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Prevalence of arthropod infestation in sheep in Karnataka, India

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Abstract
A systematic study on arthropod infestation in sheep was undertaken in nine organized and ten unorganized farms in Karnataka by considering season, breed, management system and agroclimatic zone. The prevalence of ectoparasite infestations in sheep in organised farms was found to be 20.7% and in unorganised farms it was 43.7%. Among all ectoparasites, ticks were the most frequently found species with highest number followed by lice, mites, fleas, nasal bots and flies.

Keywords: Arthropod infestation, prevalence, sheep, Karnataka

Introduction
Ectoparasites are very common and widely distributed in all agro-ecological zones of tropical countries like India. Among the livestock, small ruminants are the most affected by ectoparasites of veterinary and medical importance, hindering their productivity. Skin problems caused by ticks, lice, Keds and mange mites; are among the major diseases of sheep causing serious economic loss to small farmers, the tanning industry and to the national economy as a whole, in the form of mortality, decreased production and reproduction. Further, skin diseases caused by ectoparasites cause serious down grading and rejection of skins and hides. Their role as vectors in viral and haemoprotozoan diseases is an additional concern.
Economic importance of ticks has long been recognized due to their ability to transmit diseases to humans and animals. Blood sucking by large numbers of ticks causes reduction in live weight and anemia among animals, while their bites also reduce the quality of hides. However, major losses come by way of their ability to transmit protozoan (Theileriosis and Babesiosis), rickettsial (Anaplasmosis) and viral diseases. The present study was planned to find out the prevalence of arthropod infestation in sheep in organized and un -organized sheep farms in Karnataka.

Materials and Methods
Different organised and unorganised sheep farms in Karnataka were screened (Table.1) representing eight districts from seven agroclimatic zones. The prevalence of ectoparasites was undertaken in sheep by considering different variables like season, breed, farm management practices, and site preference. Collections of arthropods was done in different seasons, *viz.*, rainy season (south west monsoon: June, July, August, September: north west monsoon: October, November and December), winter season (January, February) and summer season (March, April and May) during 2015-16 from different locations of Karnataka state.

Sample size determination
Number of animals required to measure the prevalence of ectoparasites was calculated based on 50% expected prevalence at 95% confidence level and 5% desired absolute precision (Thrush field 2005) [20], so minimum number of animals screened for the study was 1817 and 2133 in unorganized farms.

Sampling methods
The randomly selected animals were thoroughly examined physically for the presence of ectoparasites. Physical examination was done by multiple fleece parting in the direction opposite to hair normally rests as well as by close inspection. Ectoparasites such as ticks, fleas, Keds and lice were collected from different parts of the body of the sheep by hand picking or forceps and preserved in 70% ethanol (Urquhart *et al*. 1996) [21].

Skin scrapings for mites were obtained from sheep with mange skin lesions and processed as described by Cole (1986) [3]. Flies collected by using traps were dry preserved.

Ectoparasites identification

The collected samples were examined under stereomicroscope for lice, tick and fleas through their morphological features. They were identified according to the keys and descriptions given by Ferris (1951) [4], Roberts (1952) [14], Hoogstraal (1956) [7], Soulsby (1982) [17], Shariff (1928) [19] and Geeverghese *et al.* (2011) [5]. The different study places in this study either from organized and unorganized farms from different agroclimatic zones belonged to arid and semi-arid regions as follows.

Table 1: Particulars of Arid and Semi-arid region

Sl. No	Agroclimatic Zone	Unorganised Farms	Organised Farms
1	Arid	Bidar, Athani, Haveri.	Sheep Breeding and Training Centre, Athani, Belgaum (D). Sheep Breeding and Training Centre, Guttala, Haveri (T& D).
2	Semi-arid	Bellary, Chitradurga, Davangere, Tumkur, Tiptur, Anekal, Bangalore (U), Shivamoga, Hassan, Malavalli.	SBTC- Challakere. LRIC- Konehally, Tiptur. LRIC- Nagamangala, ILRIC- Bangalore. ILFC- Shivamoga, ILFC- Hassan, BSBTCB - Dhangur, Malavalli, Mandya.

Data Management and Analysis

Data analysis was done by using Microsoft Excel and all recorded data were analysed using Statistical Package for Social Science (SPSS) version 20. To summarise the proportion of infested and non-infested animals, descriptive statistics, percentage and 95% confidence interval.

Results and Discussion

During this study, 1817 sheep from organised farms and 2133 sheep from flocks in different parts of Karnataka were screened for arthropod infestation by considering different variables such as season, breed, age, sex, farm management and agro climatic conditions. The different ectoparasites collected were identified and are listed in the Table 2.

Table 2: Different ectoparasites collected from different places of Karnataka

Ectoparasite	Species name	Places of collection	
		Organised farms	Un organised farms
Fleas	*Ctenocephalides orientis.*	ILFC - Hassan. LRIC -Nagamangala, ILFC-KVAFSU,	Tumkur, Bellary, Chitradurga, Davangere, Mandya, Belgaum, Bidar, Bangalore ®.
	Ctenocephalides felis felis.	LRIC-Nagamangala.	Chitradurga, Davangere, Bangalore ®.
Lice	*Damalinia ovis.*	BSBT-Mandya, SBTC- Chitradurga, LRIC- Nagamangala, ILFC- KVAFSU, SBTC- Athani	Tumkur, Davangere, Chitradurga.
	Linognathus stenopsis.	BSBT- Mandya, ILFC - Hassan, SBTC- Chitradurga, ILFC- KVAFSU.	Tumkur, Bellary, Mandya, Davangere, Belguam, Bidar
Mite	*Sarcoptesscabiei var ovis.*	SBTC-Chitradurga LRIC-Nagamangala, SBTC- Athani.	Tumkur, Bellary, Davangere, Mandya, Chitradurga, Bidar.
Flies	*Haematopota pluvialis.*	LRIC-Nagamangala	-----
	Musca domestica.	LRIC-Nagamangala, SBTC- Guttal, BSBT-Mandya, SBTC-Athani	Bellary, Belgaum, Chitradurga, Davangere.
	Chrysomya megacephala.	Athani	
	Tabanus striatus	---	Bellary, Davangere
Nasal bots	*Oestrus ovis.*	IILFC- Konehally, BSBT- Mandya.	Belgaum, Chitradurga, Davangere.

Out of 1817 sheep, 20.7 percent (377/1817) of the population was infested in organised farms, whereas 43.7 percent (933/2133) of the population was infested with ectoparasites in other unorganised sheep flocks in Karnataka as mentioned in Table 3.

Table 3: Overall prevalence of ectoparasites in sheep in Karnataka.

Parasites Identified	Organised farms			Unorganised farms		
	Number examined	Number infested	% infestation	Number examined	Number infested	% infestation
Ticks	1817	145	7.98	2133	533	30
Lice		94	5.17		201	9.4
Fleas		44	2.42		95	4.45
Mites		94	5.17		149	6.98
Total	1817	377	20.7	2133	933	43.74
$\chi 2$ - 234, df -1						

Note: *Significant at $p<0.05$

In this study in the organised sheep farms, prevalence of ectoparasites was higher in females with 23.3 percent (353/1515) than males with 7.90 percent (24/302). Prevalence of ectoparasites was the highest in summer of 29 percent (177/608) followed by winter with 21 percent (130/613) and rainy season of 11.7 percent (70/596).Among the age groups,

hogget animals were heavily infested with 24.5 percent (235/957) followed by adults comprising 16.9 percent (119/702) and in lambs 14.5 (23/158).Based on the farm management it was the semi intensive farm with 21.7 percent (350/1606) animals which were heavily infested with ectoparasites than intensive animals of 12.7 percent (27/211). In arid regions, 37.10 percent of sheep (128/345) were heavily infested with ectoparasites than the sheep in semi-arid region with 16.9 percent (249/1472).

In unorganised sheep flocks the prevalence of ectoparasites was slightly higher in females of 49.2 percent (893/1813) than males with 12.5 percent (40/320). Prevalence of ectoparasites was the highest in rainy season of 61.76 percent (441/714) followed by summer with 52.7 percent (378/725) and winter season with 42.48 percent (294/692). Among the age groups, hoggets were heavily infested comprising 52.27 percent (528/1010)) followed by adults with 39 percent (374/960).

With regard to farm management, semi intensive farm had heavy infestation with 49.2 percent (893/1813) that were heavily infested with ectoparasites than intensive animals with 13.2 percent (30/227). The sheep in semi-arid regions were heavily infested with ectoparasites with 45.5 percent (584/1282) than the sheep in arid region with 48.48 percent (305/629). Among the breeds either in organised and un-organised farms; the non-descriptive breeds were heavily infested than descriptive breeds.

Among all ectoparasites, ticks were the most frequently found species of ectoparasites. A total of 3233 ticks (326 from organised farms and 2907 from un-organised farms) were collected and identified as *Haemaphysalis kutchensis, Haemaphysalis intermedia, Haemaphysalis bispinosa, Rhipicephalus haemaphysaloides, Rhipicephalus sanguineus, Hyalomma anatolicum anatolicum* and *Hyalomma marginatum isaaci*. The highest number of ticks belonged to *Haemaphysalis* spp followed by *Rhiphicephalus* spp and *Hyalomma* spp. Majority of the ticks were found infested in the ears, near eyelids, axillae, around perineum, anal and tail region.

The ticks belonging to four genera and eight species were observed. Out of 3233 ticks collected from both organised and unorganised sheep farms, 1532 ticks were found to be *Haemaphysalis* spp, followed by *Rhipicephalus* spp (936), *Hyalomma* spp (645) and *Amblyomma* spp (4).

Lice were also encountered in sheep from both organised and un-organised farms. Among 1817 sheep in organised farms about 58 were infested with *Damilinia ovis* and 36 were infested with *Linognathus stenopsis.* In unorganised farms 201 animals were infested with lice in which 103 were infested with *Damalinia ovis* and 98 sheep with *Linognathus stenopsis.* Lice were found in high numbers in winter, in which adults were found heavily infested than young ones.

About 149 animals in un-organised flocks and 94 animals in organised farms were infested with *Sarcoptes scabieivar ovis* mites which were observed in hoggets and adults during winter season followed by post monsoon. *Ctenocephalides orientis* and *Ctenocephalides felis felis* were the fleas found to infest 44 and 95 animals from organised and unorganised farms. Adult sheep were heavily infested followed by young ones. Flea infestation was more wide spread in post monsoon and winter. In this study it was observed that the females were heavily infested with ectoparasites than males.

The nasal bots were collected from the farms of both organised and unorganised flocks. The prevalence was high in winter season in the LRIC, Konehally, KVAFSU an organised farms, whereas in unorganised farms it was reported in Belgaum, Chitradurga and Davangere. Fly traps placed in the farms could trap *Tabanus striatus, Musca domestica, Haematopota pluvialis, Chrysomya megacephala* flies.

Prevalence rate based on the farm conditions, in this study indicated that the animals in semi intensive farming system were more prone to ectoparasitic infestation wherein 21.7 percent prevalence was observed in organised and 49.2 percent in unorganised farms whereas in intensive management it was found to be 12.7 percent in organised farm and 13.2 percent in unorganised farms. These findings were similar to that of Rabbi (2006) [7] where they reported highest ectoparasitic infestation in semi intensive system (59.7%) followed by extensive system (33.5%) and intensive (8.27%). Even Rony *et al*. (2010) [9] and Sounadar rajan *et al*. (2014) [11] reported high ectoparasitic in semi intensive system. The reason for higher prevalence of ectoparasites in semi intensive system might be due to free range movement of animals, unhygienic farm management in pens and shed. The non-descriptive breeds were more prone to ectoparasitic infestation (43.7%) than the descriptive breeds with 20.7 percent infestation which is in agreement with Soundara rajan *et al*. (2014) [11]. Most of the non-descriptive or local breeds were reared under semi intensive farming which were susceptible to ectoparasitic infestations than the descriptive breeds reared under intensive farming system where they are not exposed to ectoparasitic infestation. The results are in agreement with the findings of Rony *et al.* (2010) [9], Abadi *et al.* (2010) [1], Kabir *et al*. (2011) [4], Meseret *et al*. (2014) [10] who recorded higher ectoparasitic infestation in small ruminants maintained under semi intensive or extensive system.

Seasonal fluctuation of the year had a significant ($P<0.05$) effect on the prevalence of the ectoparasitic infestation, a relatively higher infestation with ectoparasites was observed in summer season (29%) followed by winter (21%) and rainy season with 11.7 percent in organised farms which was similar to the findings of Yeasmin *et al.* (2014) [13] who reported the intensity of ectoparasitic infestation in sheep with 85 percent in summer followed by 75 percent in winter and 55 percent in rainy season. Whereas in unorganised farms the ectoparasitic infestation was high in rainy season with 61.7 percent (441/714) followed by summer season with 52.1 percent (378/725) and winter season 42.4 percent (294/692). Seasonal prevalence of ectoparasites was reported by different authors *viz.,* Mushi *et al*. (1996) [6], Latha *et al.* (2004) [5], Brito *et al*. (2005) [2], Yakhchali *et al*. (2006) [12] and Sarkar *et al.* (2010) [10] where the prevalence of ectoparasites was higher in rainy season followed by winter or summer season.

Among the ectoparasites, the ticks has the highest intensity followed by lice, mites, fleas and flies. Among all the ectoparasites screened ticks recorded 7.98 percent in organised farms and 30 percent in unorganised farms. This was followed by lice with percentage of 5.17 in organised and 9.4 in unorganised farms whereas the intensity of mites was 5.17 and 4.87 percent in organised and unorganised farms. Low infestation of fleas *i.e.,* 2.42 and 4.45 percent in organised and unorganised farms was reported. In this study ticks were seen in a high intensity between March to June *i.e.,*in summer. The highest prevalence in summer season may be due to high humidity with an ambient temperature and overcrowding of sheep in farms in close contact increases the probability of contamination. The variation in tick prevalence in different areas can be attributed to a variety of factors like

geoclimatic conditions, association and rareing practices of different species of animals, awareness/ education of the farmers and farm managemental practices. The high prevalence rate during the hot months (May-July) may be attributed to hot and humid season prevalent during these months as tick infestation is influenced by temperature, rainfall and relative humidity (Gosh *et al*., 2007) [3].

Conclusion

Based on the agroclimatic zones the ectoparasitic infestation in the present study was more in arid regions with 37.01 and 48.48 percent in organised and unorganised farms whereas in semi-arid regions the infestation was 16.91 and 41.7 percent in organised and unorganised farms. The high intensity of ectoparasites in arid regions in this study might be attributed to differences in husbandry practices. Further, the semi-arid zone is located at a higher elevation and has low annual mean temperatures (minimum and maximum) compared to the arid zone. Rehman. (2017) [8] had also made similar observations.

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Conflict of Interest

The author declares that there is no actual or potential conflict of interest.

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