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The incidence of lumpy skin disease outbreaks in Karnataka during the year 2022 a study report

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Abstract
Lumpy skin disease (LSD) is a host specific, non zoonotic viral disease affecting cattle and buffaloes. The diseases is considered notifiable as it causes severe economic losses to the farming community. Blood feeding vectors like flies and ticks spread the virus mechanically to the susceptible host whereas, spread by direct contact is considered to be less significant. Currently, disease is endemic to Africa and Middle east and rapidly spreading across borders including India. In 2019, disease was first reported from India and considered as a serious threat to the entire bovine population, so also in the state of Karnataka which has about 12 million bovine population accounting for 5 per cent and ranks 9th in the country. Disease is more composite in nature; serious research inputs must be pragmatic to study various factors associated with disease. This report summarises the incidence and mortality occurred in Karnataka perhaps for the first time.

Keywords: LSD, epidemiology, vector, spread, incidence and Karnataka

Introduction
Lumpy skin disease (LSD) is a poxviral disease that affects cattle and buffaloes causing severe economic loss and categorised as WOAH (OIE) notifiable disease. The disease is spread mechanically by blood feeding arthropod vectors as the principal route, the rate of spread always depends upon the vector density. The disease would mainly be transferred to infection-free zones by movement of infected animals and vectors. The commonly implicated vectors include the stable fly (*Stomoxys calcitrans*) mosquitos: *Aedes aegypti*, *Anopheles stephensi*, *Culex quinquefasciatus* flies: *Stomoxys calcitrans*, *Haematobia irritans*, Prostomoxys sp., Haematopota sp., *Biomyia fasciata* midges: *Culicoides nubeculosus* ticks: *Rhipicephalus appendiculatus*, *Rhipicephalus decoloratus*, *Amblyomma hebraeum* (Kahana-Sutin *et al*., 2017) [4]. Direct transmission between infected and susceptible animals is very rare (Carn and Kitching, 1995) [3], although the infection may be spread by contaminated feed and water (Al-Salihi and Hassan, 2015) [2]. Clinically the disease is characterised by fever (40 ˚C to 41.5 ˚C), accompanied by increased oral, nasal, pharyngeal, lachrymal secretions, enlargement of superficial lymph nodes, anorexia, dysgalactia, general depression and disinclination to move. Skin nodules appear all over the body within one to two days post infection and theses nodules induce pain, discomfort and lameness. After two to three weeks, the nodules either disappear or the skin becomes necrotic, leaving behind 'sit-fasts,' which are distinct from the surrounding skin. Far ahead 'sit-fasts,' will slough off leaving a cavity of full skin thickness eventually, animals would be infected by bacteria or may develop myiasis (Tuppurainen *et al.,* 2017) [8]. Some animals become extremely emaciated because of malnourishment which eventually succumbs to disease.

The LSD is currently endemic in majority of African countries and has moved to North Africa, Middle East and the Mediterranean areas as a result of international trade of animals and animal products (Tuppurinen and Oura, 2011 and 2012) [7]. The illness is rapidly spreading across borders, soon the scenario may be same in Asian continent especially in India, as India harbours high density of naive cattle and buffalo population, ranks first in worlds bovine population. Besides, the practises such as Illegal movement / trading of animals, communal grazing and watering certainly favours the incidences of LSD outbreaks.

Lack of strict biosecurity and vector control measures, improper market chains, illegal transport and lack of animal identification can lead to rapid spread of LSD Roche *et al.*, (2021) [5]. As an epidemiological concern, the disease was reported for the first time in India in 2019 and now has spread to several states and union territories. This recent and unprecedented spread of LSDV in India and several other countries have highlighted the need for better research efforts into a rapidly emerging pathogen. As on December, 2022 the disease has been reported from all 30 districts of Karnataka. (Source: Department of AH and VS, Government of Karnataka). It is therefore in this article, envisaged to explore and study the incidence of LSD among bovine population and summarising the overall incidence and mortality noticed in the state of Karnataka.

Materials and Methods

The present report was summarised in the state of Karnataka, India based on the data sources obtained from the Department of Animal Husbandry and Veterinary Services, Government of Karnataka with the aim of studying occurrence of LSD in the state. The data was also statistically analysed using SIR (Susceptible-Infected-Recovered) model to extrapolate the actual distribution.

Results and Discussion

As per the data obtained from the Department Animal husbandry and Veterinary Services-Government of Karnataka, Lumpy skin disease was reported from 4,380 villages of 160 taluks in 30 districts of Karnataka, as on the last week of December for the calendar year 2022. Of 1,14,53,564 bovine population (Table 1), 2,66,656 cattle were infected at a overall morbidity rate of 2.33 per cent and recoded 23,676 deaths with 8.87 per cent a mortality rate overall. The average CFR was 8.89 per cent among 30 districts. Belgaum district had a maximum number of cases and CFR; whereas, Kodagu district reported the least cases with no mortality (Table1 and Fig. 2).

Karnataka state has four revenue divisions, among four divisions, the Belgaum has the highest morbidity of 3.15 per cent of LSD followed by Kalaburagi (2.69%), Bengaluru (2.19%) and Mysuru (1.18%). The highest CFR 11.3 per cent was recorded in Belgaum division followed by Bengaluru (8.32%), Kalaburagi (7.64%) and lowest in Mysuru division at 4.31 per cent (Fig. 2). population and lesser casualties.

It is interesting to note that Belgaum division with the highest total bovine population, holding more of non-descriptive cattle and bullocks were severely affected than crossbred / lactating animals. Whereas, Gulbarga division too having similar distribution of animals but with relatively fewer cattle 2). The morbidity and mortality rates in LSD are proportional with respect to the availability of susceptible populations (Tuppureinen, 2017) [8]. This trend is also observed in Karnataka wherein the highest morbidity and CFR in Belgaum division perhaps owing to presence of dense, naive bovine population comprising mainly local and non descriptive cattle breeds. Whereas, Gulbarga division recorded relatively lower trends in morbidity and fatality rates due to availability of fewer bovine population in general.

Table 1: Particulars LSD outbreaks in Karnataka during the year 2022

Division	Name of the district	Total population	Villages affected	Animals Affected	Animals Recovered	Animals dead	CFR
Bangalore	Bengaluru urban	165029	383	1166	1014	106	9.09
	Bengaluru rural	187646	417	2331	2092	184	7.89
	Chitradurga	338907	807	11538	7679	1325	11.48
	Chikkaballapura	240212	941	3854	2639	383	9.94
	Davanagere	329697	598	15285	13593	1276	8.35
	Kolar	236162	790	3941	3644	235	5.96
	Ramanagara	307146	582	3634	1106	346	9.52
	Shivamogga	639216	1056	15736	10085	786	4.99
	Thumkur	573298	1570	8720	4964	869	9.97
Mysuru	Chamarajanagar	259279	343	5943	4763	268	4.51
	Chikkamaglur	324369	564	8815	5256	445	5.05
	Dakshin Kannada	252401	279	3143	955	58	1.85
	Hasan	656156	833	3344	1217	199	5.95
	Kodagu	76920	7	16	3	0	0.00
	Mysuru	514280	455	3378	2391	197	5.83
	Mandya	479429	1089	6256	3017	265	4.24
	Udupi	257184	201	2614	1117	13	0.50
Belgaum	Belgaum	1393711	1082	46566	28795	6005	12.90
	Bagalkot	457163	538	14264	8773	1239	8.69
	Dharwad	233464	267	7288	4776	724	9.93
	Gadag	192109	311	8624	5753	1052	12.20
	Haveri	346561	686	23852	18956	2721	11.41
	Uttara Kannada	410305	541	5079	1576	211	4.15
	Vijayapura	379190	228	1915	1033	230	12.01
Kalaburagi	Bellary	502382	828	22542	18537	2933	13.01
	Bidar	299144	131	756	564	96	12.70
	Kalaburagi	458756	486	4522	3465	243	5.37
	Koppala	294880	343	23277	21398	762	3.27
	Raichur	357794	570	6844	4640	357	5.22
	Yadagiri	290774	325	1413	861	148	10.47
	Total	1,14,53,564	17,251	2,66,656	1,84,662	23,676	8.89

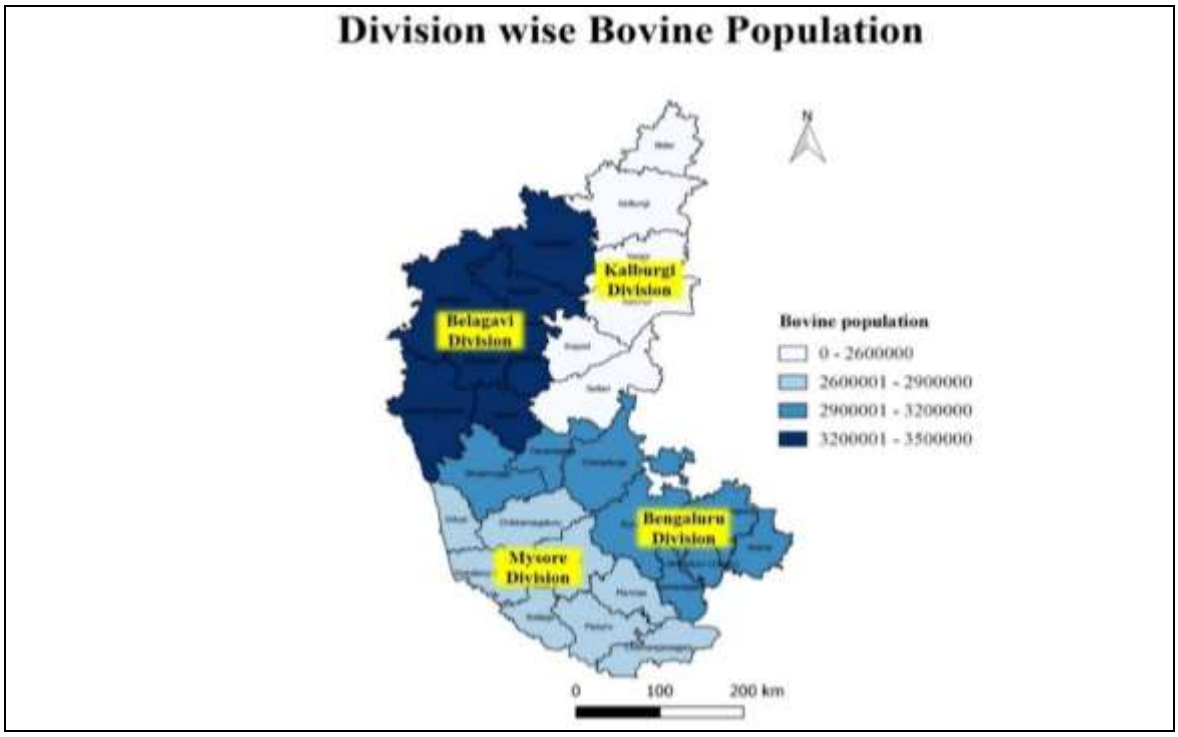

Fig 1: Distribution of division wise bovine population in Karnataka

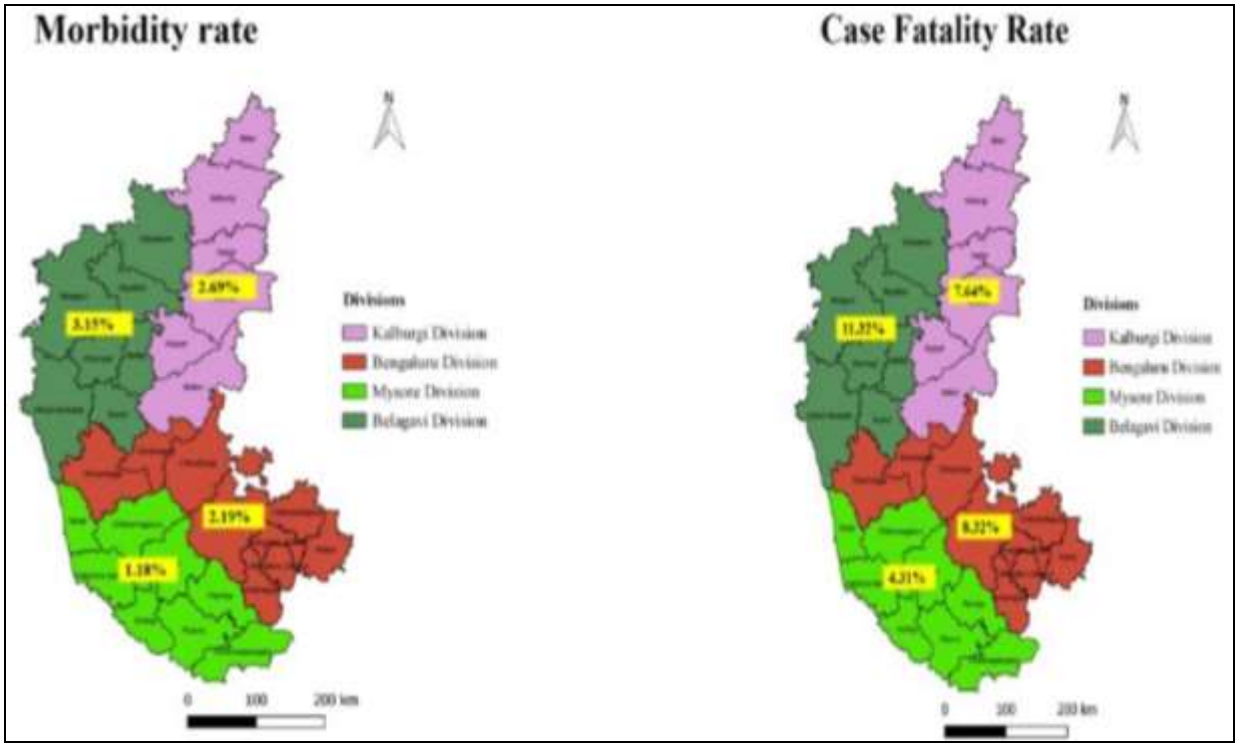

Fig 2: Map showing morbidity and case fatality rates due to LSD in different divisions in Karnataka

As the disease is newly reported, these varied figures could be due to non-implementation of immediate control measures including vaccination and vector control. Furthermore, the vector dynamics, their movement along with the direction of wind, mass movement of animals / congregation of animals; fire mishaps in sylvatic areas, fogging and presence of water stagnation / water bodies in and around the animal vicinity / housing will have a direct impact on the morbidity rates. The findings are in complete agreement with that of Vorster and Mapham, (2008) [10] and Tuppurainen *et al*., (2011) [7] wherein they opined that LSD transmission has largely influenced by geographical location of the animals, climatic conditions prevailing, husbandry / managemental practices and significantly, immune status of animal, breed, strain of virus involved and insect vectors involved in the transmission.

Asper the model output, an approximately 90 Lakhs were susceptible; 40 lakhs infected; 70 Lakhs recovered population with a Case Fatality Rate at 5 per cent at the initial stage. Over a period of time, the disease progression rate was declined by 60-80 per cent with a reproduction number (R_0 =1.5-2.0) in the initial stage. Due mainly to implementation of effective interventional strategies such as effective disease management, free vaccination coverage of all eligible population of cattle and buffaloes and strict disease control measures including restriction of animal movement, roping in other departments in vector control and free treatment of

affected animals initiated by the Government, the reproduction number (R_0) has fallen to less than 1 (R_0 <1). By analysing the model, we have found a threshold parameter (Hazard risk) will vary on account of periodic changes in vector density, continued availability of water bodies and close by vegetation, movement of cattle, susceptibility / immune status of the host, closed type of grazing and any lapses in the implementation strict disease control measures will only increase the disease outbreaks.

The model employed in the present study has two non-negative equilibrium, the disease-free equilibrium E_0 (1,0,0,0,0,0) and the endemic equilibrium was locally asymptotically stable (E <0).

Conclusion

In the upcoming years, the livestock sector is all set to become a growth engine for agriculture and considered as a potential sector for export earnings. Rising of livestock being the primary source of income for small and marginal farmers, diseases affecting livestock account for the major economic losses worth hundreds of millions of rupees. Diseases afflicting the livestock significantly affect their productivity, substantially decreasing meat and milk besides notable reduction in draught power, hide quality and manure as fuel (Alaa *et al.,* 2008) [1]. LSD is one such viral disease that affects cattle and buffaloes causing severe economic losses, especially in naive animals. LSD is endemic in many African and Asian countries, and is rapidly spreading across borders, including India. The risk factors associated with the catastrophes of LSD outbreaks are multi-factorial, they include host factors (age, breed, stress levels, immunological status), pathogen factors (sturdiness of the virus, excretion of the virus in many secretions, long time survival in the environment) and environmental factors (humidity, sunlight, direction of the wind, vector density, availability of vegetation and water bodies *etc*.,) In the current study, based on participatory epidemiological factors, LSD was considered to be one of the major cattle health problems in the study area. Locally the disease was considered unfamiliar and name given to LSD by the farmers is 'Charma Gantu Roga'. So, to tackle a disease of complex nature, such as LSD this study emphasizes the need of studying extensively about the occurrence of the disease and a plethora of epidemiological parameters contributing.

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