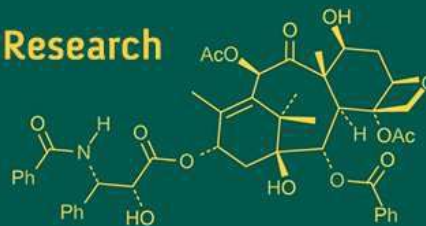


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Santhosh

M.V.Sc Scholar, Department of
 Veterinary Parasitology,
 Veterinary College, Hassan,
 KVAFSU, Bidar, Karnataka,
 India

Dr. Krishna Murthy CM

Associate Professor and Head,
 Department of Veterinary
 Parasitology, Veterinary
 College, Hassan, KVAFSU,
 Bidar, Karnataka, India

Veena M

Assistant Professor,
 Department of Veterinary
 Parasitology, Veterinary
 College, Hassan, KVAFSU,
 Bidar, Karnataka, India

Naveen Kumar S

Professor and Head,
 Department of Animal
 Genetics and Breeding,
 Veterinary College, Hassan,
 KVAFSU, Bidar, Karnataka,
 India

Pralhad

Associate Professor and Head,
 Department of Veterinary
 Microbiology, Veterinary
 College, Hassan, KVAFSU,
 Bidar, Karnataka, India

Shilpa VT

Assistant Professor,
 Department of Veterinary
 Pathology, Veterinary College,
 Hassan, KVAFSU, Bidar,
 Karnataka, India

Corresponding Author:**Dr. Krishna Murthy CM**

Associate Professor and Head,
 Department of Veterinary
 Parasitology, Veterinary
 College, Hassan, KVAFSU,
 Bidar, Karnataka, India

Prevalence of haemoprotozoan infections in cattle across different agro-climatic zones of Hassan district, Karnataka

Santhosh, Krishna Murthy CM, Veena M, Naveen Kumar S, Pralhad and Shilpa VT

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Abstract

Haemoprotozoan infections significantly affect cattle health and productivity, particularly in tropical and subtropical regions. A cross-sectional study was conducted in Hassan district, Karnataka, to determine the prevalence of haemoprotozoan parasites in cattle with respect to age, sex, and breed. A total of 200 cattle were screened from four agro-climatic zones: Central dry, Southern dry, Southern transition, and Hilly zones. Blood smear examination revealed an overall prevalence of *Theileria* spp. (41.5%), followed by mixed infections (5%), *Babesia* spp. (3.5%), and *Anaplasma* spp. (1%). The highest prevalence of *Theileria* was recorded in the Central dry zone (58%), predominantly affecting animals older than one year, with similar distributions across sexes and breeds. Mixed infections were more common in the Southern dry and Southern transition zones. Overall, Adult cattle (>1-3 years) exhibited greater susceptibility to infection compared to younger animals (0-1 year). These findings emphasize the importance of implementing focused surveillance and context-specific control measures to reduce the burden of haemoprotozoan infections in cattle across the diverse agro-climatic zones of Hassan district.

Keywords: Haemoprotozoa, *Theileria*, *Babesia*, *Anaplasma*

Introduction

Haemoprotozoan infections constitute a major constraint to cattle health and productivity worldwide, particularly in tropical and subtropical regions where vector populations thrive throughout the year. Among these, *Theileria*, *Babesia*, and *Anaplasma* species are of considerable veterinary importance due to their widespread occurrence and significant economic impact on the livestock sector. These infections are primarily transmitted by ticks and lead to clinical manifestations such as fever, anemia, reduced milk yield, weight loss, and in severe cases, mortality, thereby affecting both subsistence and commercial dairy farming systems (Maharana *et al.*, 2016) [11].

India, with its diverse agro-climatic conditions, provides a favorable environment for the survival and proliferation of tick vectors, thereby facilitating the endemicity of haemoprotozoan diseases. Several studies from different parts of India have reported variable prevalence patterns influenced by ecological and management factors (Singh *et al.*, 2012; Maharana *et al.*, 2016; Sharma *et al.*, 2021) [14, 11 13]. Karnataka, particularly the southern region, is characterized by heterogeneous agro-climatic zones ranging from dry to hilly terrains, which may differentially influence disease distribution and transmission patterns (Ananda *et al.*, 2009; Krishnamurthy *et al.*, 2016; Mankani *et al.*, 2024) [2, 9, 12].

Host-related factors such as age, sex, and breed also play a critical role in determining susceptibility to haemoprotozoan infections. Adult cattle are often reported to exhibit higher infection rates, possibly due to prolonged exposure to tick infestation, whereas younger animals may show varying degrees of resistance or subclinical infection. Similarly, crossbred cattle are generally considered more susceptible compared to indigenous breeds due to differences in genetic resistance and adaptability to local environmental conditions (Kaur, *et al.*, 2021) [8].

Despite the recognized importance of haemoprotozoan diseases, there is limited epidemiological data available for districts like Hassan in Karnataka, where livestock

farming is an integral component of rural livelihoods. Understanding the prevalence pattern across different agro-climatic zones, along with associated host risk factors, is essential for designing targeted control strategies and improving animal health management.

Therefore, the present study was undertaken to determine the prevalence of haemoprotozoan infections in cattle across different agro-climatic zones of Hassan district, Karnataka, with particular emphasis on age, sex, and breed-related variations.

Materials and Methods

Study Area: The study was conducted in Hassan district of Karnataka, comprising four agro-climatic zones, viz., Central Dry, Southern Dry, Southern Transition and Hilly zones. A total of 200 blood samples were collected from cattle following a cluster sampling method, with 50 samples obtained from randomly selected villages in each agro-climatic zone.

Sample Collection: Blood samples were collected aseptically from the jugular vein in ethylene diamine tetra acetic acid (EDTA)-coated vacutainer tubes and transported to the laboratory under chilled conditions. Thin blood smears were prepared immediately after sample collection using clean, grease-free glass slides.

Laboratory Examination: The smears were air-dried at room temperature, fixed in absolute methanol for 2-3 minutes, and subsequently stained with Giemsa stain following standard protocols. After staining, the slides were gently washed with buffered water, air-dried, and examined under a light microscope. Microscopic examination was carried out under oil immersion using a 100× objective lens for the detection of haemoprotozoan parasites. Identification of parasites was carried out based on morphological characteristics as described by Benjamin (1998) [3].

Statistical Analysis: Prevalence was calculated as percentage. Chi-square (χ^2) test was used to determine the association between infection and variables such as zone, age, sex, and breed. A p-value < 0.05 was considered statistically significant.

Results and Discussions

A total of 200 cattle from four agro-climatic zones of Hassan district were screened for haemoprotozoan parasites. *Theileria* was the most prevalent parasite, detected in 41.5% of animals, followed by mixed infections (5%), *Babesia* (3.5%) and *Anaplasma* (1%) (Table 1, Figure 1). The dominance of *Theileria* in Hassan district aligns with the findings of Mankani *et al.* (2024) [12], who reported *Theileria annulata* as the most frequent haemoprotozoan in cattle from the Hassan region of Karnataka. Similarly, Ganguly *et al.* (2017) [6] and Acharya *et al.* (2017) [1] also reports higher prevalence of *Theileria* from Haryana and Bhubaneswar.

Zone-wise, the Central dry zone recorded the highest *Theileria* prevalence (58%), whereas mixed infections were primarily seen in the Southern dry (8%) and Southern transition zones (12%). *Babesia* and *Anaplasma* infections were largely confined to the Southern transition zone. The observed significant differences in parasite prevalence among zones (χ^2 , $p < 0.05$; superscripts in Table 1, Fig. 1) indicate that agro-climatic factors, such as temperature, humidity, and tick vector abundance, play a major role in determining infection patterns, which is consistent with observations by several authors viz; Kaur, *et al.*, 2021 [8]; Kumar *et al.* 2016 [10] from different parts of India.

Age-wise distribution revealed that adult cattle (>1-3 years) were most susceptible to *Theileria* (34%) and mixed infections (5%), whereas younger animals (0-1 year) showed minimal infection (Table 1, Figure 1). Higher prevalence in older cattle agrees with reports by Sharma *et al.* (2021) [13], who found that cumulative exposure to tick vectors increases susceptibility with age. These findings supports that older cattle are more susceptible with continuous tick exposure and carrier population in the field conditions.

Slightly higher prevalence was noted in females compared to males, but these differences were not statistically significant. This observation concurs with findings of Farooq *et al.* (2019) [5], and Ghosh *et al.* (2020) [7], who also reported higher prevalence rate in females, the reason could be attributed due to physiological stress factors such as pregnancy, lactation, and hormonal influences etc.

Breed-wise analysis indicated marginally higher infection rates in crossbred cattle compared to native breeds, particularly for *Theileria* and mixed infections. (Table 1, Figure 1). This aligns with the work of Subapriya *et al.* 2021 [15]; Sharma *et al.* 2021 [13]; Ghosh *et al.* 2020 [7], who also noted that indigenous breeds often exhibit greater resistance to haemoprotozoan infections than crossbred animals, likely due to indigenous cattle possess better innate resistance to haemoprotozoan parasites, possibly due to genetic adaptation to local environmental and vector pressures.

In Karnataka, multiple region-specific investigations have highlighted the endemic nature of these infections. For instance, studies in Shimoga reported an overall prevalence of 43.3%, with *Theileria annulata* being the predominant parasite, followed by *Babesia bigemina* and *Anaplasma marginale* (Krishnamurthy *et al.*, 2016) [9]. Similarly, investigations in Mysore and adjoining districts (Mandya, Chamarajanagar, and Kodagu) revealed an overall prevalence of 40.22%, with a markedly higher occurrence of theileriosis compared to other haemoprotozoan infections (Dharanesh *et al.*, 2017) [4]. Earlier reports from Bangalore North also demonstrated a higher prevalence of *Theileria* infections in crossbred cattle, particularly during monsoon seasons (Ananda *et al.*, 2009) [2]. More recent observations from Hassan district further indicate a rising trend in haemoprotozoan infections, with *Theileria* accounting for the majority of cases, emphasizing the growing significance of these diseases in the region (Mankani *et al.* 2024) [12].

Table 1: Prevalence of haemoprotozoan infections in cattle across different agro climatic zones of Hassan district

Parasite	Zones	Total Examined (n)	Age 0-1 yr	Age >1-3 yr	Age >3 yr	Male	Female	Crossbred	Native	Total Positive (%)
<i>Theileria</i>	Central dry zone	50	0	3	26	0	29	29	0	29 (58%) ^a
	Southern dry zone	50	0	3	23	0	26	26	0	26 (52%) ^b
	Southern transition zone	50	1	2	9	1	11	12	0	12 (24%) ^c
	Hilly zone	50	3	3	10	2	14	12	4	16 (32%) ^d
	Total	200	4 (2%)	11 (5.5%)	68 (34%)	3 (1.5%)	80 (40%)	79 (39.5%)	4 (2%)	83 (41.5%)
<i>Babesia</i>	Central dry zone	50	0	0	0	0	0	0	0	0 ^a
	Southern dry zone	50	0	0	0	0	0	0	0	0 ^a
	Southern transition zone	50	0	1	6	0	7	7	0	7 (14%) ^b
	Hilly zone	50	0	0	0	0	0	0	0	0 ^a
	Total	200	0	1 (0.5%)	6 (3%)	0	7 (3.5%)	7 (3.5%)	0	7 (3.5%)
<i>Anaplasma</i>	Central dry zone	50	0	0	0	0	0	0	0	0 ^a
	Southern dry zone	50	0	0	0	0	0	0	0	0 ^a
	Southern transition zone	50	0	0	2	0	2	2	0	2 (4%) ^b
	Hilly zone	50	0	0	0	0	0	0	0	0 ^a
	Total	200	0	0	2 (1%)	0	2 (1%)	2 (1%)	0	2 (1%)
Mixed	Central dry zone	50	0	0	0	0	0	0	0	0 ^a
	Southern dry zone	50	0	0	4	0	4	4	0	4 (8%) ^b
	Southern transition zone	50	0	0	6	0	6	6	0	6 (12%) ^b
	Hilly zone	50	0	0	0	0	0	0	0	0 ^a
	Total	200	0	0	10 (5%)	0	10 (5%)	10 (5%)	0	10 (5%)

-Superscripts (a, b, c, d) indicate statistically significant differences ($p < 0.05$) among zones for each parasite.

-Age groups: superscripts reflect significance in 0-1 yr vs >1-3 yr vs >3 yr.

-Sex and breed differences were not statistically significant (NS); no superscripts added.

-Total Positive (%) calculated for each zone.

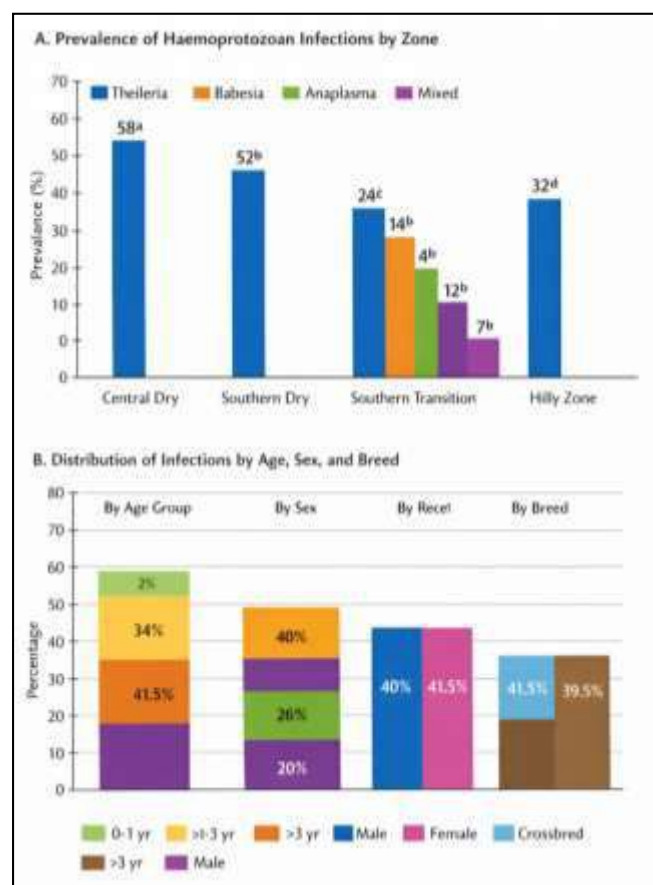


Fig 1: Prevalence of haemoprotozoan infections in cattle across different agro climatic zones of Hassan district

Conclusion

Overall, the findings demonstrate that haemoprotozoan prevalence in cattle in Hassan district is strongly influenced by local agro-climatic conditions, host age, and breed, supporting the need for targeted, context-specific surveillance and control strategies.

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Disclosure of potential conflicts of interest

The authors have no conflict of interest to declare.

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