP II), Falakata (FLKT) and Mathabhanga (MTB) respectively (Table 2 & Figure 4). Cooch Behar-I is a place where both plains as well as riverine belt mix together in a very close proximity with an easy access to swampy area which provide favourable environment for the developmental stages of the parasites.



COB I-Cooch Behar I, COB II-Cooch Behar II, MTB-Mathabhanga, DNHT-Dinhata, TFNJ-Tufanganj, FLKT-Falakata, ALP I-Alipurduar I, ALP II-Alipurduar II, DPGR-Dhupguri

Fig 4: Genera-wise percent prevalence of GI helminths in the cattle population under different study locations of sub-Himalayan Terai Zone, West Bengal

Besides, overgrazing and concurrent contamination of the common pasture in the riverside might be the reason of parasitic predominance. The genera-wise variation under different study locations could be correlated with the associated environmental factors and the existing prevalence of the GI helminthes. Among the designated geo-ecoregions, the cattle in the river belts were found to be infested with higher proportion of GI helminths (Figure 5). Dominance of humid and marshy places surrounding the river belts round the year not only favoured the development of the parasites but also suited the process for propagation of the intermediate hosts. Comparatively low level of infection was recorded in the forest fringed area. Thick cover of green vegetation and less available water bodies might be the dependable architecture of the zone for such finding. The contrasting environment in the forest fringed and river basin area might be the responsible for present observations which were parallel with the findings of [15].



1-Toxocara, 2-Strongyloides, 3-Strongyle 4-Trichuris, 5-Moniezia, 6-Paramphistomes and 7-Fasciola

Fig 5: Percent prevalence of GI helminths in the cattle population under different geographical eco-region of sub-Himalayan Terai Zone of West Bengal

3.3 Seasonal distribution of GI parasitism

The study revealed highest degree of prevalence of GI helminthes in kharif season (June-September, 2016) when significantly higher level of trematode infection was found (Figure 6). In a number of similar investigations [6, 2, 27], it was reported that the proportions of the GI parasitism were higher in rainy season. Unanimously, it was granted that an adequate moisture and optimum temperature which favoured the growth and survival of infective stages of nematodes leading to more contamination of the pasture or feed and availability of snails (*Lymnea spp.*) for paramphistomosis and fasciolosis. The Rabi season was favourable for cestode population which was documented by the significantly higher proportion of infected population when compared with other seasons. The result resembled with our previous study [21].

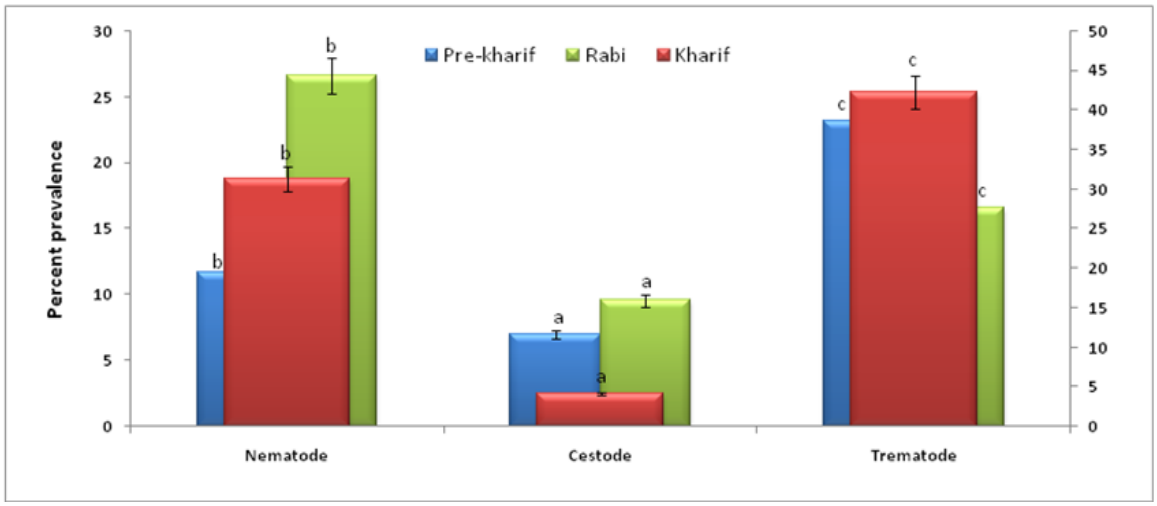


Fig 6: Occurrence of the GI helminths in the cattle population during the study period under the sub-Himalayan Terai Zone of West Bengal

The pathogenic significance of this parasite is not well understood but their occurrence was supposed to associate with the ingestion of oribatid mites infected with cysts of *Moniezia* spp [9]. However, the overall prevalence of GI helminths during Rabi season was evidently low (below 30%) that might be due to unfavourable environment for the survival and development of parasitic larvae in the pasture which is in agreement with [16].

3.4 Rearing system and prevalence of GI helminths

Three types of rearing systems are generally found in the region. Free range system allowed grazing in the nearby pasture freely at day time and called back in a paddock for night shelter when they are offered feed and water. About one third of the total cattle come under the system and mostly dominated by local non-descriptive breed. Secondly, the animals are pegged to graze in the available pasture land viz. near forest area, beside the village road or play ground during the day time.

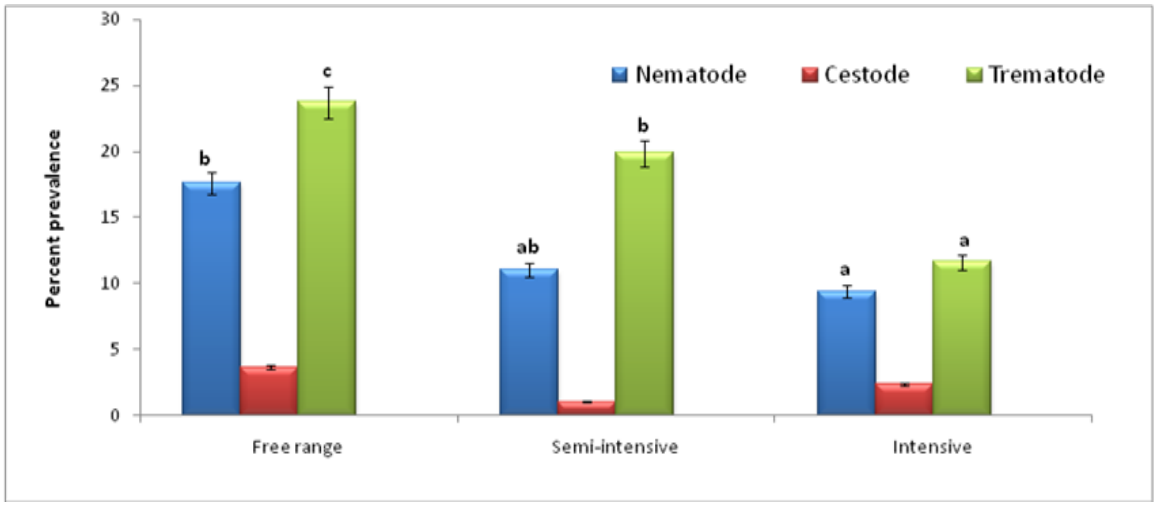


Fig 7: The percent prevalence of GI helminthes in the cattle population under different rearing cum management practices in the Sub-Himalayan Terai Zone of West Bengal

The practice encompasses more than half of the cattle population, comprising of a mixture of non-descriptive as well as cross bred cattle and was labelled as 'semi-intensive system' in our study. The remaining 10-20% population was categorized into 'intensive' system and this modified-feedlot population were mostly crossbred cattle reared primarily for milk production. A small portion of the farmers involved in intensive management, took their small enterprise as a source of primary income for livelihood.

The highest overall prevalence of GI helminths was recorded in the free-range system followed by semi-intensive and intensive rearing practice (Figure 7). Difference in awareness

and importance given to the animals by the farmers concerned in the rearing practice was thought to be the reason behind such variation. Similar result was also reported in the situation of mixed grazing practice by [25]. Though infection rates were higher in free range management practice but the survey revealed low rate of mortality and a low level of dissatisfaction among the practicing farmers due to loss out of diseases which could be attributed to the tolerance power of local breeds to all kind of adverse situation in comparison to cross bred animals. The lower rate of helminth infection in intensive and semi-intensive system could be accredited to the additional care for feeding, deworming practice, a minimum level of awareness on health management of the practicing farmers.

3.5 Prevalence of helminths at different age groups

It has been well established that young animals do not have a great deal of immunity to parasitism and are highly susceptible compared to adult animals unless they are in poor living conditions. Though we obtained a peak magnitude of cestode infection (3.14%) in calves but the overall prevalence of GI helminths was recorded to be the highest in young animal with the age between 6-24 months.

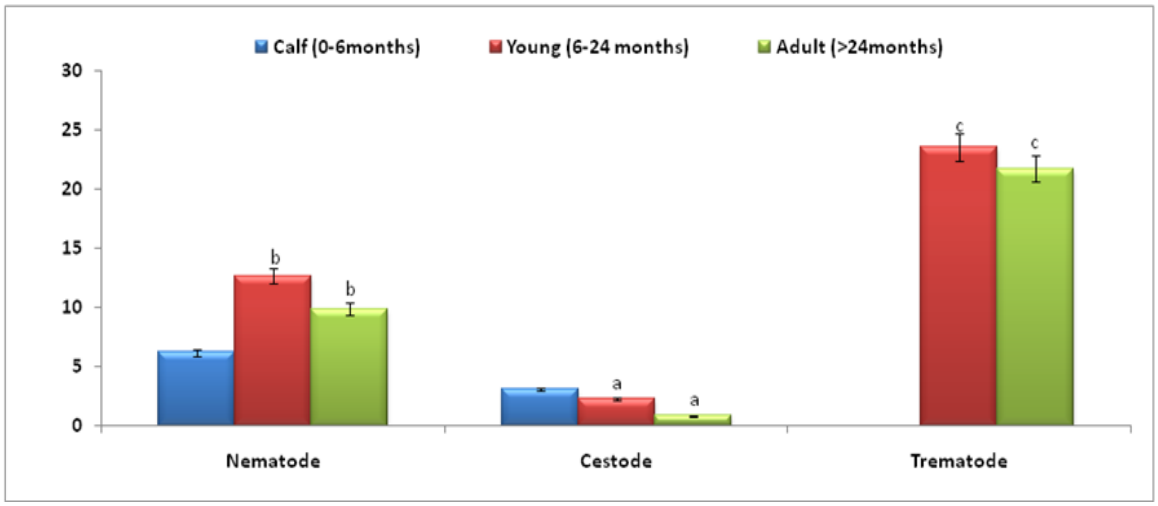


Fig 8: The genera-wise percent prevalence of GI helminths in the cattle population of different age groups under Sub-Himalayan Terai Zone of West Bengal

Failure in separating them from adults at pre-weaning age, overgrazing of infested pastures coupled with inappropriate and inadequate use of anthelmintics were suggested as the cause of such outcomes as hypothesized by [14]. The present observation is in agreement to [3, 12, 2]. However, the present finding mismatched to the report made by [1] and is presumed to be attributed by different breeds, grazing habits, husbandry practices and geo-climatic conditions. In a similar study, highest prevalence rate of GI helminths in lower age groups of small ruminants has also been confirmed by [20] that correspond to the present findings.

4. Conclusion

The results from the study indicated that the GI helminthiasis caused by single type infection is predominant over infections caused by multiple types of parasite. The prevalence of Paramphistomes (trematode) was the highest in the sub-Himalayan Terai zone of West Benagal. The area, where water bodies are in close proximity of the animals as found in COB-I, has a maximum risk of GI parasitic infection. The epimeiological data of this study may be helpful for strategic control of GI helminths among cattle population in Sub-Himalayan Terai Zone, West Bengal.

5. Acknowledgement

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