CROSS-SECTIONAL SURVEY OF VECTOR-BORNE DISEASES IN THE PUNJAB

Dr. Muhammad Nawaz Malik
Dr. Fraz Munir Khan

Livestock & Dairy Development Department
Government of the Punjab


بسم الله الرحمن الرحيم

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Dr. Muhammad Nawaz Malik
Project Director (Diagnostic Laboratories)
L&DD Punjab

Dr. Fraz Munir Khan
APVO/ Coordinator Labs. North Zone
L&DD Punjab

EXECUTIVE SUMMARY

Livestock is an integral component of a deeply rooted farming system in the Punjab. In order to achieve the overall objectives of Punjab Livestock Policy, i.e., to raise the standard of living of rural masses and marginalized segments of Punjabi society (womenfolk and landless owners of donkey and camel carts) to a higher level, to ensure food security & safety, and to compete in International market for livestock products and by-products, a paradigm shift in the mindset of all stakeholders and right positioning of all the available resources (human, intellectual, and material) is essential. Sound strategies and guidelines are the prerequisite to achieve the goals of Punjab Livestock Policy. Development of strategies requires baseline data that provide first hand intelligence on the ground realities. The present cross-sectional survey, second of its kind, is a step ahead in this direction. It fills the information-lacunas of the first cross-sectional survey, conducted from December 28, 2014 to March 18, 2015. With the successful completion of first Cross-sectional Survey (CSS), the need for the similar study on

the prevalence of haemo-parasites in livestock populations during summer, brucellosis among male (particularly breeding ones) livestock and endo-parasites in equines and camelids was realized. The worthy Secretary L&DD Punjab addressed this need and launched the second cross sectional survey of the livestock populations of the Punjab for priority setting, scenario analysis and institution of remedial measures. This survey was conducted from June 21, 2015 to September 15, 2015 at village level in all districts of Punjab. A total of 18543 villages and 40821 farmers / households were visited by deputed staff of District Diagnostic Laboratories for collection of faecal, blood, and serum samples from livestock populations. Faecal (n= 68520), blood (n= 445747), and serum (n= 63027) samples were collected and analyzed for detection of endo-parasites, haemo-parasites, and brucellosis. Out of the blood samples collected, 13.79% of blood samples exhibited positive outcome for haemo-parasites. Theileria was by far the most prevalent parasite (5.6%) followed by Babesia (4.5%), Anaplasma (2.6%), Trypanosma (1.2%), and Ehrlichia (0.1%). The highest prevalence of blood parasites is recorded in cattle (18.1%) followed by buffaloes (14.4%), camels (12.6%), equine & sheep (11% each), and goats (10%). Among cattle population of the Punjab, the highest prevalence of Theileriosis (15%), Babesiosis (13.6%), Anaplasmosis (5.5%), Trypanosomiasis (3.7%), and Ehrlichiosis (0.3%) is recorded in Faisalabad & Lahore divisions, Faisalabad division, Faisalabad division, Sahiwal division, and Gujranwala division, respectively. Among buffalo population, Babesia is the most prevalent (5.69%) followed by Theileria (4.86%), Anaplasma (2.89%), Trypanosoma (0.96%) and Ehrlichia (0.05%). Among Sheep, the most prevalent haemo-parasite is Theileria (4.23%) followed by Babesia (3.4%), Anaplasma (2.5%), Trypanosoma (0.4%), and Ehrlichia (0.05%). Among Goats, the most prevalent haemo-parasite is Theileria (3.6%), Babesia (3.27%), Anaplasma (2.1%), Trypanosoma (0.83%), and Ehrlichia (0.027%). In Equines,

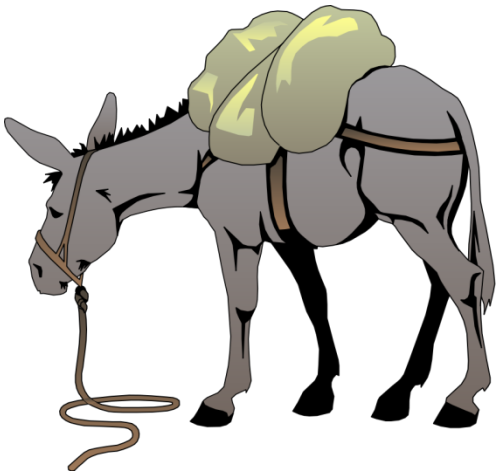
Trypanosoma is the most prevalent haemo-parasites (6.4%) followed by Babesia (2.87%), Theileria (0.65%), Anaplasma (0.5%), and Ehrlichia (0.5%). Among Camels, the most prevalent blood parasite is Trypanosoma (10.33%) followed by Babesia (0.97%), Anaplasma (0.8%), and Theileria (0.5%). Faecal examination of working equines (donkeys, mules, horses) indicates that Nematodes are the most prevalent (47.8%) followed by Trematodes (3.6%), Cestodes & Coccidian Parasites (2.8% each), and a mixed infestation of Nematodes & Cestodes (0.07%). Faecal examination of camels indicate that the highest prevalence is of Nematodes (43.4%) followed by Trematodes (11.19%), Cestodes (5.13%), and Coccidian Parasites (3.07%). The overall prevalence of brucellosis among breeding males of all livestock is recorded to be 1.25%. The point prevalence of brucellosis among breeding cattle bulls, buffalo bulls, rams, bucks, stallions/ jack donkeys, and camel bull is 7.4%, 10.8%, 5%, 6.3%, 8.7%, and 6.6%, respectively. The highest prevalence of brucellosis among breeding cattle bulls (3.13%), breeding buffalo bulls (6.15%), breeding rams (2.79%), and breeding bucks (2.6%) is recorded in the Lahore division; whereas in breeding stallions & jacks (4.1%) and breeding camel bulls (0.89%) in the Bahawalpur and Multan divisions, respectively.

INTRODUCTION

Livestock plays an indispensable role in the life of our rural masses. These animals not only are central to their livelihood (30-40% share) but also cater to the domestic demand of milk, meat and eggs. They also provide net source of foreign earnings (about 13%) as its share in export stands at 8.5%. In Pakistan, more than 8.0 million rural families are involved in raising livestock. During the financial year 2014-15, the contribution of livestock to agriculture value addition was 56.3% while its contribution to national GDP was 11.8%. An increase of 3.0% has been recorded during the financial year 2014-15 in the gross value addition of livestock (Rs. 801.3 billion) as compared to the previous financial year. Value of livestock surpasses the collective value of all crops by about 6.1% (Anonymous, 2015)

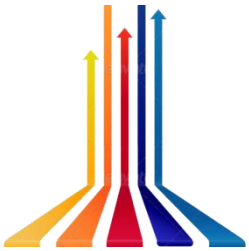
Punjab province is the major contributor (59%) to the national GDP. According to Livestock Census 2006 the Punjab province possesses 49%, 65%, 24%, 37%, 22%, 47%, 41% and 52% of Pakistan's cattle, buffalo, sheep, goat, camel, horses, mule and ass wealth, respectively. Its share in national production of milk, beef, mutton

and poultry is 62%, 43%, 32% and 75%, respectively. Despite having this much amount of livestock wealth, the status of livestock husbandry, production, productivity, veterinary services, and commercialism is far below international standards.



Working mules, donkeys and camels are linchpins in the mod cons free life of many marginalized communities (urban, sub-urban and rural) for being their sole breadwinners. Due to high petrol prices, marginalized communities use these animals as a cheap and economical means of transport and these animals play a key role in earning money for their owners and families. Under rural settings, these animals help with heavy domestic work, providing income, enabling them to play an important role in their communities (thereby enhancing their status), and providing savings by transporting goods, agricultural produce, water, firewood, animal feed and manure. That's why, despite mechanization, the number of these animals is increasing steadily. The prevailing livestock development strategy, based on "Pakistan Vision 2025", emphasized on the improvement in per unit animal

productivity through the adoption of population based disease surveillance, diagnostics, prevention and control initiatives, balanced nutrition, introduction and preservation of better germ plasm and introduction of improved livestock husbandry practices. Main aim is to appreciate the true potential of livestock assert; use it as a medium for economic growth, food security and a pathway out of poverty; and boost it up from the level of subsistence to market oriented venture and then to commercial livestock farming in the country; not only to meet the domestic demand but also the generation of exportable surpluses.



Livestock are subject to year-round attack by a wide variety of internal and external parasites. Animal parasites cause negative effects on the health (production and productivity) and welfare of the livestock and on the quality, quantity and potential marketable yield of livestock products leading to a significant adverse impact on the livelihoods of resource-poor communities. These yield losses include weight loss, reduced weight, reduced milk production, reduction in meat, hide and wool value, fetal abortion and livestock death, as well as the indirect losses through the introduction of secondary pathogens by these parasites. The determination of magnitude of animal parasites taxing the livestock population of the Punjab is the first consideration in

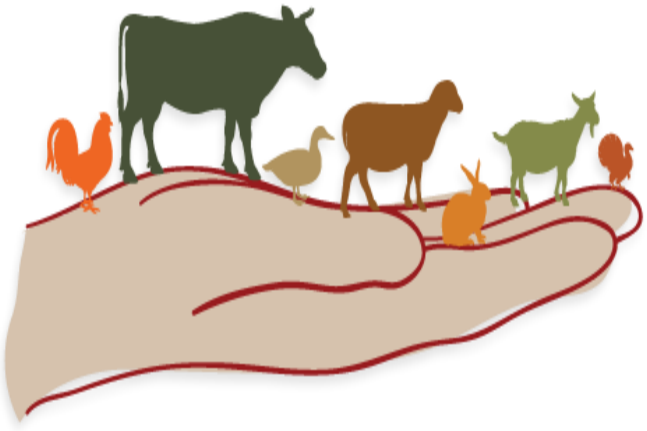
developing adequate control strategy. The magnitude of both endo-parasites and haemo-parasites on the small and large ruminant populations of the Punjab was determined during the first ever cross-sectional survey (conducted from 28.12.2014 to 18.03.2015). Working horses, donkeys/ mules, and camels were not included in the survey. In addition, as the study period was not the season for ecto-parasites, the prevalence of haemo-parasites did not truly reflect the brunt and enormity of haemo-parasitic load on the livestock populations. So lacuna of knowledge was existed in this regard.

Brucellosis is one of the world's major zoonosis that still is of veterinarian, public health and economic concern in many parts of the world. Although in some countries, the incidence of brucellosis in livestock and its transmission to the human population has been significantly decreased following the instigation of effective vaccination-based control and prevention programs yet it remains an uncontrolled problem in regions of high endemicity such as parts of Asia (including Pakistan), Middle East, Africa and Latin America. Brucellosis incur considerable economic losses in livestock due to reduced productivity, abortions and weak offspring and is a major impediment for trade and export. Human brucellosis is a severely debilitating

disease that requires prolonged treatment with a combination of antibiotics often leaving permanent and disabling sequelae and results in considerable medical expenses in addition to loss of income due to loss of working hours. Thus, its prevention control and eradication are a major challenge for public health programs. The presence of brucellosis in the livestock populations of the Punjab was established during the first ever cross-sectional survey (conducted from 28.12.2014 to 18.03.2015) to be present in all three regions of the Province (North Punjab, Central Punjab, and South Punjab). Epidemiological evidences, gleaned through that study, indicate its presence in cattle, buffaloes, sheep and goats. In the Punjab, during the financial year 2013-14, a total of 4.1 million cattle and buffaloes were served through artificial insemination (Khalid, 2015). This means

that natural breeding was used in all other cases of estrus. Again in case of small ruminants, camels, donkeys, and horses natural breeding is the exclusive way. Natural mating allows for the transfer of venereal diseases like brucellosis between males and females. So brucellosis infected carrier males pose a threat for the dissemination of infection to the population. Earnest study was required to determine the true status of brucellosis in males of all livestock species.

Livestock & Dairy Development (L&DD) Department Punjab is charged with protecting and improving the health, quality and marketability of livestock, rural poultry and products thereof by



preventing, controlling and/ or eliminating diseases, and monitoring and promoting their health and productivity. Central to the ability to carry out that charge, and the crux of appropriate application of disease control strategies is the timely, efficient and accurate collection and analysis of surveillance data. The main purpose of surveillance is to provide information to the policy makers of L&DD Punjab, thereby enabling them for appropriate and timely decisions for disease prevention and control. That is why disease surveillance is the core activity of L&DD Punjab. It is illogical to establish a disease control program for an unimportant disease, while more important diseases remain uncontrolled. With limited funds, it would be appropriate for L&DD Punjab to prioritize surveillance of those diseases that have a direct impact on the well-being of the farmers. Considering the equivalency requirements of World Organization for Animal Health (OIE), which demand all countries of the world to ensure transparency in global animal health

situation, the worthy ***Secretary Livestock Govt. of the Punjab*** envisioned to conduct a cross-sectional survey throughout the Punjab province to identify hotspots and to gauge the magnitude and impact of endo-parasites, haemo-parasites, brucellosis and sub-clinical mastitis among livestock populations of the Punjab.

In addition to endo-parasites, ticks and vector-borne diseases (VBDs) reduce the productivity of livestock or cause mortality which, in turn, can affect more than one type of capital assets. In the Punjab, these diseases pose a threat to livestock production. The costs associated with VBDs include direct losses (from mortality and reduced production) and the costs associated with control and treatment. With the successful completion of first Cross-sectional Survey (CSS), the need for the similar study on the prevalence of haemo-parasites in livestock populations during summer, brucellosis among male (particularly breeding ones) livestock and endo-parasites in equines and camelids was realized. The worthy ***Secretary L&DD*** Punjab addressed this need and launched the second cross sectional survey of the livestock populations of the Punjab for priority setting, scenario analysis and institution of remedial measures. This survey was conducted from June 21, 2015 to September 15, 2015 at village level in all districts of Punjab with the following clear cut objectives:

- To determine of magnitude of endo-parasitism in the equid and camelid populations,
- To determine the current status of haemo-parasites among all livestock populations,
- To determine the current status of brucellosis among male animals,
- To demonstrate Surf Field Mastitis Test at village level.

The intelligence gleaned though this study would be the basis for the right-positioning of all available resources (material, mental and human) available with the L&DD Punjab to institutionalize the requisite sanitary and phyto-sanitary measures with the aim to achieve following goals:

- To partake in international trade of livestock and livestock based commodities.
- To uplift the socio-economic condition of the poor and marginalized segments of the Punjabi society, i.e., landless and rural womenfolk whose subsistence is directly linked with the health and productivity of livestock.

METHODOLOGY

This cross sectional epidemiological survey was conducted by the Directorate of Animal Disease Reporting and Surveillance, from June 20, 2015 to September 15, 2015, in order to assess the magnitude and distribution of economically important livestock diseases. A total of 18543 villages and 40821 farmers / households were visited by deputed staff of District Diagnostic Laboratories for collection of faecal, blood, and serum samples from livestock populations according to Standing Operating Procedures (Appendix A). Faecal (n= 68520), blood (n= 445747), and serum (n= 63027) samples were collected and analyzed for detection of endo-parasites, haemo-parasites, and brucellosis. About one percent of population of each species of livestock was sampled to measure the prevalence of haemo-parasites. Breeding cattle bulls, buffalo bulls, bucks, rams, stallions, jack donkeys and camel bulls were targeted to collect serum samples for measuring the prevalence of Brucellosis. Working donkeys/ mules/ horses and camels were sampled for coprological examination. Concentration procedures of flotation (centrifugal or passive) and sedimentation (Gadahi *et al*., 2011) were used for coprological examination of faeces of working equids and camelids for endo-parasites. Field stained thin blood smears (Endriss *et al*., 2005) were used to differentiate blood parasites in

all livestock species of either sex. Blood samples were collected from jugular vein or marginal ear vein or transverse facial vein of heavily tick-infested animals of all age groups. Rose Bengal Plate Test (Swai & Schoonman, 2010) was used to screen male breeding stock of each livestock species for brucellosis. At least one demonstration of Surf Field Mastitis Test was given at each village visited for sample collection.

Daily progress report was submitted by each District Diagnostic Laboratory through SMS and Email on prescribed pro formas (*Appendices B & C*) to Directorate of Animal Disease Reporting & Surveillance 16-Cooper Road Lahore. Results of the surveillance were recorded on prescribed pro formas (*Appendices D to G*) and upload on SPMS-L&DD Punjab database through ICT based virtual system of e-communication on daily basis.

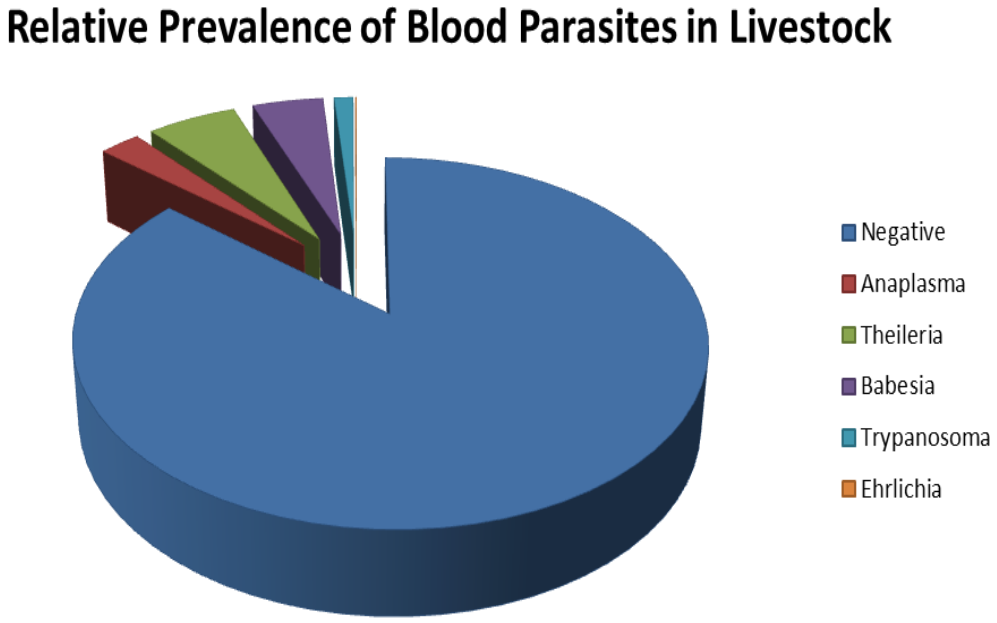
Point prevalence is amount of disease in a population at a particular point in time. For aforementioned attributes point prevalence was estimated according to recommendations of Thrusfield (2005) using following model:

$$P = \frac{Number\ of\ Cases\ of\ Diseases\ at\ a\ Particular\ Point\ in\ Time}{Population\ at\ Risk\ at\ that\ Point\ in\ Time}$$

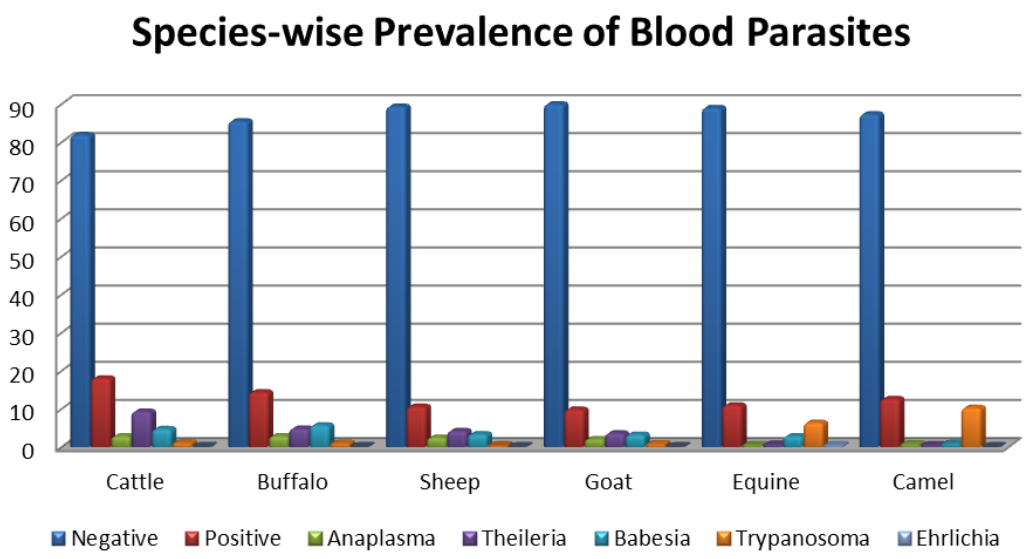
QUANTUM OF ENEMIES LURKING IN THE BACKYARD

VECTOR-BORNE DISEASES

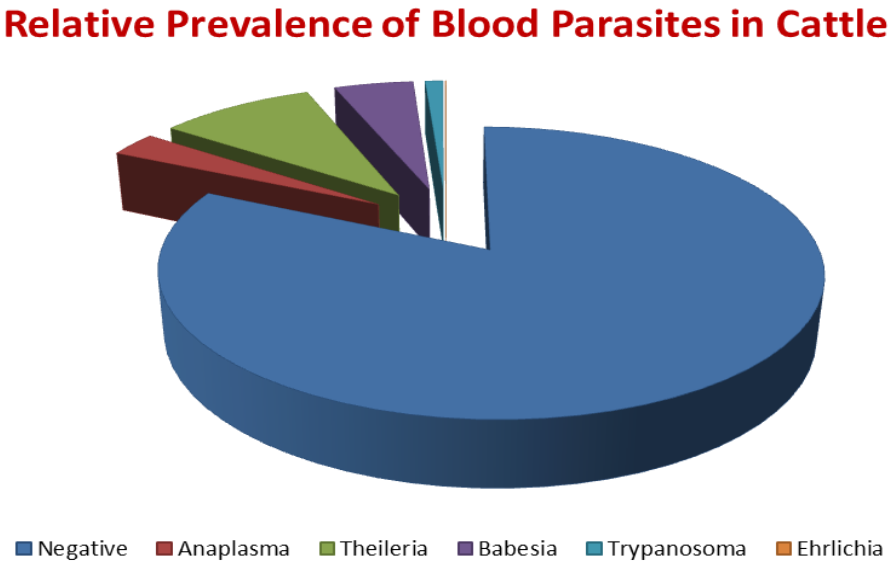
Out of the blood samples collected, 13.79% of blood samples exhibited positive outcome for haemo-parasites. Theileria was by far the most prevalent parasite (5.6%) followed by Babesia (4.5%), Anaplasma (2.6%), Trypanosma (1.2%), and Ehrlichia (0.1%).



The highest prevalence of blood parasites is recorded in cattle (18.1%) followed by buffaloes (14.4%), camels (12.6%), equine & sheep (11% each), and goats (10%).

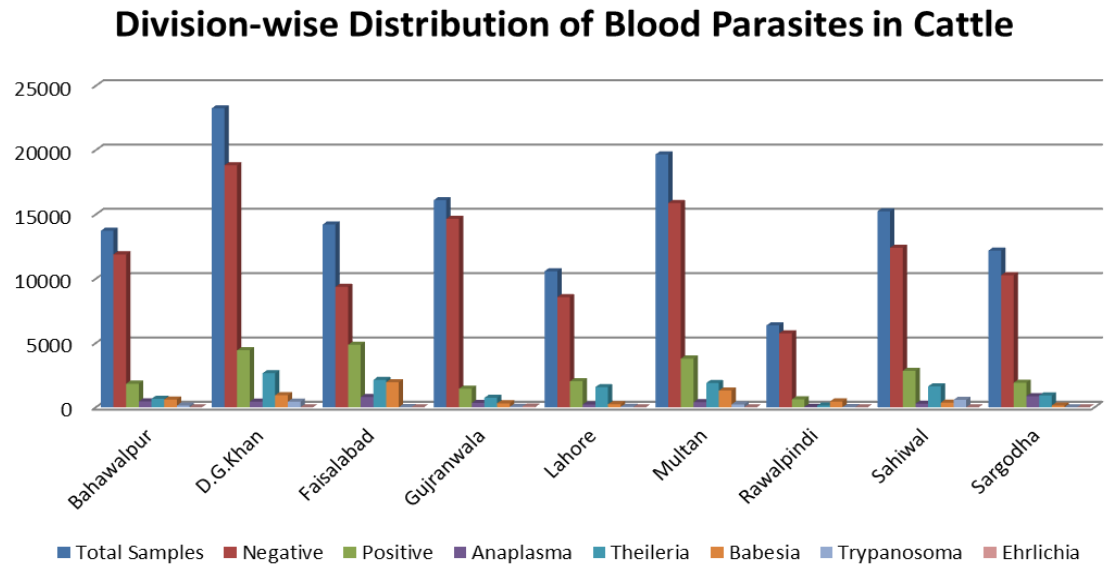


Among Cattle population, theileria is the most prevalent (9.3%) followed by Babesia (4.7%), Anaplasma (2.9%), Trypanosoma (1.1%), and Ehrlichia (0.04%). Relative prevalence of blood parasites in cattle population is given in the charts below:

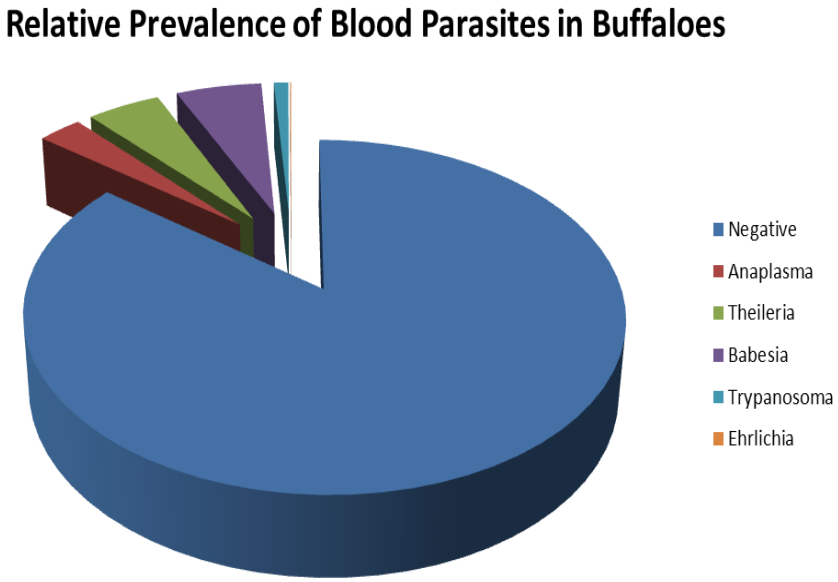


Among cattle population of the Punjab, the highest prevalence of Theileriosis (15%), Babesiosis (13.6%), Anaplasmosis (5.5%), Trypanosomiasis (3.7%),

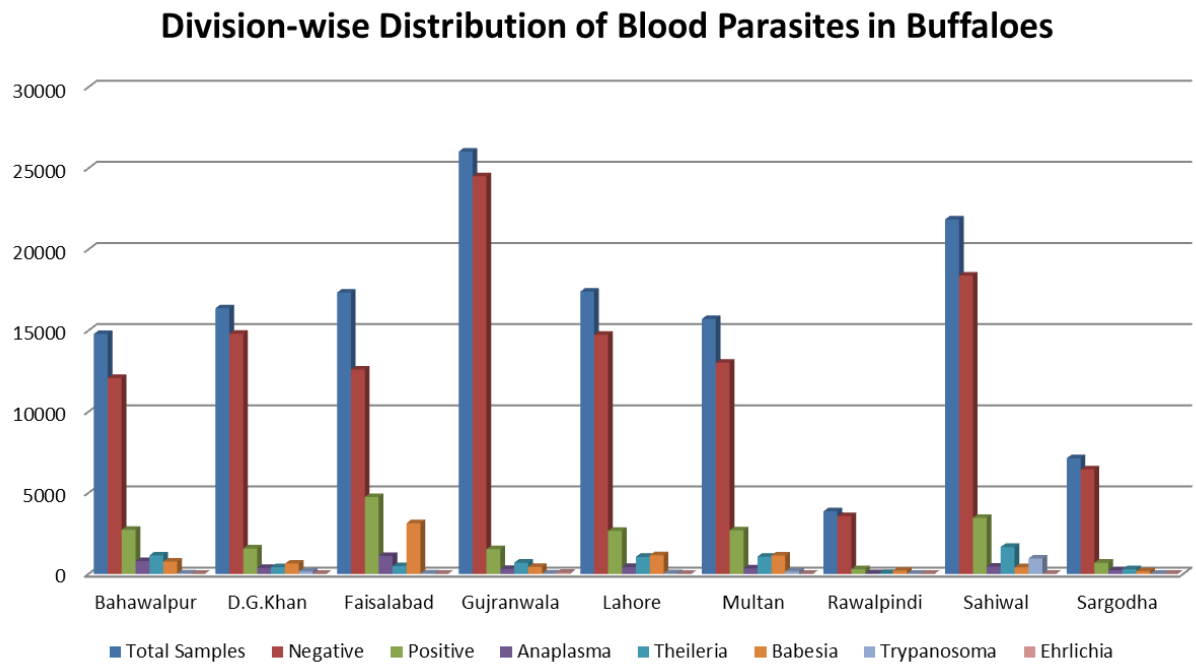
and Ehrlichiosis (0.3%) is recorded in Faisalabad & Lahore divisions, Faisalabad division, Faisalabad division, Sahiwal division, and Gujranwala division, respectively. In Faisalabad division the highest prevalence (4.6%) of theileriosis is recorded in the Faisalabad district followed by Chiniot district (4%), Toba Tek Singh district (3.9%), and Jhang district (2.4%). In Lahore division the highest prevalence (7%) of Theileriosis is recorded in Sheikhupura district followed by 3% in Lahore & Nankana districts, and 1.5% in Kasur district. In Faisalabad division the highest prevalence (8.4%) of Babesiosis is recorded in Jhang district. In Faisalabad division the highest prevalence (3.9%) of Anaplasmosis is recorded in the Faisalabad district followed by 1.45% in the Jhang district. In Sahiwal division the highest prevalence (2.3%) of Trypanosomiasis is recorded in the Sahiwal district followed by 1.4% in Pakpattan district. The highest prevalence (0.3%) of Ehrlichiosis is recorded in the Hafizabad district of Gujranwala division. Division-wise distribution of blood parasites is given in the chart below:



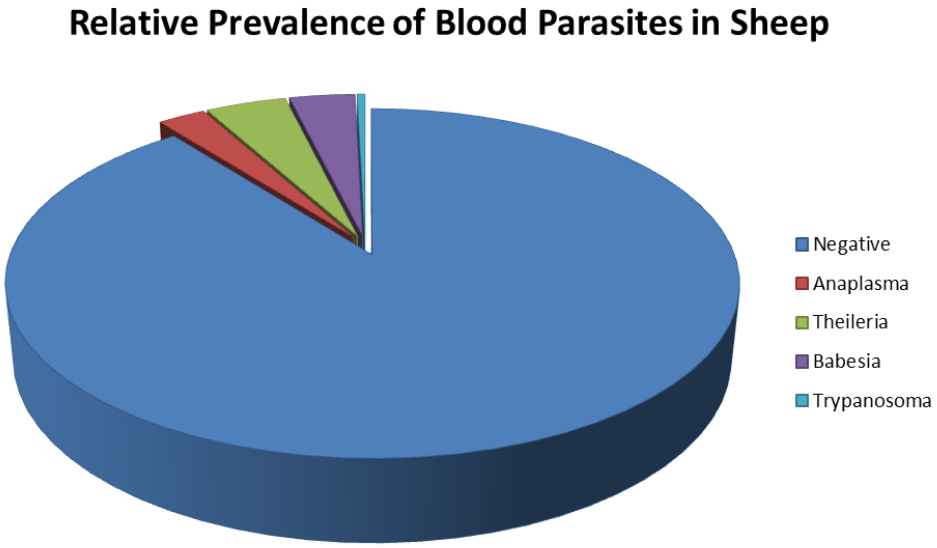
Among buffalo population, Babesia is the most prevalent (5.69%) followed by Theileria (4.86%), Anaplasma (2.89%), Trypanosoma (0.96%) and Ehrlichia (0.05%).



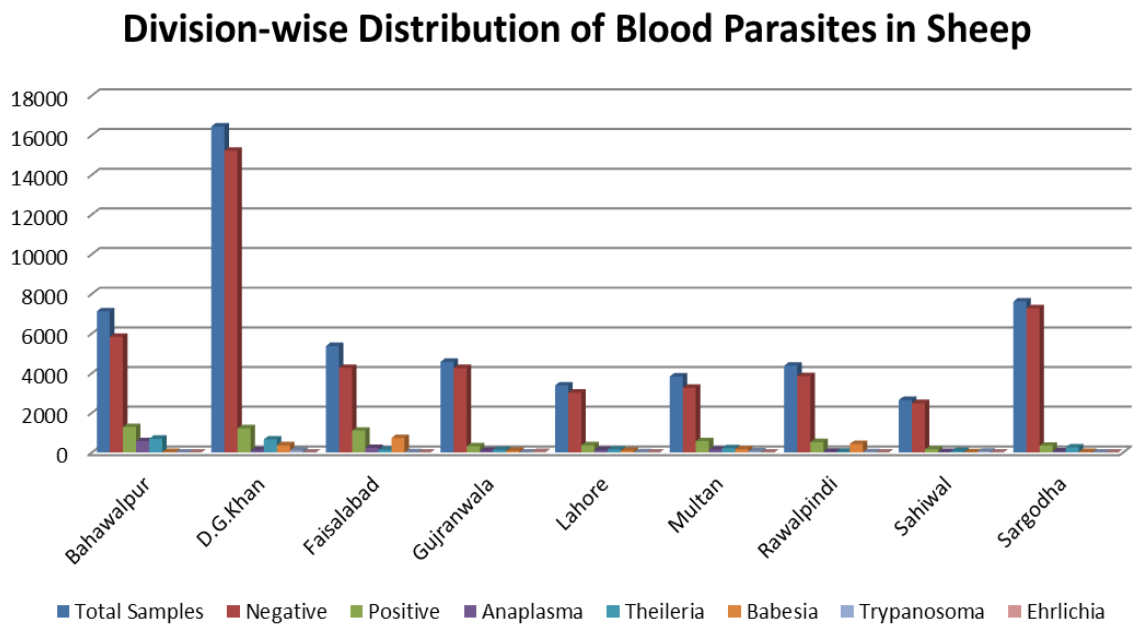
Among buffalo population of the Punjab, highest prevalence of Theileriosis (8%), Babesiosis (18%), Anaplasmosis (6.4%), and Trypanosomiasis (4.3%) is recorded in Bahawalpur & Sahiwal divisions, Faisalabad division, Faisalabad division, and Sahiwal division, respectively. In Bahawalpur and Sahiwal divisions the highest prevalence of Theileriosis is recorded in district Rahim Yar Khan (5.6%) and district Sahiwal (3.3%). In Faisalabad division the highest prevalence (8.2%) of Babesiosis (8.2%) and Anaplasmosis (3.6%) is recorded in the district Jhang and district Faisalabad, respectively. In Sahiwal division, the highest prevalence (2.3%) of Trypanosomiasis is recorded in district Sahiwal followed by district Pakpattan (2%). No case of Ehrlichiosis was recorded in buffalo population during the present study. Division-wise prevalence of blood parasites is given in the chart below:



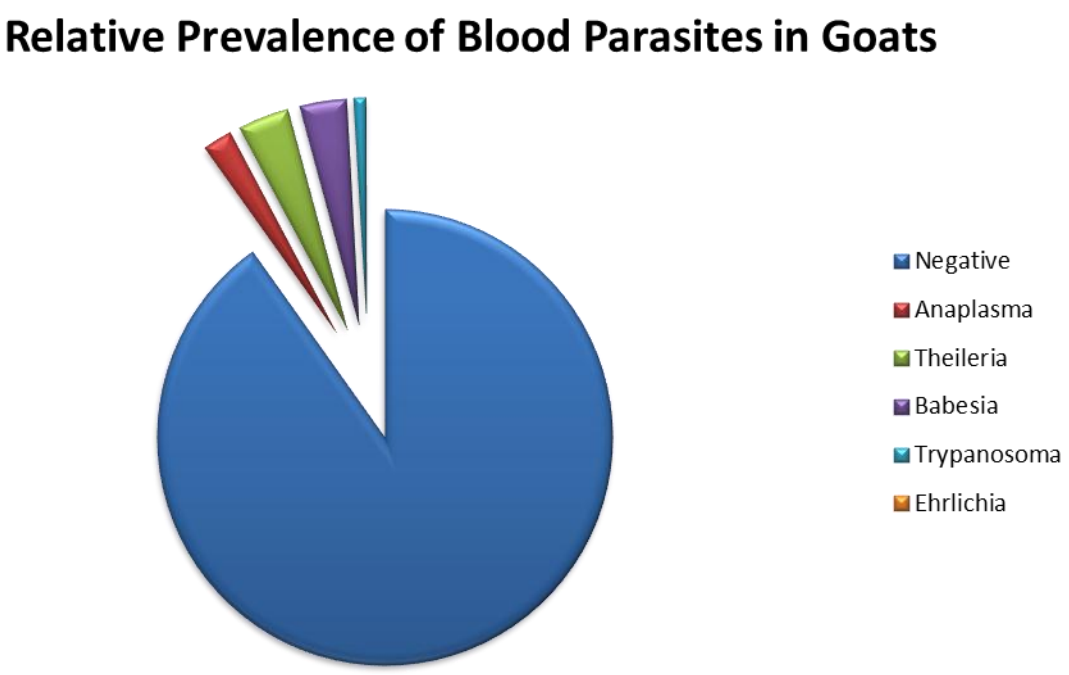
Among Sheep, the most prevalent haemo-parasite is Theileria (4.23%) followed by Babesia (3.4%), Anaplasma (2.5%), Trypanosoma (0.4%), and Ehrlichia (0.05%).



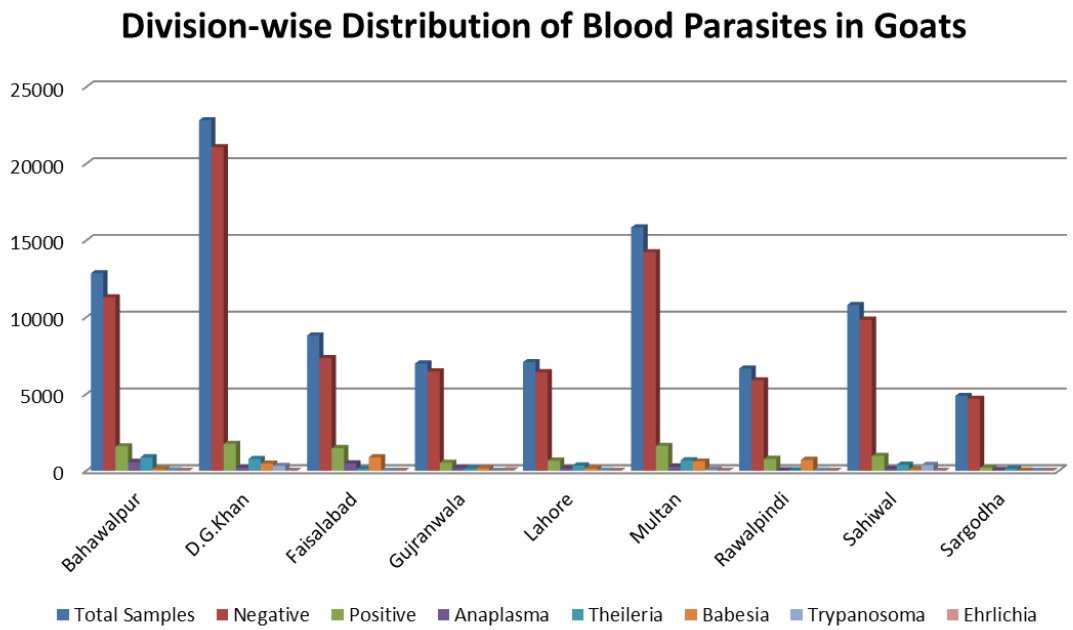
In sheep population of the Punjab, the highest prevalence of Anaplasmosis (8%) & Theileriosis (9.7%), Babesiosis (13.6%), Trypanosomiasis (1.8%), and Ehrlichiosis (0.6%) is recorded in the Bahawalpur division, Faisalabad division, Sahiwal division, and Gujranwala division, respectively. In Bahawalpur division, the highest prevalence of Anaplasmosis (6.4%) and Theileriosis (9.7%) is recorded in district Rahim Yar Khan. In Faisalabad division, the highest prevalence (10.6%) of Babesiosis is recorded in the district Jhang. In Sahwal division, the highest prevalence of Trypanosomiasis is recorded in the district Pakpattan. In Gujranwala division, the highest prevalence (0.6%) of Ehrlichiosis is recorded in district Hafizabad. Division-wise distribution of blood parasites is given in the chart below:



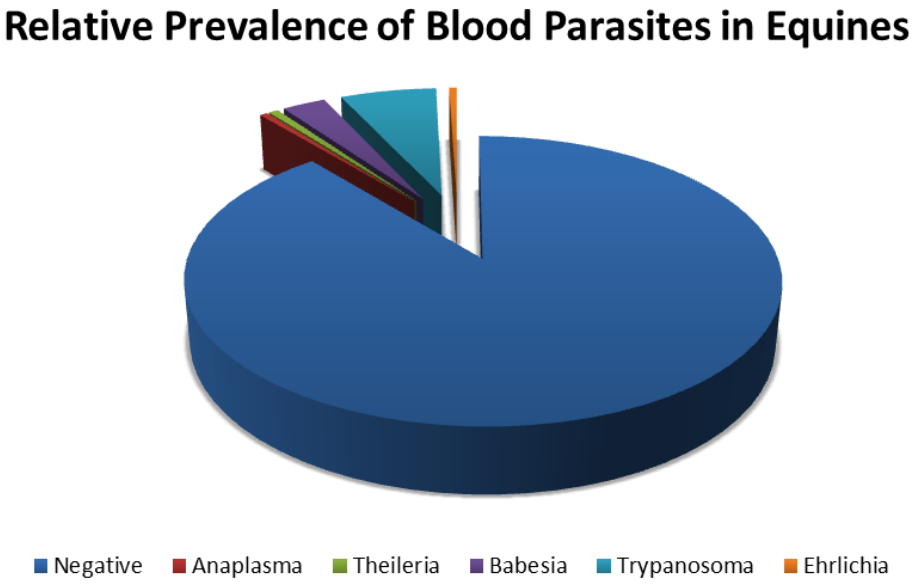
Among Goats, the most prevalent haemo-parasite is Theileria (3.6%), Babesia (3.27%), Anaplasma (2.1%), Trypanosoma (0.83%), and Ehrlichia (0.027%).



In goats, the highest prevalence of Anaplasmosis (5.45%), Theileriosis (6.8%), Babesiosis (10.7%), Trypanosomiasis (3.5%), and Ehrlichiosis (0.38%) is recorded in the Faisalabad division, Bahawalpur division, Rawalpindi division, Sahiwal division, and Gujranwala division, respectively. In Faisalabad division, the highest prevalence of Anaplasmosis is recorded in the district Faisalabad followed by 24.6% and 21.8% in districts Jhang and Toba Tek Singh, respectively. In Bahawalpur division, the highest prevalence (5.8%) of Theileriosis is recorded in the district Rahim Yar Khan. In Rawalpindi division, the highest prevalence (8.7%) of Babesiosis is recorded in district Attock; while in Faisalabad division, the highest prevalence (5.7%) of Babesiosis is recorded in district Jhang. In Sahiwal division, the highest prevalence (2.6%) of Trypanosomiasis is recorded in district Sahiwal followed by 0.9% in district Pakpattan. In Gujranwala division, the highest prevalence (0.4%) of Ehrilichiosis is recorded in the district Hafizabad. Division-wise distribution of haemo-parasites in goats is given in the chart below:

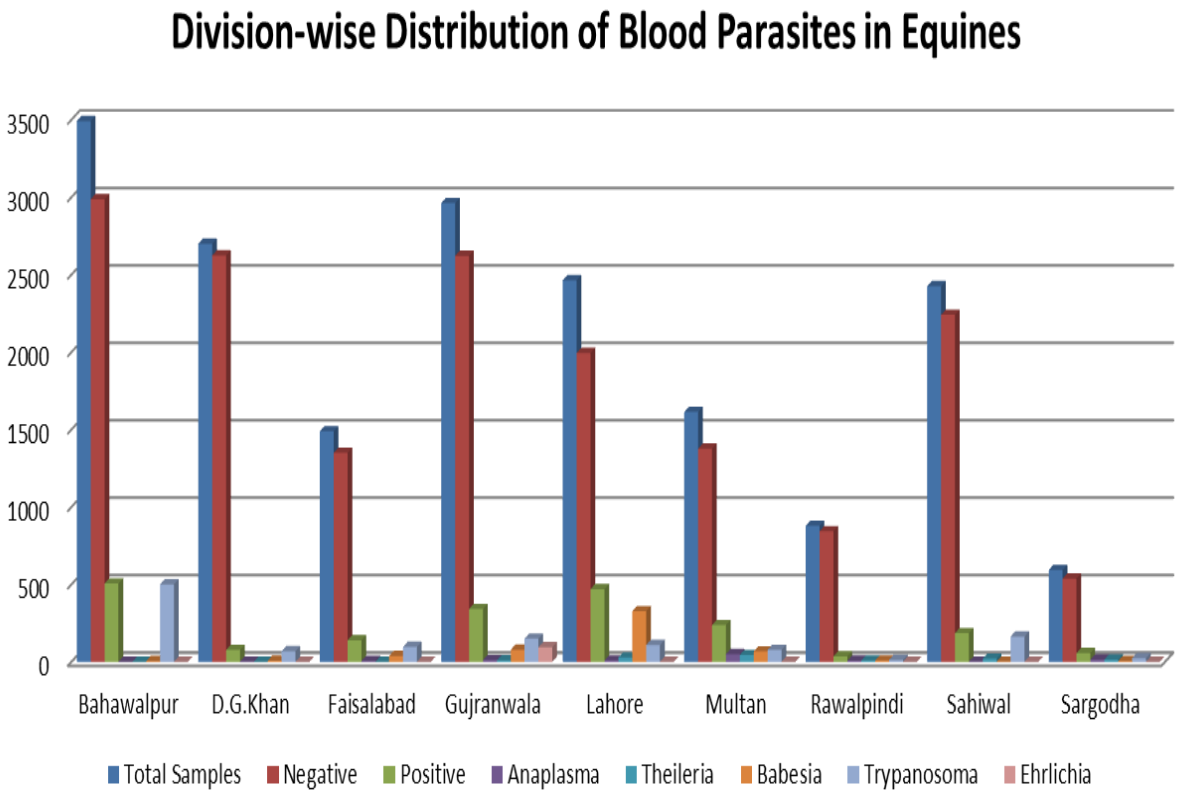


In Equines, Trypanosoma is the most prevalent haemo-parasites (6.4%) followed by Babesia (2.87%), Theileria (0.65%), Anaplasma (0.5%), and Ehrlichia (0.5%).



In Equine, the highest prevalence of Anaplasmosis (3%) & Theileriosis (2.7%), Babesiosis (13.2%), Trypanosomiasis (14.3%), and Ehrlichiosis (3.17%) is

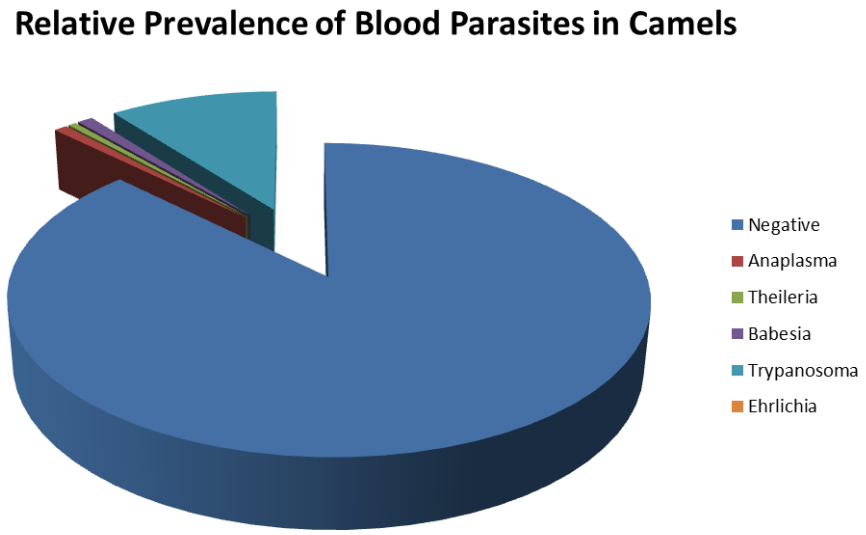
recorded in the Multan division, Lahore division, Bahawalpur division, and Gujranwala division, respectively. In Multan division, the highest prevalence of Anaplasmaosis (2.5%) and Theileriosis (1.9%) is recorded in the district Lodhran. In Lahore division, the highest prevalence (12.7%) of Babesiosis is recorded in the district Nankana. In Bahawalpur division, the highest prevalence (13.9%) of Trypanosomiasis is recorded in the district Rahim Yar Khan. In Gujranwala division, the highest prevalence (3.2%) of Ehrlichiosis is recorded in the district Hafizabad. Division-wise distribution of blood parasites is given in the chart below:



Small strongyles (cyathostomins or small red worms), large strongyles (blood worms or red worms), pinworms (*Oxyuris equi*) and *Parascaris equorum* are the nematodes recovered from the coprological analysis of donkey population.

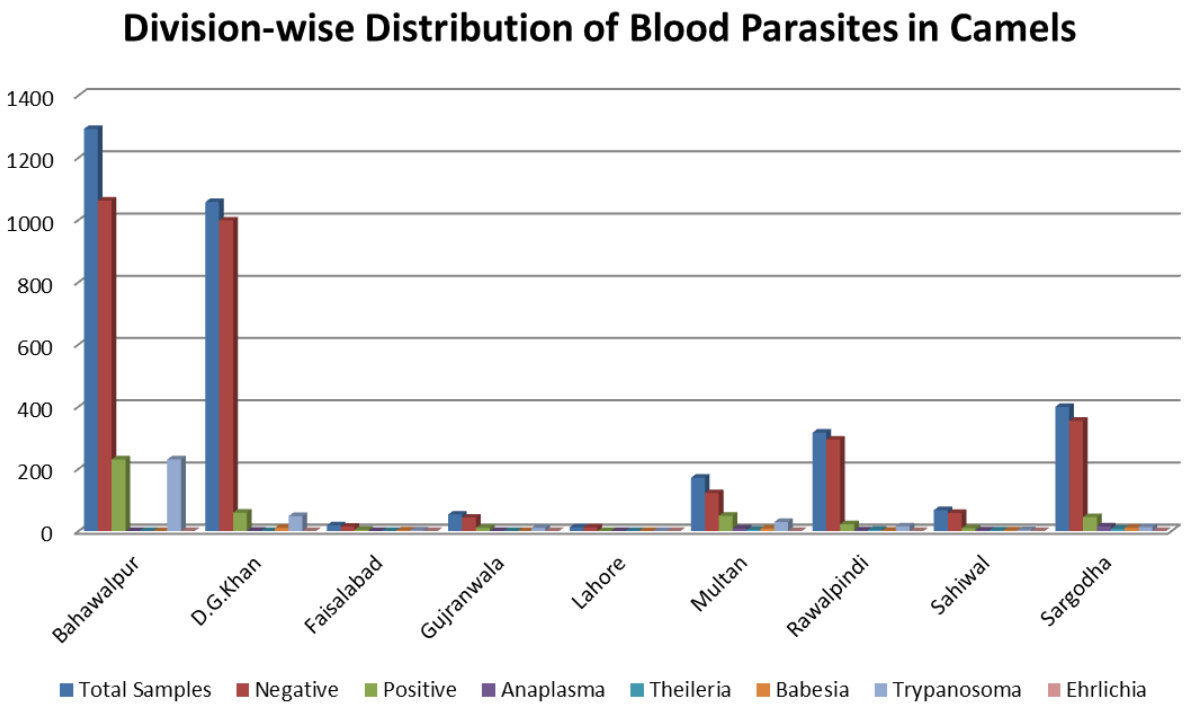
These parasites can cause extensive internal damage. Effects of these nematodes range from a dull hair coat and unthriftiness to colic and death.

Among Camels, the most prevalent blood parasite is Trypanosoma (10.33%) followed by Babesia (0.97%), Anaplasma (0.8%), and Theileria (0.5%).



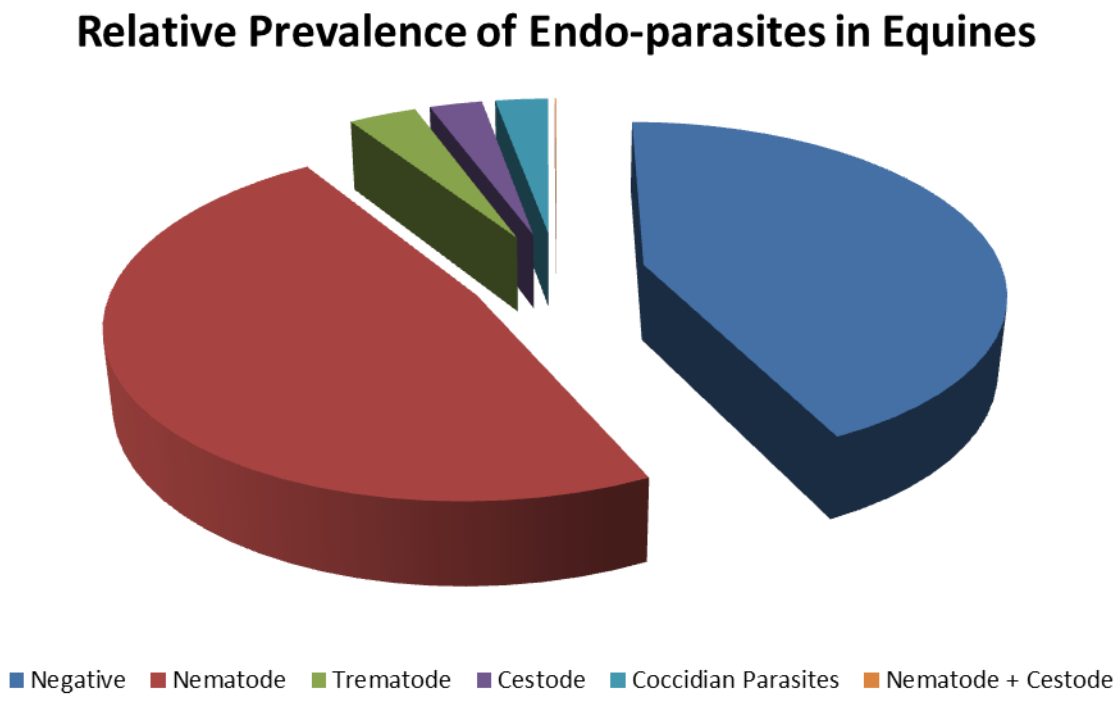
In camels, the highest prevalence of Anaplasmosis (4.7%), Theileriosis (3%), Babesiosis (11.1%), and Trypanosomiasis (18.9%) is recorded in the Multan division, Sahiwal division, Faisalabad division, and Gujranwala division, respectively. In Multan division, the highest prevalence (2.9%) of Anaplasmosis is recorded in the district Lodhran. In Sahiwal division, the highest prevalence (1.5%) of Theileriosis is recorded in camel population of the Sahiwal and Pakpattan districts. In Faisalabad division, the highest prevalence (11.1%) of Babesiosis is recorded in the district Jhang. The prevalence of Trypanosomiasis in Bahawalpur, Gujranwala and Multan divisions is 17.8%, 18.9%, and 17%, respectively. In Bahawalpur division, the highest prevalence (14.6%) of Trypanosomiasis is recorded in the district Rahim Yar Khan. In Gujranwala division, the highest prevalence (18.9%) is recorded in the district

Hafizabad. In Multan division, the highest prevalence (6.4%) is recorded in the district Lodhran followed by district Vehari (5.8%). No case of Ehrlichiosis is recorded in camels in the present study



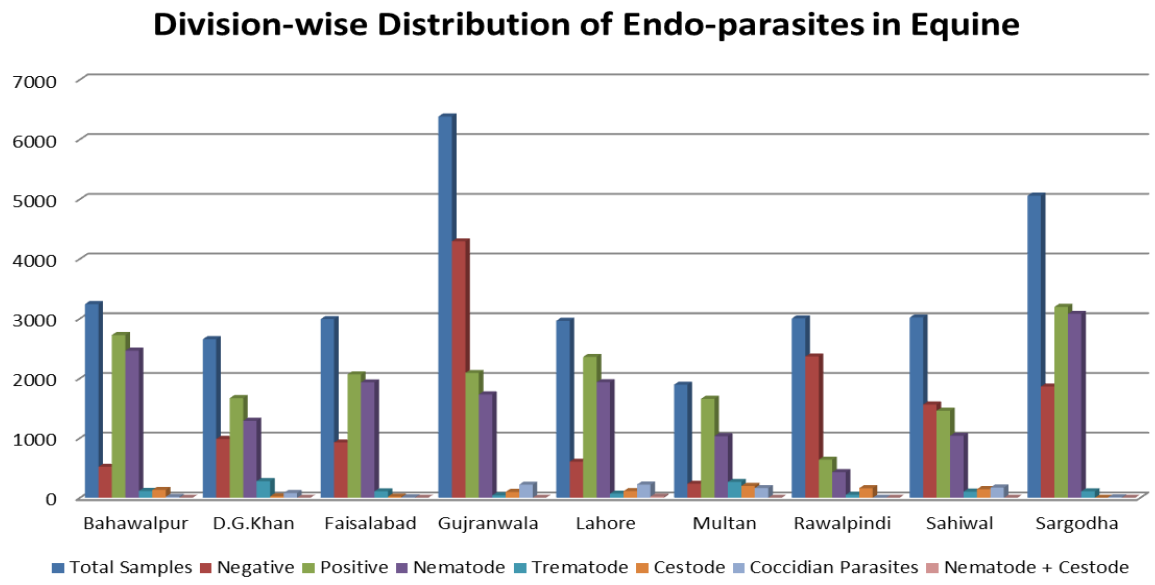
ENDO-PARASITES OF EQUINE & CAMELS

Faecal examination of working equines (donkeys, mules, horses) indicates that Nematodes are the most prevalent (47.8%) followed by Trematodes (3.6%), Cestodes & Coccidian Parasites (2.8% each), and a mixed infestation of Nematodes & Cestodes (0.07%). The relative prevalence of endo-parasites in equines of poor farmers and cart owners is given in the chart below:

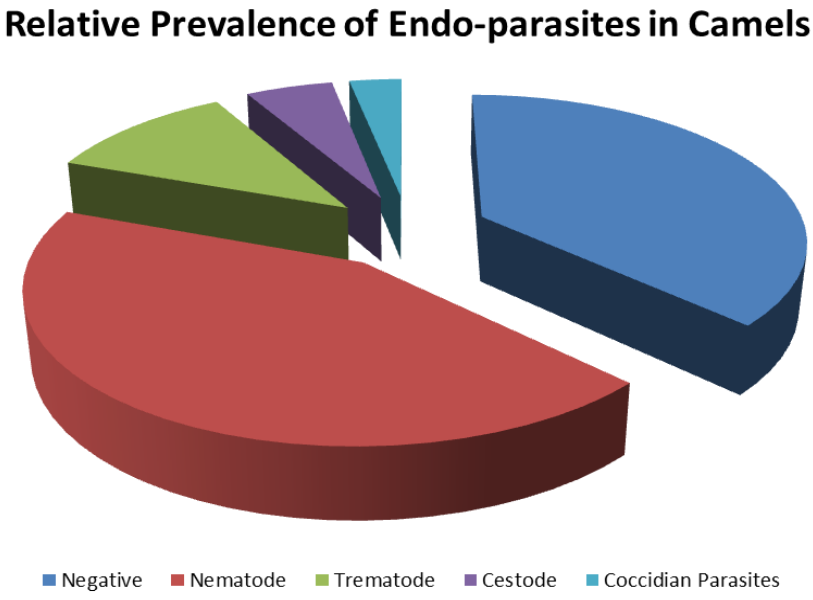


Among working equines, the highest prevalence (75.9%) of Nematodes is recorded in Bahawalpur division. The highest prevalence of Trematodes (14%), Cestodes (10.5%), and Coccidian Parasites (8.6%) is found in the Multan division. The highest prevalene of mixed infestation of Nematodes + Cestodes (0.7%) is found in the district Lahore. In Bahawalpur division, the highest prevalence (62.75%) of Nematodes is recorded in the district Rahim Yar Khan followed by the district Bahawalnagar (12.85%). In Multan division, the highest prevalence of Trematodes (7.87%), and Cestodes (3.69%) & Coccidian Parasites (5.54%) is recorded in the

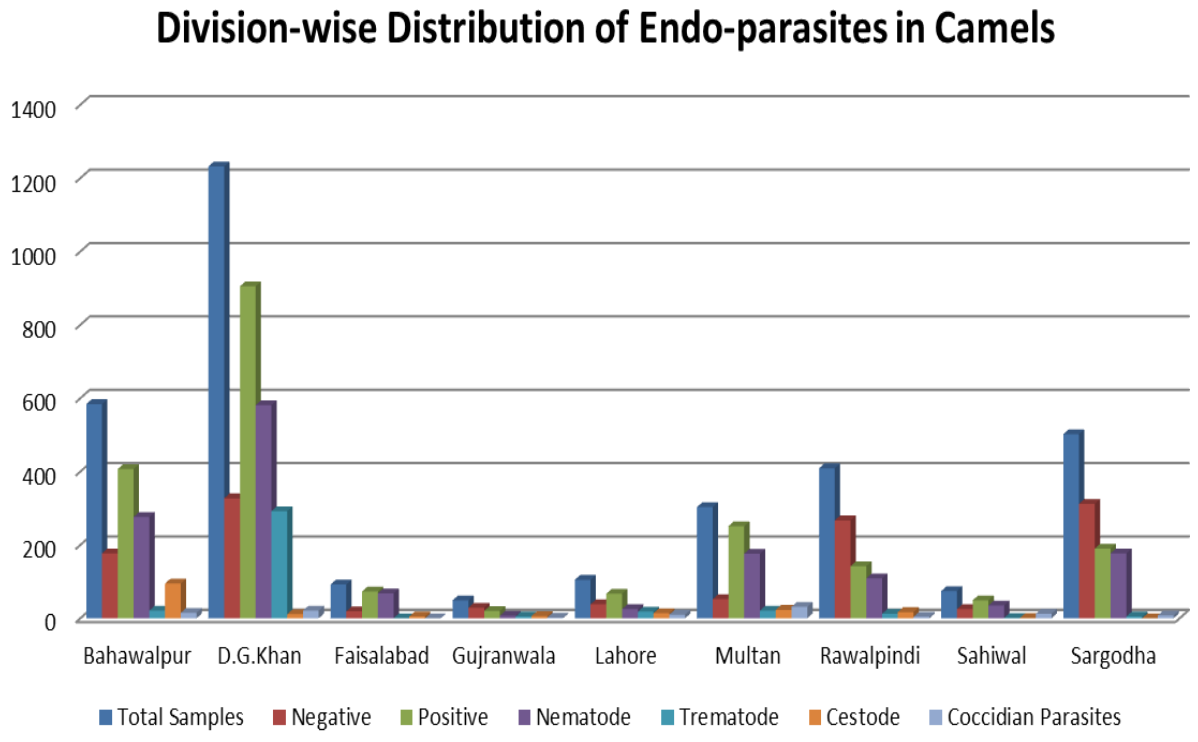
districts Lodhran, and Vehari, respectively. Division-wise distribution of endo-parasites is given in the chart below:



Faecal examination of camels indicate that the highest prevalence is of Nematodes (43.4%) followed by Trematodes (11.19%), Cestodes (5.13%), and Coccidian Parasites (3.07%). The relative prevalence of endo-parasites in camels is given in the chart below:

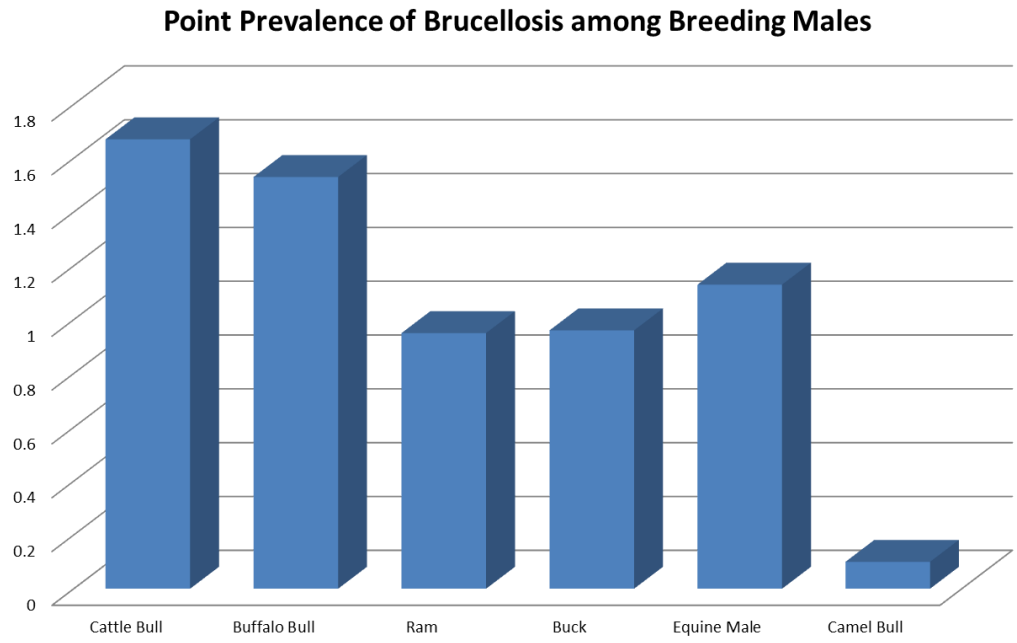


Trichostrongylus, Ostertagia, Strongyloides, Haemonchus, Cooperia, Moniezia and Fasciola are the major endo-parasites recovered during this study. Among camels, the highest prevalence of Nematodes (73.9%), Trematodes (23.7%), Cestodes (16.3%), and Coccidian Parasites (16.2%) is found in the Faisalabad, Dera Ghazi Khan, Rawalpindi, and Sahiwal divisions, respectively. In Faisalabad division, the highest prevalence of Nematodes is recorded in the district Faisalabad (42.39%) followed by 28.26% in the district Jhang. In D. G. Khan division, the highest prevalence of Trematodes is recorded in the district Muzaffargarh (17%) followed by 4.38% in the district D. G. Khan. In Rawalpindi division, the highest prevalence (3.9%) of Cestodes is recorded in the district Rawalpindi. In Sahiwal division, the highest prevalence (13.5%) of Coccidian Parasites is recorded in the district Sahiwal. Division-wise distribution of endo-parasites in camels is presented in the chart below:



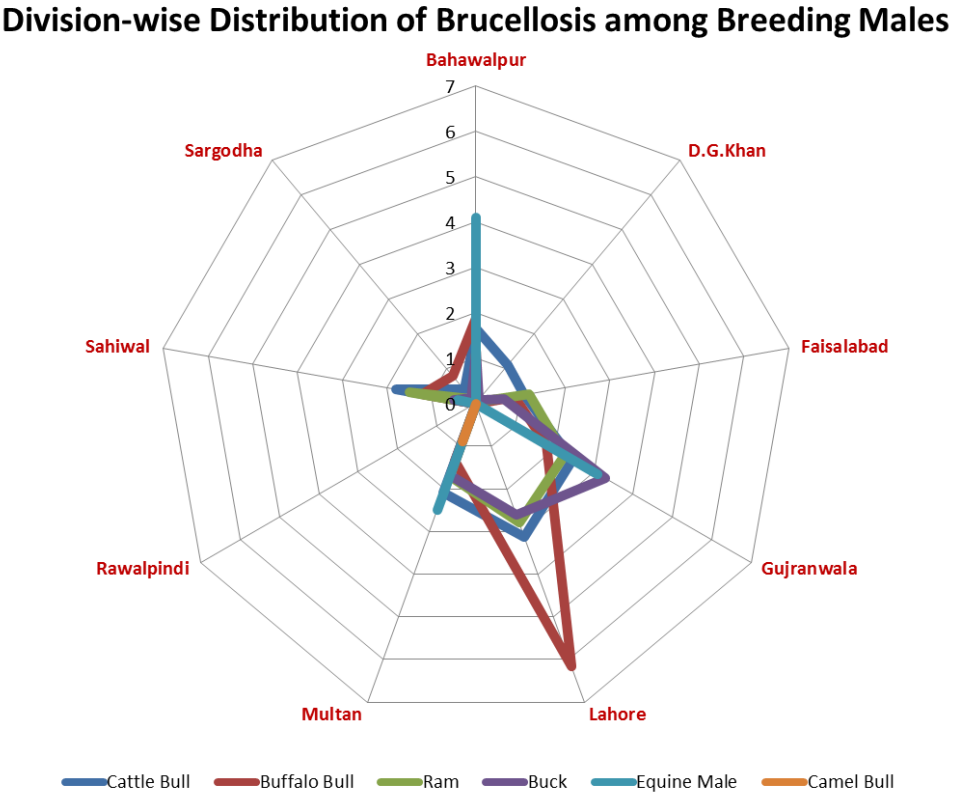
BRUCELLOSIS AMONG BREEDING MALES

During the present study the overall prevalence of brucellosis among breeding males of all livestock is recorded to be 1.25%. The point prevalence of brucellosis among breeding cattle bulls, buffalo bulls, rams, bucks, stallions/ jack donkeys, and camel bull is 7.4%, 10.8%, 5%, 6.3%, 8.7%, and 6.6%, respectively. The point prevalence of brucellosis among males of various livestock species is given in the chart below:



The highest prevalence of brucellosis among breeding cattle bulls (3.13%), breeding buffalo bulls (6.15%), breeding rams (2.79%), and breeding bucks (2.6%) is recorded in the Lahore division; whereas in breeding stallions & jacks (4.1%) and breeding camel bulls (0.89%) in the Bahawalpur and Multan divisions, respectively. In Lahore division, the highest prevalence of brucellosis among breeding cattle bulls (1.78%), breeding buffalo bulls (4.15%), and breeding rams (2.79%) is recorded in district Kasur; whereas among breeding buck (1.69%) in district Nankana. In Bahawalpur division, the highest prevalence of brucellosis

among breeding jacks/ stallions (2.7%) is recorded in the district Bahawalnagar followed by 1.36% in district Rahim Yar Khan. In Multan division, the highest prevalence of brucellosis among breeding camel bull (0.89%) in district Lodhran. Division-wise distribution of brucellosis among breeding males of all livestock species is presented in the chart below:



THE PUNCH LINES

In our society, working equines (donkeys, mules, horses, and hinnies) are raised and exploited as pack animals. Donkeys and mules are mainly used at brick kilns, for drawing sand from river bed and as pack animals. Due to their compact body and a docile nature ("no problem-no complaint" attitude) they are the poor man's companion and beast of burden. Working donkeys are overloaded in routine. Same is the case with working camels. These stoic and acquiescent poor animals are the most neglected ones among all the domesticated animals in the Punjabi society. On getting sick, there owners are penurious enough to treat them. That's why most of these poor animals have virtually never seen a veterinarian during their lifetime. Their impoverished owners not only have little knowledge of humane husbandry methods but are also least concerned about their welfare. These working donkeys and camels are seldom dewormed in routine. Understanding the grossly compromised welfare of these poor animals

L&DD Department Punjab embarked upon a cross-sectional survey to determine the brunt of endo-parasites among working equids and camelids in all ecological zones of the Punjab. In addition, prevalence of vector-borne diseases among all livestock species and brucellosis among breeding males of all livestock species was also on the agenda of this cross-sectional survey.

Cross-sectional studies are carried out at one time point or over a short period. They are usually conducted to estimate the prevalence of the outcome of interest for a given population, commonly for the purposes of veterinary public health planning (Levin, 2006). Present cross-sectional study was conducted throughout the Punjab with the following clear cut objectives:

- To describe the point prevalence of brucellosis among breeding males of all livestock species and its geo-nautical distribution.
- To describe the point prevalence of endo-parasitosis within equine and camel populations of the Punjab and their geo-nautical distribution.
- To describe the point prevalence of vector-borne diseases within the livestock populations of the Punjab and their geo-nautical distribution.

The information gleaned through this study would be used in veterinary public health policy planning and in the development of targeting strategies.

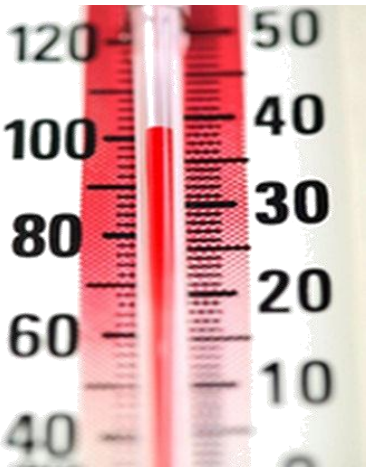
The parasites can have a negative effect on the productivity of livestock by:

- Reducing growth rates.
- Reducing reproductive rates.

- Causing condemnation of carcass parts at slaughter.
- Reducing milk production.
- Reducing fleece weight, fiber diameter and staple strength.
- Damaging hides and fleeces.

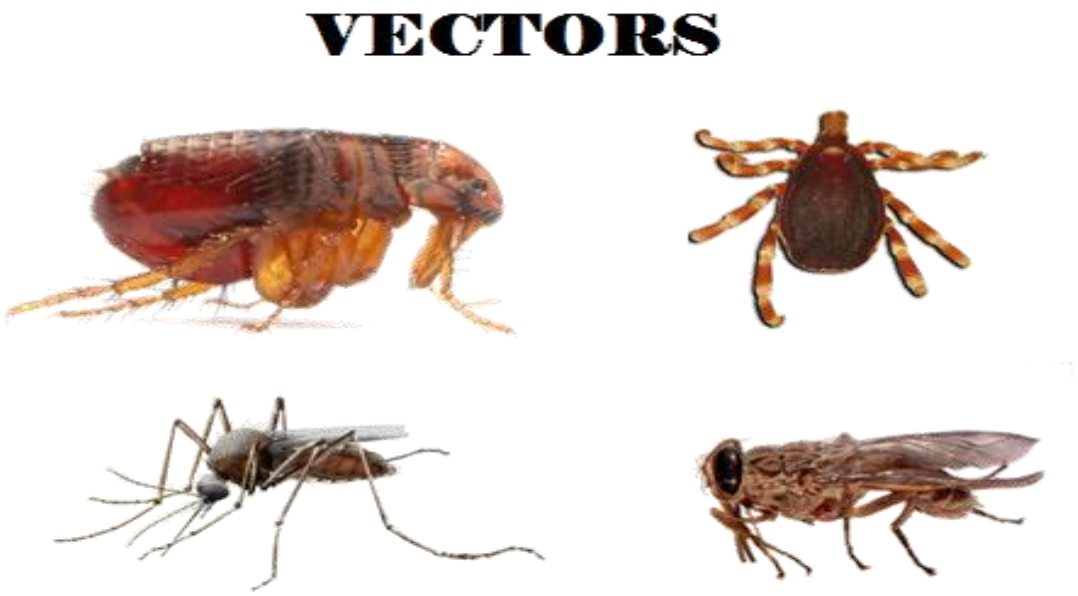
These negative effects of parasites are through lowered intake of food, poorer efficiency of nutrient use and nutrient loss, including blood loss into the digestive tract and intra-vascular hemolysis due to intra-erythrocytic parasites. Parasites take energy and proteins away from the animals. Resultantly the infested animals either succumb to infestation or got weak and wasted. The majority of the animals are not obviously affected but their productivity declines. Parasites of livestock can also be zoonoses, meaning humans can become infected as well e.g., hydatid tapeworm found in sheep.

Some ecto-parasites (mosquitoes, ticks, fleas, flies, etc.) also act as vector i.e., they carry and transmit parasitic, viral, bacterial and rickettsial diseases to livestock.



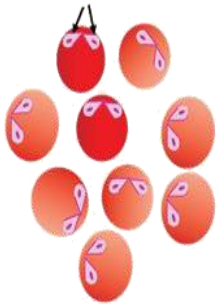
Climatic changes that are spurred by climate change – notably higher temperatures and greater humidity – increase the development, reproduction, and survival rates of vectors (disease-bearing ecto-parasites). These climate-related factors will also alter behavior of the vectors, influencing them to bite more often. Higher temperatures can also speed up pathogen development within vectors, and higher temperature and increased precipitation may also shift vectors' geographic range or result in their expansion

to higher elevations. These diseases reduce the productivity of livestock or cause mortality. Loss of an animal or reduction of its productivity can, in turn, affect more than one type of capital asset (Okorafor and Nzeako, 2014). In the present study five groups of vector-borne diseases (VBDs) were recorded in livestock populations: Anaplasmosis, Babesiosis, Theileriosis, Trypanosomiasis, and Ehrlichiosis. In the Punjab, these diseases pose a threat to livestock production. The costs associated with vector-borne diseases include direct losses (from mortality and reduced production) and the costs associated with control and treatment.

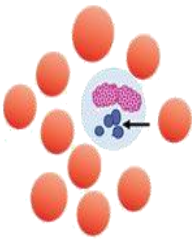


The most prevalent vector-borne disease (VBD), recorded during the present study, is Theileriosis followed by Babesiosis, Anaplasmosis, Trypanosomiasis, and Ehrlichiosis. The highest prevalence of VBDs is found in cattle followed by buffaloes, camels, equines, sheep, and goats.

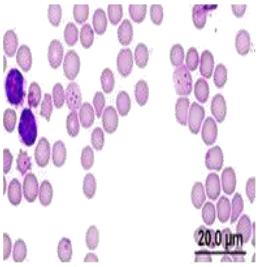
BABESIOISIS



ANAPLASMOSIS



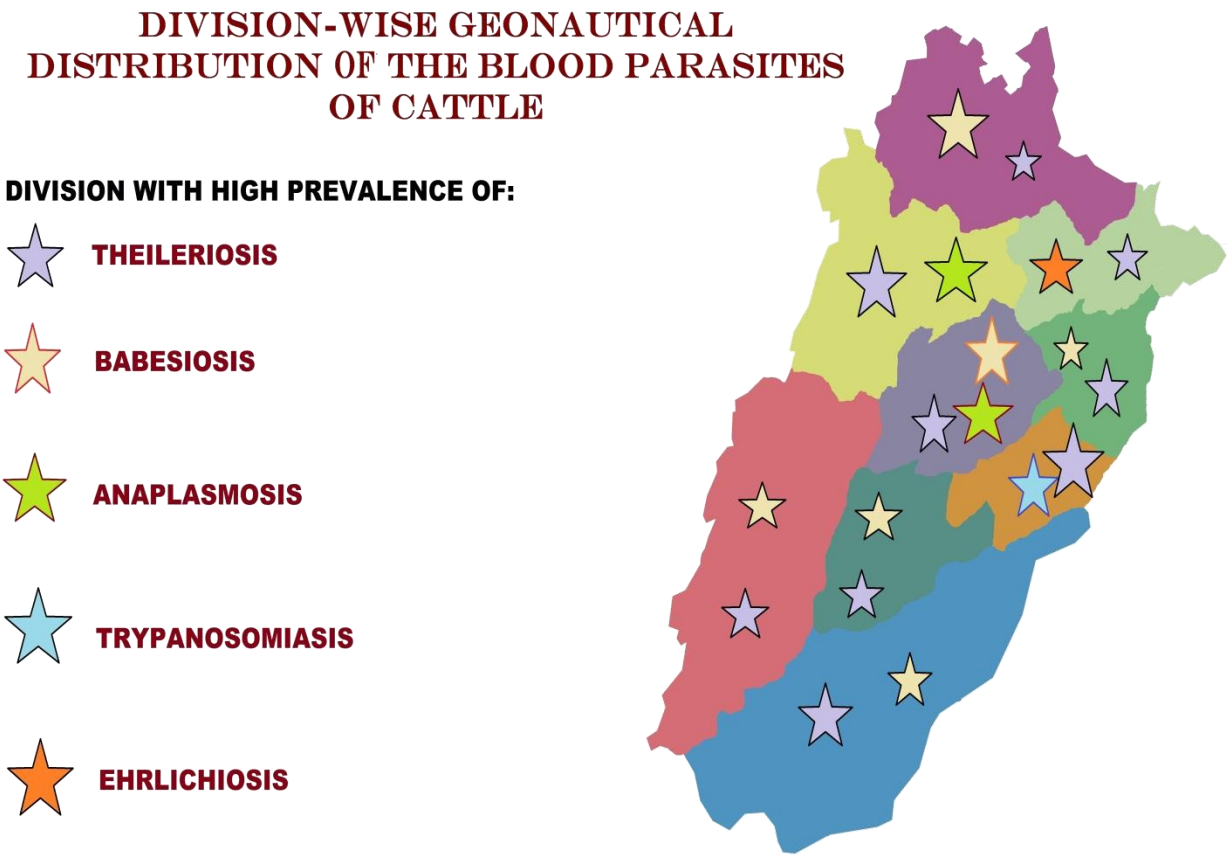
THEILERIOSIS



TRYPANOSOMIASIS

In cattle, Theileriosis is found to the most prevalent VBD, followed by Babesiosis and Anaplasmosis. Hot spots of Theileriosis in cattle are Faisalabad, D.G.Khan, Lahore, Multan and Sahiwal divisions. Faisalabad, Multan, and Rawalpindi divisions are the hot spots of Babesiosis in cattle; whereas Faisalabad and Sahiwal divisions are the infernos of Anaplasmosis and Trypanosomiasis in cattle.

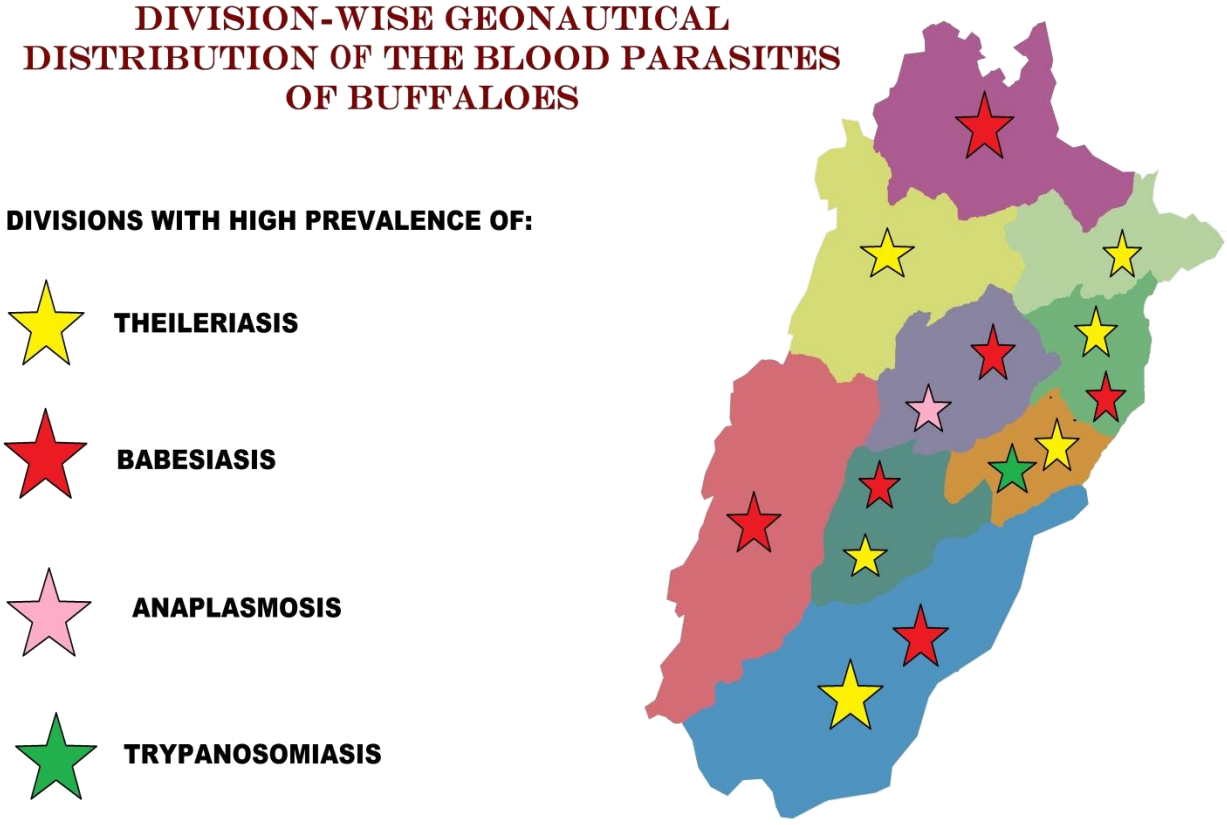
The geonautical distribution of major VBDs of cattle is presented in the map below:



Babesiosis is the major VBD among buffaloes followed by Theileriosis and Anaplasmosis. Faisalabad, Multan, Lahore, Rawalpindi, and Bahawalpur divisions are the hot spots of Babesiosis among buffaloes.

Bahawalpur, Sahiwal, Multan, and Lahore are the hot spots of Theileriosis among buffaloes. Faisalabad and Sahiwal divisions are the infernos of Anaplasmosis and Trypanosomiasis in buffaloes, respectively.

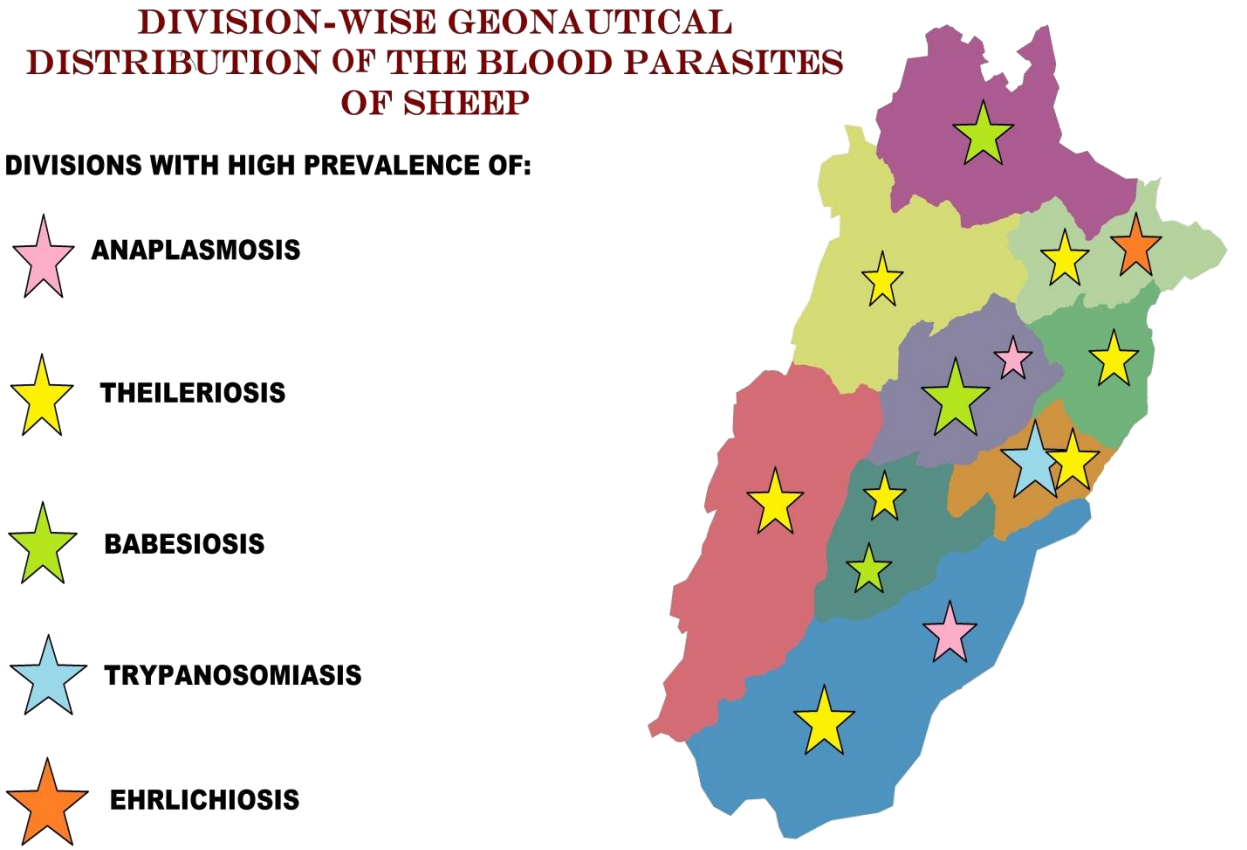
The geonautical distribution of major VBDs of buffaloes is presented in the map below:



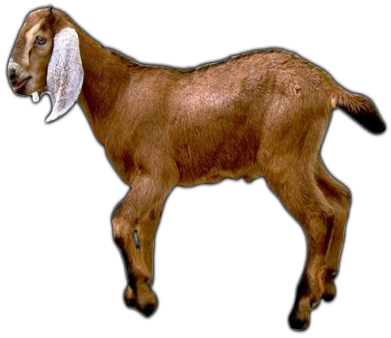
Among Sheep, Theileriosis being the most prevalent VBD is followed by Babesiosis and Anaplasmosis. Theileriosis is the most prevalent TBD among sheep population of Bahawalpur, Multan, Lahore, and D.G. Khan divisions. The highest prevalence of Babesiosis is recorded in the sheep populations of Faisalabad and Rawalpindi divisions.

The highest prevalence of Anaplasmosis is recorded in the Bahawalpur division.

The geonautical distribution of major VBDs of sheep is presented in the map below:

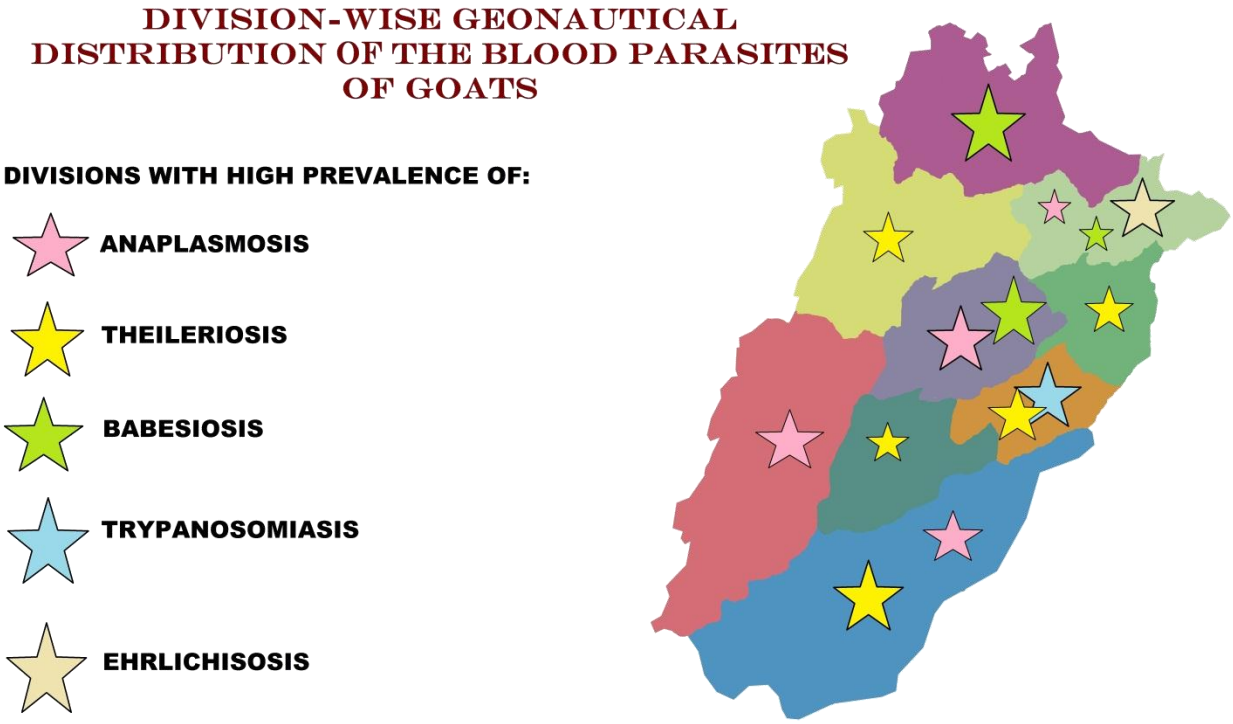


Among goats Theileriosis is the most prevalent VBD followed by Babesiosis and Anaplasmosis. The highest prevalence of Theileriosis is among the goat population of Bahawalpur and Multan divisions. Faisalabad and Rawalpindi divisions are the main infernos of Babesiosis among goats. The highest prevalence of Anaplasmosis and Trypanosomiasis in goats is in Faisalabad and Sahiwal



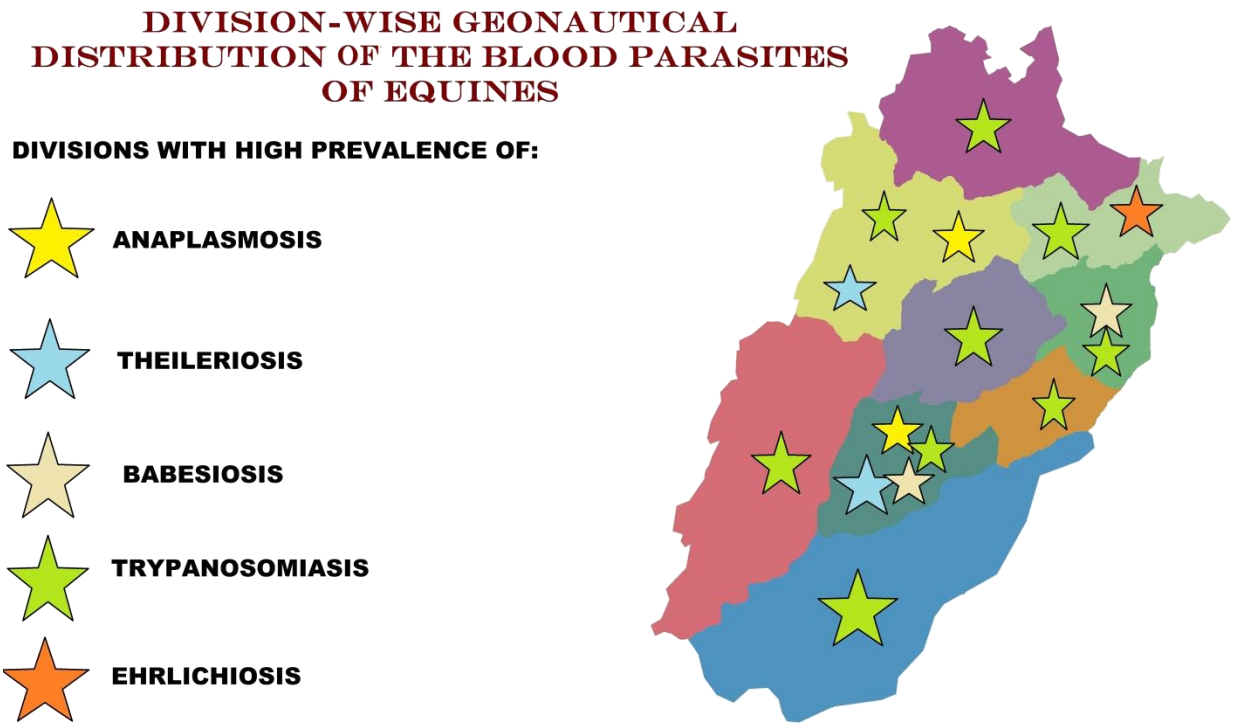
divisions, respectively.

The geonautical distribution of major VBDs of goats is presented in the map below:



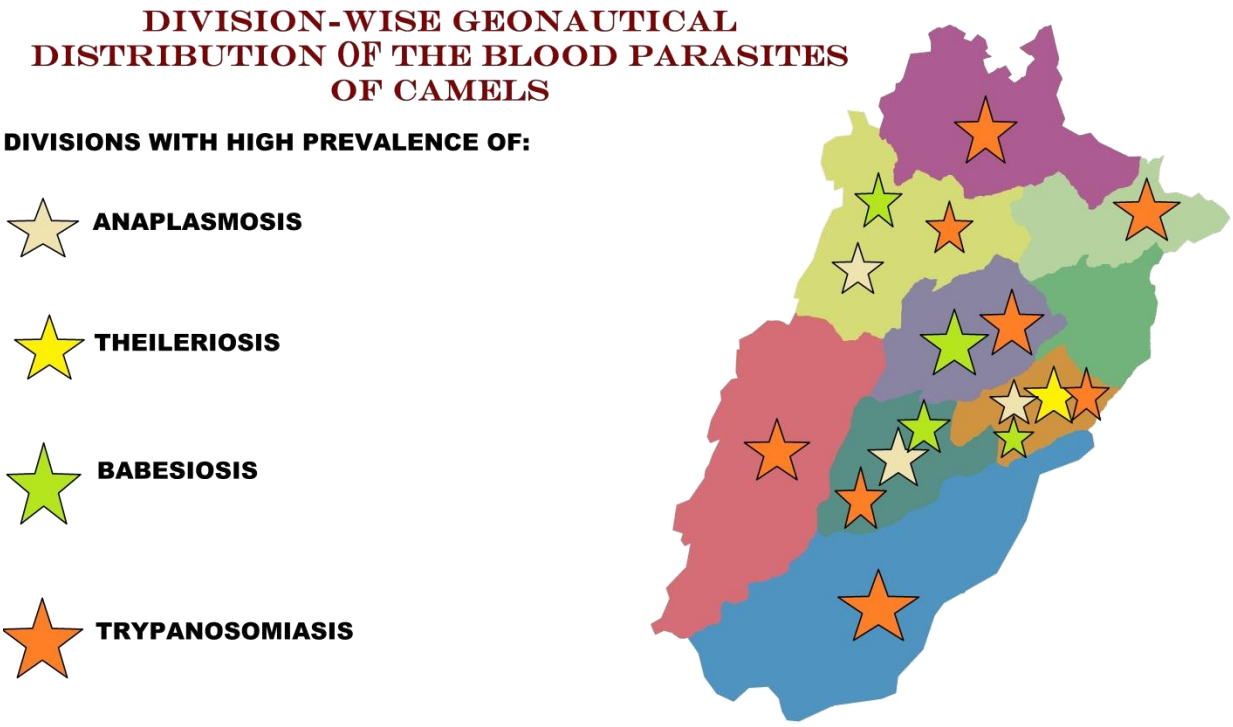
The most prevalent VBD among working equines is Trypanosomiasis followed by Babesiosis. The hot spots of Trypanosomiasis in equine are Bahawalpur, Faisalabad and Sahiwal divisions. The highest prevalence of Babesiosis is recorded in the equine population of Lahore division. The geonautical distribution of the most

prevalent VBDs of working equine is presented in the map below:



The most prevalent VBD among camel population of the Punjab is Trypanosomiasis. The major hot spots for Trypanosomiasis in camel are Gujranwala, Bahawalpur, Multan, and Faisalabad divisions.

The geonautical distribution of the most prevalent VBDs of camels is presented in the map below:

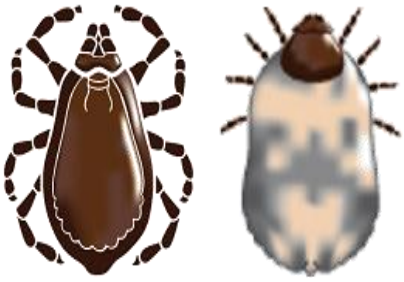


Anaplasmosis	Babesiosis	Theileriosis	Trypanosomosis
• Anaemia • Emaciation • Abortion	• Anaemia • Red Water • Abortion • Infertility	• Fever • Diarrhoea • Emaciation	• Emaciation • Listlessness • Depression

Theileriosis, a disease caused by infestation with intracellular protozoan parasites of the genus Theileria, is transmitted by Ixodid ticks (Hard Ticks) to wild and domesticated ruminants. In Punjab, hard tick belonging to the genera Hyalomma is responsible for the transmission of *Theileria annulata* to cattle and buffaloes. Theileriosis is more severe in exotic

and cross-bred cattle than indigenous ones. Mostly, the disease occurs in its subclinical form, leading to significant economic losses. Major clinical signs include: fever, enlargement of lymph nodes, increased heart and breathing rates, nasal discharge, loss of weight, oedema, and death in severe cases. Specific anti-theileria drugs, such as buparvaquone and parvaquone can be used to treat theileriosis.

Babesiosis, a disease caused by infestation with intra-erythrocytic protozoan parasites of the genus Babesia, is transmitted by hard ticks to ruminants. In Punjab, a hard tick of the genus Rhipicephalus is responsible for the transmission of *Babesia bigemina* and *B. bovis* to cattle and buffaloes. Major clinical signs include: high fever, depression, loss of appetite, haemoglobin in urine (red water), jaundice, abortion, nervous and respiratory signs, and death in severe cases. For treatment and prophylaxis of theileriosis, diminazine and imidocarb can be used.



Anaplasmosis, caused by infection with intra-erythrocytic rickettsiae of the genus Anaplasma (species: *A. marginale* and *A. central*), is usually transmitted by hard ticks of genus Rhipicephalus and Hyalomma. Biting flies, and contaminated surgical instruments/ needles can also transmit anaplasmosis. Major clinical signs include: fever, progressive anaemia, jaundice, loss of appetite, depression, reduced milk production, abortion, and death especially in exotic breeds of cattle. Recovered animals usually develop an asymptomatic carrier status. The treatment of anaplasmosis includes the parenteral administration of chlortetracycline or oxytetracycline or imidocarb dipropionate.

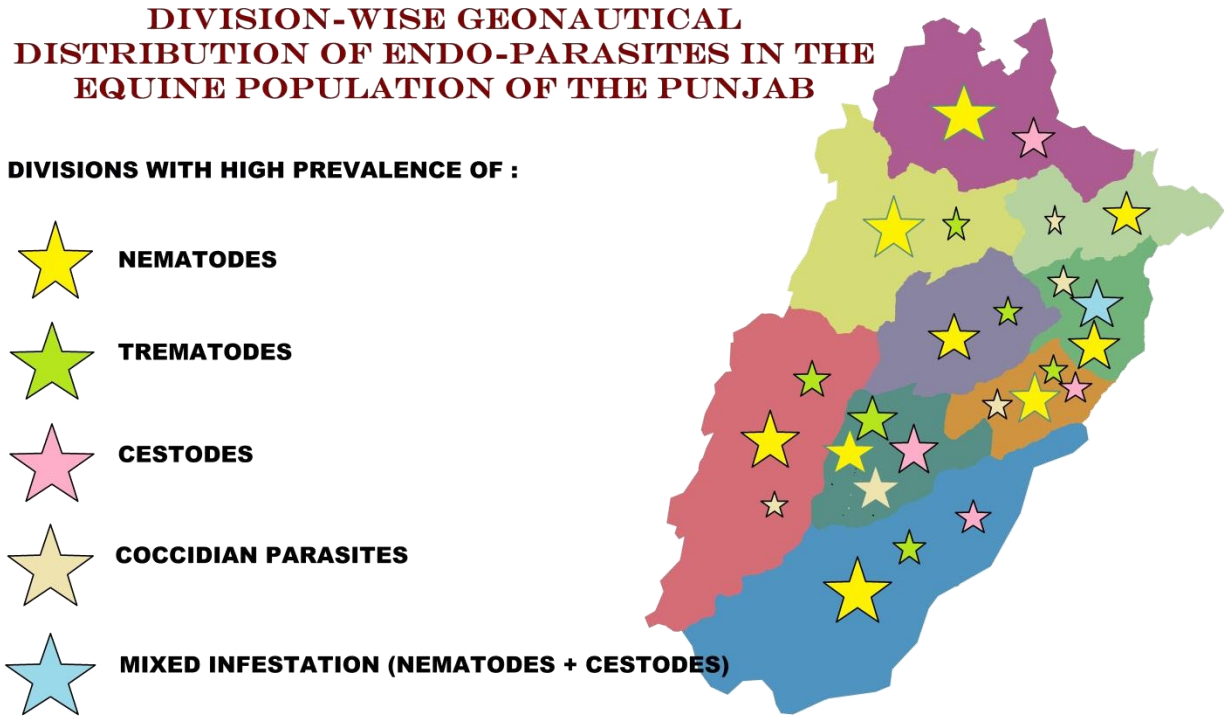
SURRA (in Equines)

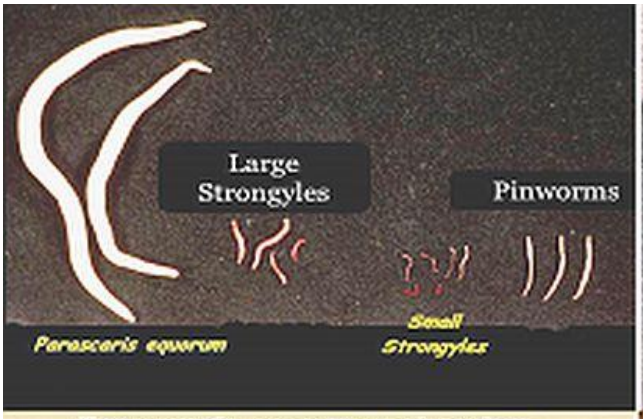
SURRA (in Camelids)

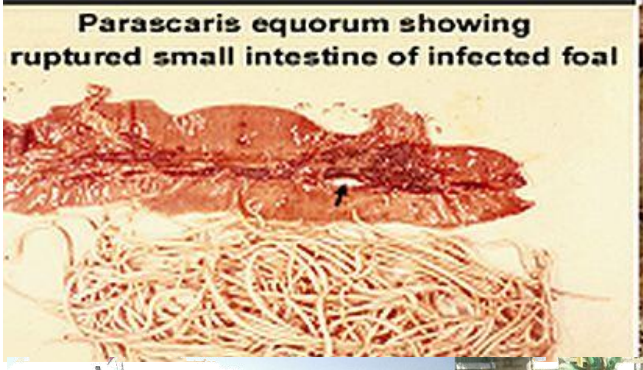
Trypanosomiasis (Surra) is caused by *Trypanosoma evansi*. In equine the disease is transmitted by horse fly. In equines it is characterized by recurrent episodes of fever, progressive anaemia, oedema of lower parts of the body, urticarial plaques, petechial hemorrhages of serous membranes, immuno-deficiencies and nervous signs. In camels the disease, mostly chronic (lasts 2-3 years) wasting disease, is characterized by acute bouts of fever, dullness, lack of appetite and lachrymation. Gradually the animal loses condition, the hump

shrinks and progressive weakness becomes noticeable. Oedema may occur. Pregnant animals often abort. The disease is usually fatal. In equines the effective drugs are: Diminazene aceturate, Quinapyramine Sulphate + Quinapyramine Chloride, Isometamedium chloride. In camels the effective drugs are: Quinapyramine Sulphate + Quinapyramine Chloride, Isometamedium chloride.

In working equines the most prevalent endo-parasites are Nematodes. In Multan and D.G. Khan divisions the prevalence of Trematodes is also noticeable. Cestodes have been recovered from the equine populations of Multan, Rawalpindi, Sahiwal, and Lahore divisions. This status of endo-parasitism indicates that the anthelmintics of choice for working equines are albendazole and oxfendazole. The geonautical distribution of endo-parasites of working is given in the map below:

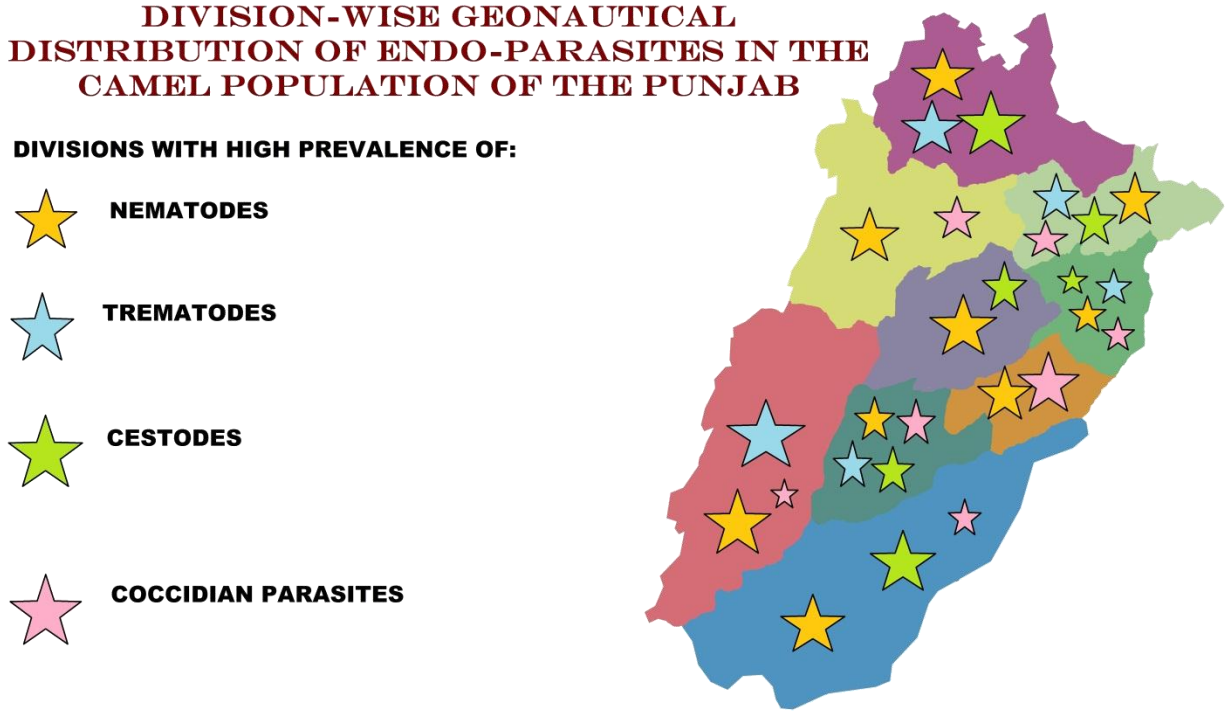






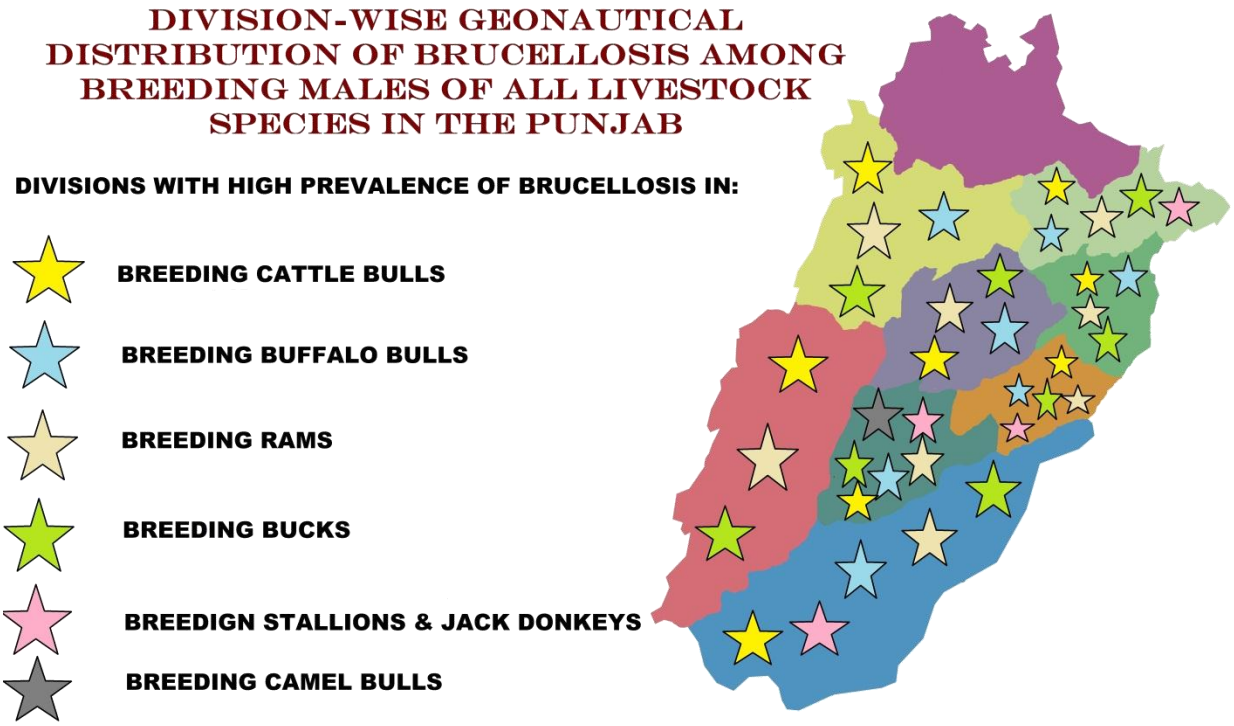
Large Red Worms	Small Red Worms	Pin Worms	Parascaris equorum
• Unthriftiness • Poor Growth • Anaemia • Colic	• Slow Growth • Poor Coat • Lethargy	• Anal Pruritis • Restlessness • Anorexia	• Enteritis • Intestinal Obstruction

In camel, the most prevalent endo-parasites are nematodes. The prevalence of trematodes is also noticeable in D.G. Khan, Lahore, and Gujranwala divisions. Cestodes have also been recovered from the camel populations of Bahawalpur, Lahore, and Gujranwala divisions. This status of endo-parasitism indicates that the anthelmintics of choice for camels are albendazole and oxfendazole. The geo-nautical distribution of endo-parasites in the camel population of the Punjab is given in the chart below:



The highest prevalence of brucellosis is noticed among breeding buffalo bulls followed by cattle bulls and male equines. The most noticeable prevalence of brucellosis is recorded in breeding males of cattle, buffalo, sheep, and goats of Lahore division. In Bahawalpur, Gujranwala, and Multan divisions brucellosis is recorded among stallions/ jack donkeys. Among breeding camel bulls brucellosis is only recorded in Multan division. The specificity of RBPT is quite low. To rule out the possibility of false positive reactions, confirmation through Brucellin Skin Test

or PCR is required (Safirullah *et al*., 2014). The geonautical distribution of sero-prevalence of brucellosis through RBPT among breeding males of all livestock species is given in the map below:



Brucellosis is a contagious disease of domestic animals. The disease is caused by fastidious gram-negative coccobacilli of the genus Brucella. *Brucella melitensis* is primarily found in sheep, goats and camels; while *Brucella abortus* is found in cattle, buffalo and equines. *B. melitensis* is the most invasive and produces the most severe disease. *B. abortus* is the most invasive and causes the mildest illness.

The animal-to-animal transmission is usually venereal or by ingestion of infected tissue or milk. Human brucellosis is a zoonotic disease of worldwide distribution. It is prevalent in developing countries where humans and animals live in close proximity. Prevalence in humans is directly proportional to animal disease. Animal handlers are specifically more susceptible due to their occupation. It is associated with lot of morbidity and loss of man days. Brucellosis is characterized by protean clinical manifestations though it commonly presents as pyrexia of unknown origin or osteoarticular disease. Other manifestations include glomerulonephritis, pneumonitis, encephalitis and hepatitis (Pandit and Pandit, 2013).

THE WAY FORWARD

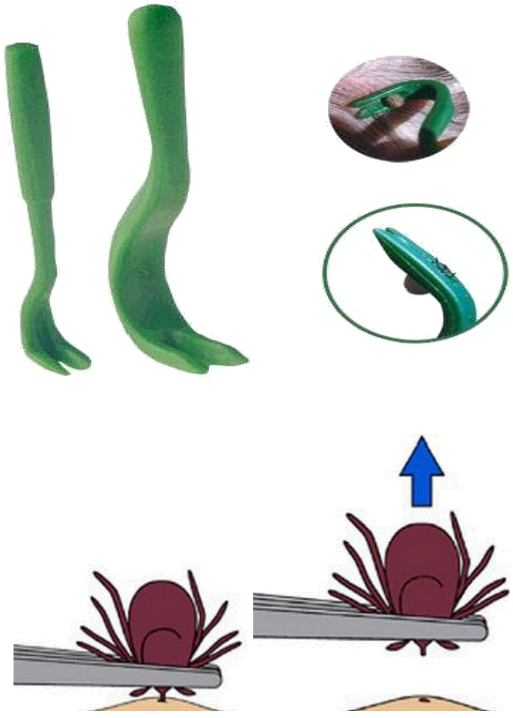
- Nutrition has a remarkable effect on the establishment and retention of parasites, particularly where multiple parasite exposure may occur. Susceptible animals, even on an optimal/ balanced diet, will become parasitized, but if re-exposed to the same species of parasite, animals on an optimal diet may be able to resist infection, whereas those on deficient diet will not. Strategy should be chalked out for the availability of succulent and preserved (silage, hay, haylage, etc) roughages in all ecological zones of the Punjab round the year.

- Animals develop immunity against endo-parasites as they age. Immune animals carry fewer worms and suffer less from parasitism. Young animals get more worms and suffer more seriously. Therefore, in any mass de-worming campaign, 100% coverage of young stock should be ensured.

- Worldwide some breeds of livestock are inherently carrying fewer endo-/ ecto-parasites. Cross-breeding of the indigenous non-descript breeds, having low production potential, should only be done with those exotic high yielders having innate immunity to endemic endo-/ ecto-parasitic species.

- Following flood events (or significant amount of rain), the populations of biting insects (flies, midges, mosquitoes) and ticks can increase dramatically. Post-flood/ -rain relief plan must include the mass scale de-worming and/or acaricides spray/ dip campaigns in the livestock populations of flood-/ rain-ravaged areas. Awareness should be created among the farmers of such areas to prevent animal welfare issues and losses in productivity.

- Globally, a number of methods, including chemical tick control, chemotherapy as well as prophylaxis and/ or vaccination are being used to reduce the economic losses incurred by VBDs. The reliance of chemicals is decreasing at large due to the possible emergence of acaricide-resistant ticks and the public health concerns over the drug residues in the meat and milk of treated animals. At present, no plan for chemoprophylaxis of VBDs is in place in the Punjab, simply because of the paucity of ecological, epidemiological and pharmacological knowledge in this regard. Considering the farming practices in the Punjab, the most suitable method would be regular grooming involving manual removal of ticks and burning them on the fire made with



dung cakes. The use of ivermectin/ doramectin would be an option for severely infested animals. The repeated use of these macrocyclic lactones should be avoided due to their possible adverse effects.

- The current control of VBDs in the Punjab relies mainly on tick control using acaricides, no study has yet assessed the status of acaricidal resistance in ticks. To ultimately achieve improved and sustainable control of VBDs an alternate and safer method is the use of vaccines. These sorts of vaccines are being successfully used in many countries to control theileriosis, babesiosis and anaplasmosis. Veterinary Research Institute Lahore may be entrusted the task to prepare such vaccines against local pathogen species and strains of VBDs.

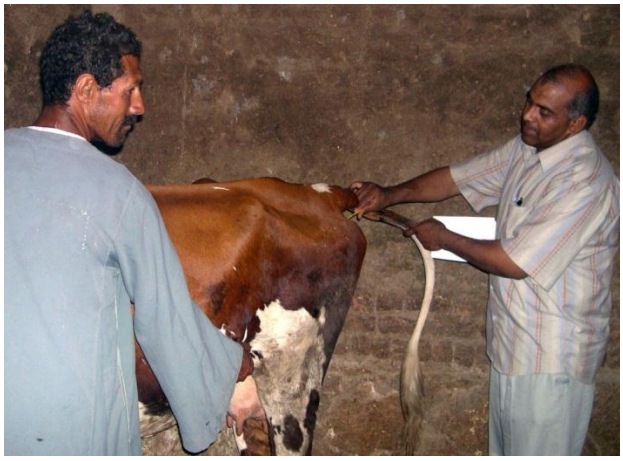
- Another possible vaccination strategy to control VBDs is the use of tick vaccines, which might offer a cost-effective, environmentally friendly alternative to the use of acaricides. A comprehensive survey regarding the prevalent tick species would be a prerequisite before the institution of such a venture.

- Unrestricted trade and movement of animals, use of local cattle yards and fairs for trading, sending dry animals back to villages for maintenance, free grazing and movement with frequent mixing of flocks of sheep and goats, use of semen from unscreened bull for artificial insemination, use of unscreened males for natural service and poor farm hygiene probably all contribute to the spread and transmission of the brucellosis. Increasing demand of dairy products and red meat, changing agricultural methods, and

increased trade and movement of animals have caused concerns the prevalence may increase with the passage of time. Therefore, because of huge economic and public health impact, there is an urgent need for the chalking out of a comprehensive control strategy about brucellosis in domesticated animals.

- Mass vaccination is crucial for the control and eradication of bovine, ovine and caprine brucellosis but other complementary measures that may need consideration include farm hygiene, restriction and control of trade and movement of animals, testing of animals and isolation/ removal/ treatment of infected animals. Though the existing vaccines for bovine brucellosis, the *Brucella abortus* strain 19 (S19) and strain RB 51, and the vaccine for ovine and caprine brucellosis, the *B. melitensis* strain Rev 1, have some undesirable traits, these have proved to be very useful under most conditions. Scientists of Veterinary Research Institute Lahore may be entrusted the task to prepare vaccines at a mass scale after propagation of imported seed cultures of RB 51 and Rev 1.

- Given the complexity of the epidemiology of brucellosis involving various animal species, the effective control will require a long lasting and carefully controlled and monitored effort. Therefore, preventive measures would be essential to minimize the risk of infection to the human population. Such measure should include improved food hygiene including the pasteurization



of milk and protection from infection of high risk groups such as farmers, shepherds/ pastoralists, gawalas (milkman/ milkmaid) and those field veterinarians who attend cases of abortion and retained placenta in routine. Need for such approach is further accentuated by the fact that there is currently no licensed vaccine for brucellosis in humans. Available animal vaccines may cause disease in humans and such are unsuitable for use in humans. So with the collaboration of Health Department, health education of risk groups through community participation and health education programs should be conducted. This would play an important role to increase the acceptance and use of preventive and prophylactic measures.

- Working equids and camelids remained largely invisible in the eyes of decision and policy makers to the extent that these poor animals were often excluded from the definition of "livestock" which may lead to them being excluded from critical interventions such as vaccination campaigns and other animal health related initiatives. This was particularly the case with donkeys due to the fact that they are less expensive and more resistant to different diseases and environmental stress. They are mostly used by resource-poor

communities under intense heat and difficult terrains, with less provision for their welfare. The lack of recognition of their importance and their chronic neglect by institutions also meant depriving women of the additional benefits they could obtain from them..

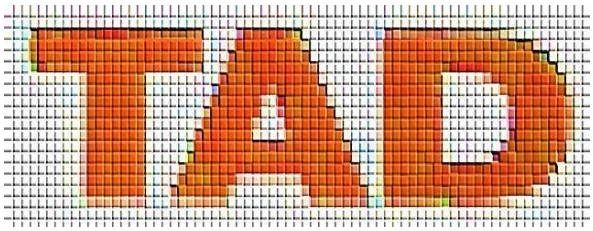
- The diseases of working donkeys/ mules/ horses would be most effectively managed through working in tandem with animal owners and community groups. It would not be possible for the Department alone to muster all resources; close liaison with international agencies and local NGOs would be required to face this challenge.

- In rural settings, where local culture and traditions are still strongly rooted, responsibilities and tasks are often assigned to women and men on the basis of traditional gender roles. Women are often in charge of a large variety of labor intensive activities in agriculture. These duties coupled with their responsibilities at household level make a substantial work load that often, especially in case of younger girls, prevent them from pursuing an adequate education and self-development. Working equids and camelids play a fundamental role by lessening women's work burden and by improving women's and families' livelihood through their direct and indirect contributions. This implies that

empowerment of rural womenfolk is directly linked with the welfare of working donkeys, mules, and camels in rural areas.

- Requirements of the World Organization for Animal Health (OIE) include that countries ensure transparency in the global animal health situation. This can only be accomplished through monitoring and surveillance for diseases that are both endemic and foreign to country. For equivalency requirements in international trade, surveillance for diseases is again a prerequisite. Applying equivalency in trade negotiations requires the use of surveillance data in risk assessment and analysis. This scenario demands surveillance for diseases to be the paramount feature of the Department.
- Taking one step ahead, these cross-sectional surveys should be transformed into eradication programs for diseases like brucellosis, Foot & Mouth Disease and *Peste des Petits Ruminants*. For the success of these eradication programs, it would be imperative for the surveillance process to be perpetual and synergistically coincides with the ongoing FAO-FMD Project and FAO-PPR Project, aimed at progressive control of these diseases in Pakistan.
- Rapidly evolving technological advances in disease diagnostics, animal identification and database management will improve animal disease surveillance system's ability to supply information to decision makers. Key to accurate surveillance is an identification system that accurately links an animal to its stall, livestock market and slaughter establishments. The use of barcoding, radio frequency identification (RFID) and geospatial information systems are currently used effectively in many countries. Animal traceability would be the prerequisite for all future endeavors.

- Essential to the effective implementation and monitoring of ICT based 9211 Virtual Governance System is the collaborative interaction with federal and international agencies (like FAO, OIE, WHO, etc.). Data gathered through such a system will be critical not only to ensure and affirm the health of the livestock populations of the Punjab, but also to provide decision makers with information required for an effective, timely response in the case of an epidemic of a prevalent trans-boundary animal disease (TAD) or an accidental or intentional introduction of a foreign animal disease.



- Cross-sectional studies are carried out at one time point and give no indication of the sequence of events. So on the basis of this sort of studies it is impossible to infer causality. In order to overcome this, repeated cross-sectional studies may be carried out to pseudo-longitudinal study. To develop "an efficient and percipient livestock disease surveillance system" in the Punjab is a journey of many small steps and the present cross-sectional survey is an important milestone in this direction. A repeated series of cross-sectional survey would lead to a perpetual surveillance program for diseases of both International (TADs) and National (Parasitism, Brucellosis, Tuberculosis, and Sub-clinical Mastitis) importance.

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Appendix A: Task Analysis of Cross-Sectional Survey for Tick-Borne Diseases of Livestock in the Punjab

Task Component	Responsible Resource Office	Standing Operating Procedures
Printing & Publication	Director (C&E)	➢ Leaflets containing comprehensive information about Tick-Borne Diseases (TBDs) in Urdu. ➢ These brochures would be distributed during Cross-sectional Survey (CSS) and farmer meetings in routine.
Advertisement & Promotion	Director (C&E)	➢ Promotion of CSS would be done through print and electronic media.
Collection and Laboratory Analyses of Blood Samples.	1. ADIOs 2. DLOs	➢ Minimum number of 6 samples (2 samples each of faecal, blood and serum) would be collected from a village/ mouza/ urban area. NOTE: The total samples collected from a district must be more than 1% of the total livestock population of that particular district. In this regard, every laboratory coordinator (host ADIO) will calculate the minimum number of samples to be collected from each village. ➢ Blood samples will be collected only from tick-infested animals. ➢ Detail of samples will be recorded on the prescribed *pro forma* (Appendix D). ➢ One demonstration of Surf Field Mastitis Test would be done at each village. ➢ Two local Personnel familiar with the area and well versed in the collection of blood samples would be provided by the concerned DLO in each Tehsil to each of the teams of the diagnostic laboratories. ➢ Staff of Diagnostic Laboratories (of DADRS, of Poultry Production and of Livestock Farms) of each Division will constitute a team that will work together in each district of that Division to speed up the process of collection of samples, laboratory diagnosis and recording of results on prescribed *pro formas* (Appendices E, F, and G). ➢ Results would be recorded at Diagnostic Laboratory and would be e-communicated to SPMS-L&DD Punjab through virtual ICT based channels.
Provision of Treatment to Positive Cases	DLOs	➢ Detail of infected animals/positive samples will be conveyed to respective DLO for provision of necessary treatment.
Overall Monitoring	1. Director General (Research) 2. Project Director (Diag. Labs.)	➢ DG (Research) L&DD Punjab would be responsible for the successful completion of CSS and the generation of a comprehensive report on its completion. ➢ PD (Diag. Labs.) would assist the DG (Research) and keep a close liaison with Resource Offices/ Teams and directly monitor the progression of each task activities (manual and mental), task and element durations, task frequency and logistics management.

Appendix B: Pro-forma for Submission of Daily Progress Report of Cross-sectional Survey through Email

Progress Report of Cross-sectional Survey at District _____ on ___/___/2015

Total No. of Villages	No. of Villages Covered So Far	Sample	Previous Total	Today's Total	Progressive Total
		Faecal			
		Blood			
		Serum			
		Total			
		No. of Surf Test Demonstrations			
	Information Submitted through Email on dadrs@livestockpunjab.gov.pk				

Appendix C: Pro-forma for Submission of Daily Progress Report of Cross-sectional Survey through SMS

Progress Report of Cross-sectional Survey at District _____ on ___/___/2015

Total No. of Villages	No. of Villages Covered	No. of Samples Collected				No. of Surf Test Demonstrations
		Faecal	Blood	Serum	Total	

Information submitted through SMS on 03088697665 OR 03336563463

Appendix D: Pro-forma for Recording of Detail of Samples Collected during Cross-Sectional Survey for Tick-Borne Diseases of Livestock in the Punjab

DETAIL OF SAMPLES COLLECTED

Sr. No.	Date of Sample Collection	Farmer's Name	Cell No.	CNIC No.	SPMS Sample No.	District	Tehsil	Union Council	Village/ Mouza/ Urban Area	Mouza Code	Number of Blood Samples Collected							Number of Serum Samples Collected							Number of Faecal Samples Collected		
											Buffalo	Cattle	Goat	Sheep	Horse	Donkey/ Mule/ Hinny	Camel	Breeding Buffalo Bull	Breeding Cattle Bull	Breeding Buck	Breeding Ram	Breeding Stallion	Breeding Jack Donkey	Breeding Camel Bull	Horse	Donkey/ Mule/ Hinny	Camel

Appendix E: Pro-forma for Recording of Results of Blood Analysis for Vector-borne Diseases

PRO FORMA FOR RECORDING OF RESULTS OF BLOOD ANALYSIS FOR VECTOR-BORNE DISEASES

Sr. No.	Farmer Name	Cell No.	District	Tehsil	Union Council	Village/ Mouza/ Urban area	Mouza Code	Animal (B, C, S, G, D, H, K)	SPMS Sample Numbers	Total No. of Samples	Negative	Positive	Anaplasma	Theileria	Babesia	Trypanosoma	Ehrlichia

Appendix F: Pro-forma for Recording of Results of Coprological Examination

Pro Forma for Recording of Coprological Examination of Working Equids and Camelids Faeces

Sr. No.	Farmer Name	Cell No.	District	Tehsil	Union Council	Village/ Mouza/ Urban area	Mouza Code	Animal (D, H, K)	SPMS Sample Numbers	Total Samples	Negative	Positive for			
												Nematode	Trematode	Cestode	Coccidian Parasites

Appendix G: Pro-forma for Recording of Results of Sero-surveillance for Brucellosis among Male Breeding Stock through Rose Bengal Plate Test

PRO FORMA FOR RECORDING OF RESULTS OF ROSE BENGAL PLATE TEST FOR BRUCELLOSIS BY DISTRICT DIAGNOSTIC LABORATORY _____

Sr. No.	Farmer Name	Cell No.	District	Tehsil	Union Council	Village/ Mouza/ Urban	Mouza Code	Breeding Buffalo Bull			Breeding Cattle Bull			Breeding Buck			Breeding Ram			Breeding Stallion			Breeding Jack Donkey			Breeding Camel Bull		
								Total Samples	Positive	Negative	Total Samples	Positive	Negative	Total Samples	Positive	Negative	Total Samples	Positive	Negative	Total Samples	Positive	Negative	Total Samples	Positive	Negative	Total Samples	Positive	Negative

ACKNOWLEDGMENT

Acknowledgment is due to all the ebullient Veterinary Assistants, Laboratory Assistants, Laboratory Attendants, Drivers, Sweepers, Peons, and Watchmen of Livestock & Dairy Development Department Punjab, who earnestly work to make this Cross-sectional Survey (CSS) a success story.

Special thanks to all the Regional Directors, EDOs, DLOs, APVOs, SVOs, VOs, private field veterinarians, medicasters, and quacks, those extended their cooperation and support to District Diagnostic Laboratories during this CSS.

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