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Short Communication

Influence of weather variables on cattle diseases in Ranchi, Jharkhand

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The livestock sector is considered as a major part of food security in Jharkhand along with agriculture. Weather and climate are closely associated to the incidence and intensity of infectious diseases in animal which is the single greatest threat to livestock assets and needs to identify for forewarning. Livestock products are an important agricultural commodity for global food security because they provide 17% of global kilocalorie consumption and 33% of global protein consumption (Rosegrant *et al*., 2009). The livestock sector contributes to the livelihoods of one billion of the poorest population in the world and employs close to 1.1 billion people (Hurst *et al*., 2005). There is a growing demand for livestock products, and its rapid growth in developing countries has been deemed the "livestock revolution" (Thornton, 2010, Wright *et al*., 2012). Hemoprotozoan diseases especially theileriosis, babesiosis and anaplasmosis are considered some of the major impediments in the health and productive performance of cattle (Rajput et al., 2005). Tick-borne diseases cause substantial losses to the livestock industry throughout the world (Ananda *et al.*, 2009; Kakarsulemankhel, 2011) as these have got a serious economic impact due to obvious reason of death, decreased productivity, lowered working efficiency (Uilenberg, 1995), increased cost for control measures (Makala *et al.*, 2003) and limited introduction of genetically improved cattle in an area (Radostits *et al*., 2000). There are chances of increased spread of existing vector-borne diseases and macro parasites of animals as well as the emergence and spread of new diseases due to direct effects of climate change particularly higher temperatures and changes in rainfall patterns (Boomiraj *et al.* 2010).

Foot and mouth disease (FMD) is a highly contagious acute viral infection of cloven-hoofed animals and is one of the most important diseases of cattle. Livestock are considered as "moving banks" because of their potentiality to dispose off during emergencies. To face these new menaces, the need for strong and efficient Veterinary Services is irrefutable, combined with good coordination of meteorological services. Present study has been formulated with a view to develop weather-based disease forecasting system for enhanced livestock production through sustained reduction of animal diseases.

An investigation was undertaken on the occurrence of haemoprotozoan disease especially Theileriosis, Babesiosis, Anaplasmosis and viral disease Foot and mouth disease (FMD) in livestock at Ranchi District by using the retrospective data from the period 2012 to 2020. Data regarding the disease attack in cattle was collected monthly from the Institute of Animal Health and Production (IAHP) Kanke, Ranchi, Instructional Bovine Farm of RVC, Kanke. The meteorological data regarding daily temperature, humidity and rainfall of Ranchi district were collected from the agromet observatory situated in BAU, Ranchi during 2012 to 2020. The latitude and longitude of Ranchi, Jharkhand is 23.34°N and 85.3°E with altitude of 625m msl, respectively**.** Summer temperatures range from 20°C to 42°C where the winter temperatures from 0°C to 25°C. December and January are the coolest months, with temperatures dipping to the freezing point in some areas (Kanke). The annual rainfall is about 1430 mm (56.34 inches) whereas the rainfall is about 1,100 mm during June to September.

The year was divided into three seasons viz. summer (March-May), monsoon (June – Oct) and winter (Nov – Feb). The monthly temperature, humidity and rainfall were converted into seasonal average temperature, humidity and rainfall. The percent incidence of the diseases was calculated on the basis of total number of diseases reported in a particular season. The attack percentage of the diseases in the Ranchi district were correlated with the meteorological parameters. The seasonal occurrences of diseases were recorded and their statistical analysis of variance was done to see that whether the difference in the occurrence of diseases were significant or not.

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Table 1: Average attack % of diseases during different season (2012-2020)

Season	Theileriosis	Babesiosis	Anaplasmosis	FMD
Summer	32.8	36.5	47.9	24.4
Monsoon	44.8	45.3	33.5	32.8
Winter	22.4	18.2	18.6	42.8
CD at 5%	2.28	4.46	8.44	1.05

Table 2: Correlation coefficient between weather parameters and disease attack in cattle

Weather Parameters	Theileriosis	Babesiosis	Anaplasmosis	FMD
Maximum temp. (Tmax)	0.49	0.52	0.78*	-0.84*
Minimum temp. (Tmin)	0.88*	0.74*	0.62**	-0.75*
Morning RH (RHI)	0.44	0.19	0.13	-0.21
Evening RH (RHII)	0.53	0.27	-0.37	0.18
Rainfall (RF)	0.88*	0.72*	0.15	-0.36

* Significant at 0.01 level; ** Significant at 0.05 level

Table 3: Multiple regression between weather parameters and disease attack in cattle

Theileriosis	Y= -1.37- 0.74 Tmax + 1.17 Tmin + 0.54RHI- 0.25RHII+ 0.03RF
	R^2 = 0.97*
	(P-value Tmax = 0.13, Tmin = 0.01, RHI= 0.15, RHII= 0.39, RF= 0.03)
Babesiosis	Y= 9.26+0.32 Tmax -0.07 Tmin -0.19RHI+0.06RHII+0.01RF
	R^2 = 0.71**
	(P-value Tmax = 0.39, Tmin = 0.81, RHI= 0.49, RHII= 0.79, RF= 0.19)
Anaplasmosis	Y= 20.892.05MXT-0.86 Tmin -0.77RHI+0.14RHII+0.02RF
	R^2 = 0.93*
	(P-value Tmax = 0.003, Tmin = 0.04, RHI= 0.06, RHII= 0.63, RF= 0.09)
FMD	Y= 62.10-4.08 Tmax +0.92 Tmin +1.41RHI+0.17RHII-0.07RF
	R^2 = 0.82*
	(P-value Tmax = 0.11, Tmin = 61, RHI= 0.44, RHII= 0.91, RF= 0.26)

* Significant at 0.01 level; ** Significant at 0.05 level

Relation between weather parameters and diseases

The results revealed that average attack percentage of Theileriosis and Babesiosis in cattle (Table 1) was significantly highest in monsoon (44.8% and 45.3%) followed by summer (32.8% and 36.5%) and lowest in winter (22.4% and 18.2%), respectively. Prevalence of Anaplasmosis was significantly highest in summer (47.9%) followed by monsoon (33.5%) and lowest in winter (18.6%). Cattle was more susceptible to FMD in winter season when the average attack percentage was 42.8% followed by monsoon (32.8%) and lowest in summer season (24.4%).

Theileriosis

Data presented in Table 2 showed that the correlation between Theileriosis with minimum temperature (r= 0.88*) and rainfall (r = 88*) was found positively significant for cattle. The non-significant and positive correlation was observed between Theileriosis and morning and evening relative humidity. The multiple regression equation fitted with weather parameters in order to predict Theileriosis attack revealed that the various abiotic factors were found to be most influencing factors which contributed R^2= 0.97 (97%) variation in Theileriosis disease in cattle (Table 3).

Babesiosis

Among weather parameters, minimum temperature and rainfall had significantly positive correlation with Babesiosis in cattle similar to Theileriosis. Minimum temperature and rainfall exhibited significant positive relationship with Babesiosis. This indicates that increase in minimum temperature and rainfall will increase the incidence of Babesiosis in cattle. Weather parameters exhibiting strong significant correlation with Babesiosis attack have been considered for developing regression equation for its prediction by taking weather variables as independent and number of attacks as dependent variables. Multiple regression equation for prediction of babesiosis disease using maximum, minimum temperatures, morning and evening relative humidity and rainfall together explained 71 percent variation in disease attack in cattle (Table 3).

Anaplasmosis

The data in table 2 revealed the correlation of Anaplasmosis with weather parameters, that maximum (r=0.78*) and minimum (r=0.62**) air temperature were highly and positively significant in cattle. Other weather parameters like morning relative humidity and rainfall had positive and evening relative humidity had negative and non-significant association with prevalence of Anaplasmosis. The

results indicated that cattle were more susceptible to Anaplasmosis with increased in air temperature. It also revealed that increase in maximum temperature was more detrimental to disease prevalence than increase in minimum temperature. The multiple regression equation fitted with weather parameters in order to predict the attack of Anaplasmosis in cattle has the coefficient of determination (R^2) of 93 per cent indicating that the predictions of the attack of disease by using weather parameters were reliable (Table 3).

Foot and mouth disease (FMD)

The impact of weather factor on the FMD in cattle during study period (2012-2020) is presented in Table2. The result revealed that there was significantly negative correlation with maximum (r = -0.84*) and minimum (r = -0.75*) temperature and non-significant negative correlation with morning relative humidity and rainfall while evening relative humidity showed a non-significant positive correlation with FMD incidence. Above results indicated that lower maximum and minimum temperature is conducive for FMD incidence in cattle and decrease in maximum temperature is most detrimental for FMD than decrease in minimum temperature. The multiple regression equation (Table 3) fitted with weather parameters in order to predict FMD attack in cattle revealed that the various weather parameters (abiotic) factors were found to be most influencing factors which contributed R^2= 0.82 (82%) variation in FMD disease in cattle.

From the study of passive data (2012-2020) it was found that cattle suffering from Theileriosis and Babesiosis was highest in Monsoon. The average attack percentage of Anaplasmosis was significantly higher in summer whereas attack percentage of FMD in cattle was highest in winter season. Therefore, the different species of haemoprotozoa and viral diseases obtained in the present study should be exploited for strategic control programme in cattle of Ranchi district. Early forewarning of disease would be possible on the basis of above investigation and risk can be minimized by adopting the preventive measures in advance.

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