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Epidemiological study of ixodid ticks infesting cattle reared by small holder farmers

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Abstract
The present study was conducted to investigate the occurrence of ticks on cattle kept by small holder farmers and livestock keepers in Lucknow, U.P, India. A total of 2710 cattle were examined on random basis throughout the year, out of which 1602 cattle were found infested with ticks. The overall prevalence of ticks infestation in cattle was observed 59.11%. A total of 2042 ticks were collected from the cattle's body. The collected ixodid tick species were identified as *Rhipicephalus* (*Boophilus*) *microplus*, the most prevalent (59.74%) species followed by *Hyalomma anatolicum anatolicum* (26.80%) and *Haemaphysalis bispinosa* (18.80%). The number of ticks collected from cattle was dominated by the male species of the ticks. The prevalence of ixodid ticks was analysed and discussed with respect to sex, breed and age of cattle, season, management practices and predilection site.

Keywords: Ixodid ticks; prevalence; livestock etc

1. Introduction
India's livestock sector is one of the largest in the world and plays an important role in country's economy. In India, 70% of the rural households own livestock for generating additional employment through milk, meat, and wool and eggs production [1]. Therefore, it is considered to be the most promising fields of diversification of national economy as well as socio-economic status of millions of rural people. Cattle occupy a unique role in human history as they are domesticated since ancient period [2]. They are considered to be multipurpose since they are raised as dairy animals for milk and other dairy products, as beef animal for meat, as draught animals for agriculture land preparation, in inter- cultural operations like raking, carting and transportation of goods in rural areas, and in threshing and crushing of sugarcane and oil seeds in the country among many others [3].
According to the latest 19th Livestock Census, the state of Uttar Pradesh (U.P.) has the second highest cattle population and highest buffalo population in the country [4]. Majority of the rural population of the state is engaged either in the livestock breeding or in dairying, in one way or the other with the contribution of livestock to agricultural income being 30% [5]. The major constraints in the livestock sector are the parasitic infections, out of which the ectoparasitic infestation is among the serious veterinary problems [6 7]. The ectoparasites are known to cause heavy economic losses to livestock industry due to their usual habit of blood sucking, which adversely affects the economic production [8]. Ectoparasites including lice, ticks, mites etc., apart from pathogenic effects, also play an important role in the transmission of certain pathogens belonging to protozoa, virus, bacteria etc. and among the various ectoparasites, ticks are the most important [9].
Ticks belong to phylum Arthropoda and order Acarina. There are 899 tick species that parasitize the vertebrates including Argasidae (185 species), Ixodidae (713 species) and Nuttalliellidae (1 species) [10]. Argasidae ticks are soft ticks while Ixodidae are hard ticks. Hard ticks feed for extended periods of time on their hosts, varying from several days to weeks, depending on such factors as life stage, host type, and species of tick. The outside surface, or cuticle, of hard ticks actually grows to accommodate the large volume of blood ingested, which, in adult ticks, may be anywhere from 200 to 600 times their unfed body weight [11].
Ticks have got high veterinary and medical importance. Globally, the ticks are second only to mosquitoes as vectors of infectious pathogens of humans and animals. They transmit a large variety of pathogens such as bacteria, rickettsiae, protozoa, spirochaetes and viruses, more than any other arthropod vector [12]. They transmit diseases like babesiosis, theileriosis, anaplasmosis and many more that are considered as a major constraint on livestock

productivity [13 14]. In some cases, ticks have been reported to cause lowered productivity and mortality [15]. An adult female tick can cause blood loss that can result in reduction in live weight gain of cattle, dry matter intake and milk yield [16]. Ticks parasitizing livestock can reduce the quality of animal products and can even cause livestock death [17].

They are also reported to transmit pathogens that cause some human diseases such as lyme diseases, ehrliciosis, babesiosis, rocky mountain spotted fever, Kyasanur Forest disease (KFD), Indian Tick typhus (ITT), Crieman Congo Haemorrhagic fever (CCHF), tularemia and tick borne relapsing fever [18, 19].

Ticks act not only as potential vectors but also as reservoirs of certain infectious agents e.g. *Pasteurella multocida, Brucella abortus* and *Salmonella typhimurium* in man and animals [20].

In India, tick and tick borne diseases causes loss of US $498.7 million (more than 2000 crores) per annum [12]. Over the past two decades, the incidence of tick borne diseases has increased and poses a major public and animal health problem. The recent report of increasing number of tick borne diseases (KFD, ITT and CCHF) essentially underlines the need for strategic and effective tick control methods, as in neglected and untreated animals death could occur [21].

In India, ticks are common in all agro-ecological zones of the country [12]. Different tick species are widely distributed in India and a number of researchers have reported the distribution and abundance of tick species in different parts of the country.

The incidence and prevalence of ixodid ticks were reported from different parts of the country viz. Gujarat, Haryana, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal [22 33].

Uttar Pradesh is well known for its livestock as the state has got the second highest cattle population and highest buffalo population in the country [4]. Over 42 different species have been reported so far from Uttar Pradesh [12]. However, studies on prevalence of ixodid ticks on the cattle in U.P is very sparse, it is reported from Azamgarh and Mathura [32, 34]. Although 106 tick species are reported from India, however, a systemic survey of the ticks in different regions has not been done yet.

The variation in tick prevalence in different areas is attributed to a variety of factors like geo-climatic conditions, association and life style of different species of animals, awareness/education of the farmers, and farm management practices [35]. The study of ticks on livestock, under their natural conditions, without any control measure is also useful for understanding the host- parasite relationship and the variation of tick population. The study of distribution pattern of ticks in the different agro-climatic area would also provide a basis for evolving strategic and tropical control of ticks and diseases caused by them.

A systematic survey on ixodid ticks infesting cattle in the area is still lacking, which hampers the tick control management system. Keeping in view the clinico-economic importance of ticks and the lack of sufficient data on the prevalence of ticks on cattle, the proposed study was designed to collect, identify and determine the prevalence of ixodid ticks on cattle in Lucknow district, Uttar Pradesh.

2. Materials and Methods

2.1 Study Period

The study was conducted from March, 2015 to February, 2016. The data was recorded and analyzed. The study was conducted in three seasons *viz.* summer (March to June), rainy (July to October) and winter (November to February) season.

2.2 Study Area

The present study was carried out in Lucknow, the capital city of Uttar Pradesh. The area lies at 26.8467° N, 80.9462° E. It covers a geographical area of 2528 km^2 and lie at 123 meters above sea level. The city is situated in the middle of the Indo-Gangetic Plain. The river Gomti meanders through the city and divides it into the Trans-Gomti and Cis-Gomti regions. The city is surrounded by rural towns and villages (Fig. 1). The climate of Lucknow is humid, subtropical with hot, dry summer; and cool, dry winters. In the rainy season, the city gets an average rainfall of 896.2 millimetres (35.28 in) from the south-west monsoon winds, and occasionally frontal rainfall occurs in January (Source: www.wikipedia.com).

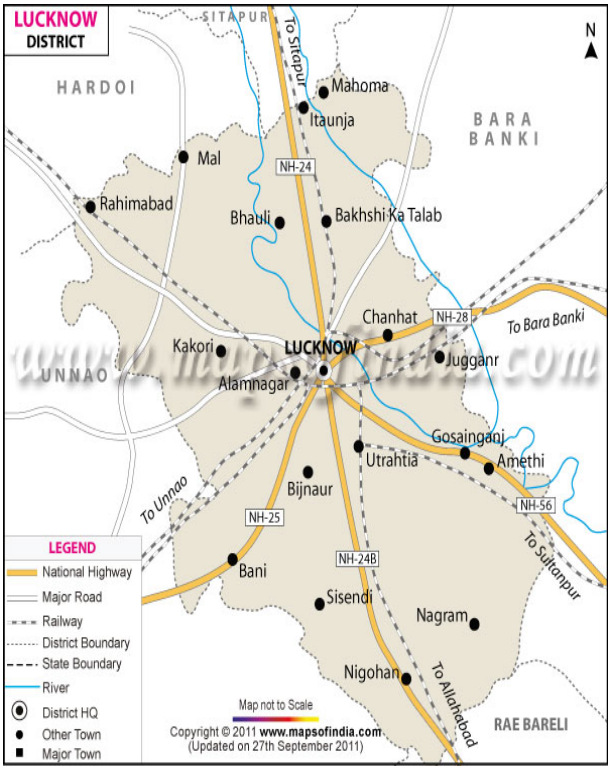

Fig A: Map of the Study Area

2.3 Study Animal

In the present study cattle of different breeds, age, and sex were surveyed for the tick infestation. For the convenience of the study the cattle were grouped accordingly. The animals of genus *Bos,* widely used as livestock in the region, were selected for the study.

2.4 Study Design and Epidemiological Survey

A cross sectional study was conducted to determine the prevalence of ticks in cattle. The animals were randomly selected as sampling unit and were checked thoroughly for any tick infestation. The selected places where the cattle were kept by the livestock holders/farmers for their livelihood were visited monthly in order to collect the relevant information including species, breed, age and sex of host, infested number of animals, type of management system, season, number of ticks per animals, site of attachment of ticks on host body.

2.5 Collection of ticks

Adult ticks were collected from different body parts of the cattle. The ticks (un-engorged, semi-engorged, fully-engorged) were removed from the skin of cattle with the help of blunt forceps without damaging their mouth parts [36].

2.6 Preservation of samples
Collected adult ticks from each body region were preserved in 70% Alcohol separately, labeled with the area within the zone, host age, host breed and date of collection of the sample in well-stopped glass vials. These samples were brought to the Parasitology Laboratory of Department of Applied Animal Sciences, Babasaheb Bhimrao Ambedkar University, Lucknow for permanent mounting and morphological identification.

2.7 Identification of ticks
Presumptive identifications were made under stereoscopic microscope. Final identifications were made under compound microscope according to Keys and Description [37].

2.8 Formulae and Statistical Analysis
2.8.1 Studies on Prevalence
The prevalence of ticks was recorded according to age, sex, breed, different body parts of the cattle, season and management practices. The prevalence (P) was estimated according to standard methods [38] and by the formula as given below:

$$P = \frac{\text{No. of infested cattle during specified period}}{\text{Total Cattle surveyed}} \times 100$$

2.8.2 Statistical Analysis
The epidemiological data were subjected to Chi-square (X^2) test to assess if there was a statistically significant association in tick infestation in the various groups [39].

3. Results
The present study was designed to collect an epidemiological data on ixodid ticks infesting cattle on various parameters during the period of 2015-16 in and around Lucknow district, Uttar Pradesh, India. The data was collected, analyzed and prevalence was recorded.

3.1 Prevalence of tick infestation on cattle
During the study period a total of 2710 cattle were surveyed, out of which 1602 cattle were found to be infested with ticks. Overall prevalence was found to be 59.11%. A total of 2042 ticks were collected from the cattle's body. The collected ixodid tick species were identified as *Rhipicephalus (Boophilus) microplus, Hyalomma anatolicum anatolicum, and Haemaphysalis bispinosa.* In the present study, the relative infestation rate of tick species on cattle sampled showed that *Rhipicephalus (Boophilus) microplus* was the most prevalent (59.74%) species followed by *Hyalomma anatolicum anatolicum* (26.80%) and *Haemaphysalis bispinosa* (18.80%) (Table 1, Fig.2). The number of ticks collected from cattle was dominated by the male species of the ticks.

The age of the host animals has an important role on the infestation pattern of tick species [3]. The result of the rate of prevalence among different age groups is shown in Table 2. Highest prevalence (79.2%) was recorded in the cattle of age group I (< 2 years) followed by (68.30%) group II (2-8 years). The least infestation (48.06%) was observed in cattle of group III (>8 years). The variation in prevalence among the groups of different ages was found to be significant.

The results of prevalence of tick infestation with respect to cattle's sex are presented in Table 3. In the present study, a total of 1010 male cattle and 1700 female cattle were examined, out of which 290 male cattle and 1312 female cattle were found to be infested with ixodid ticks. The rate of prevalence of tick infestation in female cattle (77.17%) was found to be significantly higher than in the males (28.71 %) (Table 3).

The prevalence of tick infestation on the host cattle was studied with respect to the prevailing seasons in this region. The area witnesses three seasons *viz.* summer (March to June), rainy (July to October) and winter (November to February) seasons. The results are depicted in Table 4. During the survey, the tick infestation in rainy season (73.55%) was significantly higher followed by summer (57.05 %) and winter (46.27%).

Cattle are generally reared under extensive, semi-intensive and intensive system. Extensive practices consist of rearing of cattle where feeding is totally dependent on grazing. In semi-intensive type of rearing, the feeding of cattle/animal is partially on grazing as well as on indoor feeds. However, in intensive rearing, the feeding of animals is completely indoor. The findings of present study show that the semi-intensive and intensive rearing systems were found to be most popular among the rearers of this region. It was also observed that mostly calves <2 years, and very weak and diseased cattle were reared intensively. A significantly higher prevalence of tick infestation was observed in the cattle reared intensively (77.11%) by their owners as compared to cattle reared by semi-intensive modes (51.52%) (Table 5). The variations in the prevalence of tick infestation in relation to management practices were found to be significant.

During the study, the various breeds of cattle encountered mainly belonged to four categories: Sahiwal, and Zebu among the local breeds; Holstein Friesian, a pure exotic breed; and cross between exotic and cross breed. The Breeds of cattle were determined by the origin and physical characteristics of respective breeds. In the present study, a total of 1050 local, 850 cross bred and 720 exotic breeds of cattle were examined (Table 6). Out of these 490 local, 502 cross bred and 610 exotic cattle breeds were found to be infested with ixodid ticks. The rate of prevalence of tick infestation in exotic bred (80.26%) was found to be significantly higher as compared to the cross breeds (59.05%) and local breeds (44.54%).

The present study also targeted to identify the association of the ixodid ticks in cattle with their specific attachment site. The tick burden with respect to different attachment sites is given in Table 7. The tick burden ranged from high (26.93%) on dewlap followed by flank (21.05%), perineum (14.78%), genitalia (12.24%), groin (9.79%), udder (7.83%) and ear (7.34%) (Table 7 and Fig. 3).

4. Discussion
Ticks are known to have high medical and veterinary importance. The distribution and abundance of ticks species infesting cattle vary greatly from one area to another. In the survey period, it was observed that more than half of the cattle examined were infested with different species of ixodid ticks. Studies on the prevalence of ixodid ticks has been done by several workers in India [22 34]. The findings of prevalence as reported in this study are similar to those reported by a study in Mathura, where 2515 cattle were examined and an infection rate of 60.07% was found [32]. Some workers have also reported more than 50.00% prevalence in cattle [40 41], however others have reported low prevalence rate of tick infestation (<45%) [3 27]. Several factors such as lack of improved husbandry practices, inadequate use of veterinary services and poor awareness of the harmful effects of ticks

among the cattle owner in rural areas have been found to contribute to the wide prevalence of tick species in the study area. The variations in the prevalence reported in the present study as compared to previous findings by other workers may be attributed to the variations in climatic, geographical conditions of the study area and methodology adopted for the study [42].

Rhipicephalus (Boophilus) microplus has also been reported as one of the common ixodid tick of cattle in the districts of Tamil Nadu and Uttar Pradesh by other workers [24, 32]. The tick species was also reported in buffalo [26 43]. However, the infestation rate of *Rhipicephalus (Boophilus) microplus* was found to be higher in cattle than in buffalo probably due to preference of denser hair coat in cattle than buffalo and also due to the fact that buffalo have access to mud for wallowing that might cause tick dropping [32]. In this study *Rhipicephalus (Boophilus) microplus* was most prevalent species whereas *Hyalomma analoticum analoticum* was found to be more prevalent in cattle in Mathura region with a prevalence rate of 21.59 % [32]. In another study, the tick species *Haemaphysalis bispinosa* has been reported as a common tick species infesting cattle, goat, buffaloes, sheep and monkeys [25, 43, 45]. *H. bispinosa* was also found as the most common tick infesting a range of domestic animals in Kerala state of India [26].

The male to female tick ratio (M:F) on the cattle's body in all the three species found in the area shows that male ticks are in higher abundance as compared to the female ticks (Table 1). The reason for this may be attributed to the findings of a study that suggests that the higher number of male ticks on the cattle's body than the female ticks is due to the fact that fully engorged female tick drops off to the ground for egg laying while male tends to remain on cattle's body to continue feeding and mating [18].

4.1 Factors Affecting Prevalence of Tick Infestation the Cattle

4.1.1 Host Age

In the present study it was observed that the young cattle are very prone to tick infestation. Similar results have been obtained in a study in Mathura district of Uttar Pradesh where infection rate was found to be 80.20% in <1 year age of cattle [32]. In a different study, it is reported that young cattle were 2.23 times more susceptible to tick infestation and it is also observed that age of the host had a significant (p<0.01) effect on the prevalence of tick and other ectoparasite infestation [42]. It is very difficult to give the exact reason of high infestation rate of ticks in young calves, however, it is suggested that less developed immune system of calves might be responsible for high prevalence rate of tick infestation on them [43]. In contrast, higher infestation of ticks in adult cattle as compared to the young calves has also been reported by other workers [39, 46, 48].

4.1.2 Host Sex

The female cattle were found to be more infested with ticks as compared to male cattle. A significant higher prevalence in female cattle has also been reported by other workers [43, 49]. The higher prevalence rate in female cattle may be due to hormonal effects [42, 43, 49]. It is reported that high levels of prolactin and progesterone hormone make the individual more prone to any infection [50]. Female cattle bear higher stress than males due to pregnancy, lactation and production which makes them more prone to infection [43]. However, some studies in different part of the world had showed a higher prevalence of tick infestation in male cattle as compared to the female cattle [29, 39, 51]. The reason for the higher prevalence of tick infestation in males was attributed to the fact that male animals are neglected and that least care is provided to them with only occasional use of acaricides [39]. It is reported that the farmers considered male animals as useless after the popularization of artificial insemination which could be the reason for their neglect and reported consequently higher infestation by ticks [29].

4.1.3 Season- wise Prevalence of Tick Infestation

In the present study high infestation rate was seen in rainy season followed by summer and winter. The seasonal variations in ticks infestation is reported by several other workers from different parts of the world. In Uttar Pradesh, in a study in Mathura district, highest prevalence was reported in the rainy season (69.46%) followed by summer (62.55 %) and winter (47.96%) [32]. Studies by other workers have also found higher prevalence of tick infestation in the rainy season [27, 51, 53]. The higher prevalence of ticks in rainy season suggests that humidity may be macroclimatic factor influencing infestation rate of ticks [27]. Some studies have reported higher rate of infection in the summer season [42, 54] while others have reported higher tick prevalence in the winter season [43]. The seasonal variation in prevalence of tick infestation may be due to variations in geographical locations, topography and composition of soil type, temperature and humidity of the surveyed areas.

4.1.4 Management practices

The higher rate of infection of ixodid ticks in the intensively reared cattle was observed in the present study which may be due to the fact that there is a higher risk of infection in the animals which are kept in confined places as compared to those practices in which animals are free for short/long period as in the case of semi-intensive or other rearing systems. The cattle which are semi-intensively or extensively reared have greater chances of tick removal as the ticks might be fed by crow or other birds that feed on small insects or ticks from the body of cattle. However, some workers have reported a higher rate of infection in cattle which are kept under extensive production system [42 55].

4.1.5 Host Breed

In the present findings, high infestation rate was observed in exotic followed by cross and local breeds. Differences in the tick burdens of different breeds of cattle under the same environmental conditions have been well known for many years [56]. The results obtained in the present study coincides with that reported by other workers [47, 57]. It is established that the local breed *B. indicus* (Brahman) cattle had resistance levels of about 99 percent [58]. However, in a study, it is detected that prevalence of tick infestation was significantly higher (p< 0.01) in local cattle (Prevalence=43.82%) as compared to the crossbred (Prevalence= 24.13%) cattle [42]. The differences in the tick burden in different breeds might be attributed to the variation in adoption of the different management systems, lack of supplementary feeding for local breeds, and lack of tick control measures for the local breeds. Furthermore, epidemiological survey carried out in the present study also revealed that higher tick infestation in the local breeds might be due to lack of interest of farmers for local breeds, as well as their taking more care in rearing cross and exotic breeds as compared to local breeds. There is a positive correlation between the prevalence and production system and breed of cattle [59].

4.1.6 Predilection site

The high tick burden was observed in dewlap (26.93%) followed by flank, perineum, genitalia, groin, udder and ear. Similarly, high tick burden on these area of cattle have been observed by other workers [51, 53, 57]. In a study, it is observed that the most infested region of the animal were udder-scrotum (32.4%), anno-vulva (21.9%), perineum (18.77%) dewlap (16.7%) and brisket (3.1%) [60]. The predilection site for high tick burden *i.e* dewlap and flank observed in the present study was similar to those reported by other authors [61]. Several factors such as density [62], time and season [63], and accessibility for grooming [64] have been reported to determine the attachment site of ticks. The predilection site of tick infestation may vary with the tick species and with the animal host. Generally most of the ticks have been reported to infest the sites with the thinner skins and shorter hairs and the area which are richly supplied with blood as it allows easy penetration. Information on predilection sites of ticks is helpful in tick control by targeted spraying on specific sites in the individual animals as it gives a clue as to which part of the body requires more attention [65].

5. Conclusion

The present study was related to the epidemiological investigations of tick infestation on cattle in Lucknow. The important and abundant tick species found during the study were *Rhipicephalus (Boophilus) microplus, Hyalomma analoticum analoticum, and Haemaphysalis bispinosa*. The study indicated that although there was a high burden of ticks on the cattle raised by the small holders reares in the area, scant attention was being paid to them. The results obtained in the present study showed that the prevalence of ticks has a seasonal distribution and preferable host selection and also depends on rearing practices adopted by small holders and the rearers. The observations from the present study may contribute to the increased understanding of epidemiology of ticks in the area.

It was observed that more focus should be given on tick distribution pattern on different attachment sites on host body, tick prevalence in relation to body score, and other host breeds to arrive at better conclusions regarding the susceptibility of the cattle host to tick infestation and thereby lead to better understanding of its prevention and control.

Table 1: Sex wise Distribution of different tick species

Tick species	Male ticks	Female ticks	M:F ratio	Total count of tick species	Prevalence%
Rhipicephalus (Boophilus) microplus	690	530	1.30:1	1220	59.74
Hyalomma anatolicum anatolicum	327	253	1.29:1	580	26.80
Haemaphysalis bispinosa	129	113	1.14:1	242	18.80
	1146	896		2042	

Table 2: Prevalence of Ticks with respect to Age of Cattle

Range of Age of Cattle	Total Cattle Surveyed	Infected Cattle	Prevalence%
< 2 year	500	396	79.2
2-8years	710	485	68.30
> 8years	1500	721	48.06
X^2 =184.047***, P=1.082			

Table 3: Prevalence of Ticks with respect to Gender of Cattle

Gender of Cattle	Total Cattle surveyed	Infected Cattle	Prevalence%
Male	1010	290	28.71
Female	1700	1312	77.17
X^2= 615.700, P= 6.44			

Table 4: Prevalence of Ticks with respect to Seasons of the Year

Season	Total Cattle surveyed	Infected Cattle	Prevalence%
Summer (March to June)	950	542	57.05
Rainy (July to October)	900	662	73.55
Winter(November to February)	860	398	46.27
X^2=137.948, P= 1.108			

Table 5: Prevalence of ticks with respect to cattle management practices

Rearing system	Total Cattle surveyed	Infected Cattle	Prevalence%
Semi-intensive	1906	982	51.52
Intensive	804	620	77.11
X^2=153.245, P=3.38			

Table 6: Prevalence of ticks with respect to breeds of cattle

Breed of Cattle	Total Cattle Surveyed	Infected Cattle	Prevalence%
Local	1100	490	44.54
Cross	850	502	59.05
Exotic	760	610	80.26
X^2=237.246,P=3.038			

Table 7: Incidence of Ticks with respect to site of attachment on Cattle

Body Parts	Ticks Collected	Prevalence %
Ear	150	7.34
Dewlap	550	26.93
Flank	430	21.05
Udder	160	7.83
Perineum	302	14.78
Groin	200	9.79
Genitalia	250	12.24
Total Ticks Collected	2042	

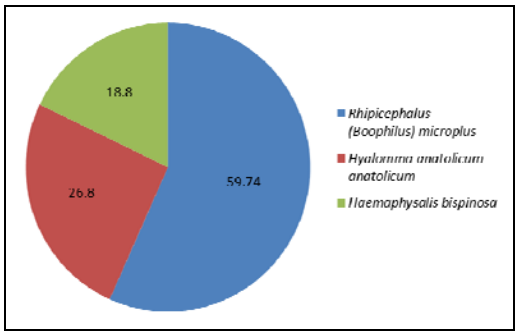

Fig 1: Graph showing the distribution of ticks

a b c

d e f

Fig 3: Tick infestation at different predilection sites in Cattle

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References

1. Ali J. Livestock sector development and implication for rural poverty alleviation in India. Livestock research for rural development 2007; 19(2)
2. Cattle. http://eol.org/pages /7009174/details. 1.1.2017
3. Manan A, Khan Z, Ahmad, Abdullah B. Prevalence and identification of ixodid tick genera in frontier region Peshawar. Journal of Agriculture and Biological Science. 2007; 2(1):21-25.
4. 19th Livestock census-2012 All India report. http://dehd.nic.in/sites/default/files/livestock%20%205.pdf. 2.2.2016
5. Dairy fest. http://www.dairyfest.in/why_Uttar_pradesh.php. 1.1.2017
6. Hourrigan JL. Spread and detection of *Psoroptic scabies* of cattle in the United States. Journal of American Veterinary Association. 1979; 175:1278-1280.
7. Colebrook E, Wall R. Ectoparasites of livestock in Europe and the Mediterranean region. Veterinary Parasitology. 2004; 120:251-274.
8. Branscheid W, Schroer. Damage to cattle hides, detection, frequency and economic importance. Fleischwirtschaft. 1997; 77:333-37.
9. Loomis EC. Ectoparasites of cattle. Veterinary Clinics of North America: Food Animal Practice. 1986; 2(2):299-321.
10. Barker SC, Murrell A. Systematics and evolution of ticks with a list of valid genus and species names. Parasitology. 2004; 129:S15-S36.
11. Sonenshine DE. Biology of ticks, Oxford University Press, New York. 1991; 1:345.
12. Ghosh S, Bansal GC, Gupta SC, Ray D, Khan MQ, Irshad H *et al*. Status of tick distribution in Bangladesh, India and Pakistan. Parasitology Research. 2007; 101(2):S207-S216.
13. Norval RAI, Fivaz BH, Lawrence JA, Brown AF. Epidemiology of tick-borne diseases of cattle in Zimbabwe. Tropical Animal Health and Production. 1984; 16:63-70.
14. French MP, Tyer J, Hirst WM. Smallholder dairy farming

in the Chikwaka communal land, Zimbabwe: birth, death and demographic trend. Preventive Veterinary Medicine. 2001; 48:101-112.
15. Niyonzema A, Kiltz HH. Control of ticks and tick-borne diseases in Burundi. Proceedings of Australian Centre for International Agricultural Research 1986; 17:16-7.
16. Pengram RG, Oosterwijk GPM. The effect of *Amblyomma variegatum* on live weight gain of cattle in Zambia. Medical and Veterinary Entomology 1990; 4:327-330
17. Elango G, Rahuman AA. Evaluation of medicinal plants against ticks and fluke. Parasitology Research 2010; 108(3):513-9.
18. Solomon G, Night M, Kaaya GP. Seasonal variation of ticks on calves at Sabetha, Western Shewa zone. Ethiopian Veterinary Journal. 2001; 7(1-2):17-30.
19. Parola P, Raoult D. Ticks and tick borne bacterial diseases in humans: An emerging infectious threat. Clinical Infectious Diseases. 2001; 32:897-928.
20. Jongejan F, Uilenberg G. The global importance of ticks. Parasitology. 2004; 129:S3-S14.
21. Manurung, Beriayaya J, Stevenson P. The efficacy of ivermectin in treating scabies and mange in buffaloes. Penyakit Hewn. 1986; 19(33):26-29.
22. Sanyan AK, De SK. Status of ticks (Acari: metastigmata) of Rajasthan Records of Zoological Survey of India 104 2005; (3-4):129-136.
23. Bhadesiya CM, Raval SK, Patel PV, Patel DM. Prevalence and Epidemiological Aspects of *Rhipicephalus sanguineus* in and Around Areas of Anand, Gujarat. International Journal of Interdisciplinary Research and Innovations. 2014; 2(4):164-168.
24. Kumar K, Balakrishanan N. Prevalence of ixodid ticks in Nilgiri district of Tamil nadu state (India). Journal of Communicable Diseases. 2002; 34:124-127.
25. Latha BR, Aiyasami SS, Pattabiraman G, Sivaraman T, Rajavelu G. Seasonal activity of ticks on small ruminants in Tamilnadu state, India. Tropical Animal Health and Production. 2004; 36:121-133.
26. Prakasan K, Ramani N. Ticks parasites of domestic animals of Kerala, South India. Asian Journal of Animal and Veterinary Advances. 2007; 2(2):74-80.
27. Vatsya S, Yadav CL, Kumar RR, Garg R. Prevalence of ixodid ticks on bovines in the foothills of Uttarakhand state: A preliminary report. Indian Journal of Animal Science 2008; 78(1):40-42
28. Jawale CS, Vinchurkar AS, Dama LB, Dama SB. Prevalence of ixodid ticks in post acaricide treated cattle and buffaloes at Sinner district Nashik (M.S) India. Trends in Parasitology Research. 2012; 1(1):2319-3158.
29. Singh NK, Rath SS. Epidemiology of ixodid ticks in cattle population of various agroclimatic zones of Punjab, India. Asian Pacific Journal of Tropical Medicine. 2013; 6(12):947-951.
30. Chhillar S, Singh J, Kaur H. Investigations on some hard ticks (acari: ixodidae) infesting domestic buffalo and cattle from Haryana, India. Journal of Entomology and Zoology Studies. 2014; 2(4):99-104
31. Sanyan AK, De SK. Diversity in Ticks (Acari) of West Bengal. Records of Zoological Survey of India. 2001; 99(1-4):65-74
32. Patel G, Daya-Shanker, Jaiswal AK, Sudan V, Kumar S, Verma J. Prevalence and seasonal variation in ixodid ticks on cattle of Mathura district, Uttar Pradesh. Journal of Parasitic Diseases. 2012; 37(2):173-176.
33. Kaur DK, Jaiswal K, Mishra S. Studies on prevalence of ixodid ticks infesting cattle and their control by plant extracts. IOSR Journal of Pharmacy and Biological Science. 2015; 10(6):01-11
34. Ali SZ, Singh RP. Observation on the prevalance of habitat of full-fed ixodid ticks in Azamgarh district of Eastern Uttar Pradesh. Indian Journal of Science and Research. 2013; 4(2):193-194.
35. Khan MN, Hayat CS, Iqbal Z, Hayat B. A Nadeem. Prevalence of ticks on livestock in Faisalabad (Pakistan). Pakistan Veterinary Journal. 1993; 13:182-184.
36. Soulsby EJL. Helminths, Arthropodes and Protozoa of Domesticated Animals, 7th edition the ELBS and Baillieve, Tindal cass LTD, London. 1982, 766.
37. Walker AR, Bouattour A, Camicas JL, Estrada Pena A, Horak IG, Latif AA *et al*. Ticks of domestic animals in Africa: A guide to identification of species 2003, 1-221.
38. **T**hrusfield M. Veterinary Epidemiology, 2nd Ed. UK Black Well Science Ltd. 1995, 182-198.
39. Wasihun P, Doda D. Study on prevalence and identification of ticks in Humbo district, Southern Nations, Nationalities, and people's region (SNNPR), Ethiopia. Journal of Veterinary Medicine and Animal Health. 2013; 5(3):73-80.
40. Misra SC. A note on the incidence and control of ixodid ticks at Bhubaneswar. Cheiron. 1984; 13(1):5-8
41. Sajeed MS, Iqbala Z, Khan MN, Ghulam M, Khan KM. Prevalence and associated risk factors for bovine tick infestation in two districts of lower Punjab, Pakistan. Preventive Veterinary Medicine. 2009; 92(4):386-391.
42. Kabir MHB, Mondal MMH, Eliyas M, Manan MA, Hashem MA, Debnath NC *et al*. An epidemiological survey on investigation of tick infestation in cattle at Chittagong district, Bangladesh. African Journal of Microbiology Research. 2011; 5(4):346-352
43. Mamun MAA, Begum N, Shahadat HM, Mondal MH. Ectoparasites of buffaloes (*Balbulus balbulis*) in Kurigram district of Bangadesh. Journal of Bangladesh Agricultural University. 2010; 8(1):61-66.
44. Saxena VK. Ixodid ticks infesting rodents and sheep in diverse biotopes of South India. Journal of Parasitology. 1997; 83:766-767.
45. Trapido H, Govardhanan MK, Rajagopalan PK, Rebello MJ. Tick ectoparasites on monkeys in the KFD area of Shimoga distrit, Mysore state, India. American Journal of Tropical Medicine and Hygiene. 1964; 13:736-772
46. Feseha B. Species composition and distribution of *Ixodid* ticks in Eastern Harerghiea, Ethiopian journal of Agricultural Science. 1997; 16:37-51.
47. Tessema T, Gashaw A. Prevalence of ticks on local and crossbreed cattle in and around Asela Town, South East, Ethiopia, Amber Animal Health Department, East Gojam, Ethiopian Veterinary Journal. 2010; 14(2):79-89.
48. Belew T, Mekonnen A. Distribution of Ixodidae ticks on cattle in and around Holeta Town, Ethiopia. Global Veterinaria. 2011; 7(6):527-531.
49. Bilkis GD, Mondal MMH, Rony Sa, Islam MA, Bengun N. Host determinant based prevalence of ticks and lice in cattle (Bos indicus) at Borga district of Bangladesh, Progressive Agriculture. 2007; 22(1-2):65-73.
50. Lloyd M. An experiment in the organization of a minimum complex measures against haemosporidiasis in northern Tadzhikistan. Journal of Veterinary Research. 1983; 6:64-74.

51. Atif FA, Khan MS, Iqbal HJ, Ali Z, Ullah S. Prevalence of cattle tick infestation in three districts of the Punjab, Pakistan. Pakistan Journal of Science. 2012; 64:49.
52. Sanjay K, Prasad KD, Deb AR. Seasonal prevalence of different ectoparasites infecting cattle and buffaloes. Journal of Research. 2007; 16(1):159-163.
53. Rony A, Mondal MMH, Begum N, Islam MA, Affroze S. Epidemiology of Ectoparasitic Infestations In Cattle at Bhawal Forest Area, Gazipur. Bangladesh Journal of Veterinary Medicine. 2010; 8(1):27-33.
54. Islam MK, Alim MA, Tsuji N, Mondal MM. An investigation into the distribution, host-preference and population density of ixodid ticks affecting domestic animals in Bangladesh. Tropical Animal Health and Production. 2006; 38(6):485-490.
55. Tiki B, Addis M. Distribution of ixodid ticks on cattle in and around Holeta town, Ethiopia. Global Veterinaria. 2011; 7(6):527-531.
56. FAO Animal Production and Health Guidelines Guide to good dairy practice. 2011, 1-34.
57. Asmaa NM, El Bably MA, Shokier KA. Studies on prevalence, risk indicators and control options for tick infestation in ruminants. Journal of Basic and Applied Science. 2014; 3:68-73.
58. Utech KBW, Wharton RH, Kerr JD. Resistance to *Boophilus microplus* (Canestrini) in different breeds of cattle. Australian Journal of Agricultural Research. 1978; 29:885-895.
59. Yacob HT, Ataklty H, Kumsa B. Major ectoparasites of cattle in and around Mekelle, northern Ethiopia. Entomology Research. 2008; 38(2):126-130.
60. Katuri RN, Das G, Chalhotra SK, Singh AK. Analysis of site of prediliction for the ticks of family ixodidae. International Journal of Food, Agriculture and Veterinary Sciences. 2013; 3(2):42-46.
61. Okello-Onen J, Hassan S, Essuman S. Taxonomy of African ticks, an identification manual. International Center for Insect Physiology and Ecology press, Nairobi, Kenya. 1999, 1-124.
62. Kettle DS. Medical and Veterinary Entomology. 2nd Edition. UK: CAB International. 1995, 420-460.
63. Seyoum Z. Distribution of host parasite relaionship of Ixodids ticks in Eastern Amhara, Ethiopia. Ethiopian Veterinary Journal. 2005; 9(1):9-17.
64. Chandler C, Read P. Introduction to Parasitology, Jhon Weakly and Sons Inc. UK. 1994; 10:882
65. Pegram G, Hoogsstraal H, Wassef HP. Ticks Argasidae, Ixodidae of Ethiopia; Distribution, ecology and host relationship of species Infecting livestock. Bulletin of Entomology Research. 1981; 71:339-359.