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Suspected Anthrax Outbreaks or Sudden Animal Deaths in Hyati Mundaragi Village in Koppal, Karnataka, India: A Farmer Prospective

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Anthrax, caused by *Bacillus anthracis*, is a persistent global threat to both public health and livestock industries. This study investigates an outbreak of sheep anthrax in Hyati Mundaragi Village, Karnataka, India. The demographic and ecological characteristics of this region are pivotal factors influencing disease emergence, with varying outbreak years observed among sheep farmers. Socio-economic factors and Risk and Emergency Management Behaviour (REMB) were found to be critical determinants of anthrax incidence, emphasizing the multifaceted nature of the disease's spread. Sheep migration and proximity to water bodies, notably the Tungabhadra reservoir, facilitated spore transfer and contributed to the outbreak in this village. The study highlights the urgency of proactive measures, including comprehensive disease surveillance, vaccine accessibility, training initiatives for local veterinarians and farmers, and the integration of AI tools for early detection and rapid response.

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Keywords: Anthrax outbreak; sheep anthrax; disease surveillance; livestock trading; disease prevention.

1. INTRODUCTION

Anthrax is an acute, infectious, non-contagious, zoonotic disease that remains a threat to public health throughout the world. The causative agent of anthrax is *Bacillus anthracis*, which is a rod-shaped, spore-forming, soil-borne bacterium that survives in the soil under suitable conditions for long periods of time. *B. anthracis* is an extracellular pathogen that replicates rapidly in the blood, conquering high density to make the host diseased. Animals come into contact with the spores by grazing grass closer to the surface when the grass is low or scarce, or by moving herds to restricted areas when water is scarce [1]. The spores are very resistant to unfavourable environmental extremes of heat, cold, desiccation, chemicals, and irradiation [2,3]. The incidence of anthrax varies with the type of the soil and climate. It is often restricted to a particular area where it is endemic and such areas are known as “Anthrax belts”. Cattle and sheep are very susceptible to anthrax and dogs and cats are quite resistant. There are only a few reports of anthrax outbreaks in domestic animals in India. Venkatesha, et al., [4] reported 2 anthrax outbreaks in Hassan and Kolar districts of Karnataka State. Anthrax poses a significant economic and health risk to livestock industries due to its potential for rapid spread, high mortality rates, and the necessity for strict biosecurity measures to control outbreaks. Humans can also be infected by handling infected animals which underscores the importance of vigilant surveillance and control measures [5-7]. The outbreak investigation team initiated an expedition to scrutinize the suspected outbreak in Hyati Mundaragi Village, equipped with extensive preliminary data encompassing clinical diagnoses obtained from previously recorded cases, including reports from the Institute of Animal Health (IAH), the Veterinary Bureau (VB), and veterinary officers in the respective area.

2. CASE PRESENTATION

2.1 Demography, Ecology and Population Dynamics of Hyati Mundaragi Village, Koppal Taluk, Koppal District

Hyati Mundaragi village in Karnataka, India, is situated in Koppal taluk of Koppal district. It is positioned 36km away from the district and sub-district headquarters at Koppal. The area of the location is 1952.86 hectares, with coordinates at approximately 15.2670°N latitude and 76.9195°E longitude (Fig. 1), situated at an altitude of 526 meters. It is home to 399 families, comprising a total population of 2,314, with a literacy rate of 61.1% (Table 1).

In Hyati Mundaragi village, livestock population in the area consists of 463 cows, 169 buffaloes, 202 sheep, and 95 goats, totalling 632 cattle and 297 goats in total livestock population comprises 495 cows, 199 buffaloes, 12,720 sheep, and 1,632 goats, with a total of 694 cows and buffaloes, and an overall total of 14,352 animals (Table 2). The ecology of Hyati Mundaragi village of Koppal district is characterized by its semi-arid climate, diverse vegetation, wildlife adapted to dry conditions, agricultural practices, and the influence of human activities. The Tungabhadra reservoir, situated at Munirabad and bordering Hatti village, serves as a primary water resource for nearby villages, fulfilling water needs for both communities and livestock. Hyatti Mundargi Village has an average annual temperature of 32.8°C and receives an average annual rainfall of 587 millimetres, spread over 30-40 days. The village experiences an average annual wind speed of 6.85 meters per second, and the atmospheric pressure averages around 1010 millibars (mb) annually. These ecological factors play a significant role in shaping the local climate and environment, with potential implications for agriculture and the overall quality of life in the area (Table 3).

Table 1. Demographic details of Hyati Mundaragi village

Area	1952.86 ha
Latitude	15.2670°N
Longitude	76.9195°E
Altitude	526 meters
Families	399
Population	2314
Literacy rate	61.1 %

Fig. 1. Google map of Hyati Mundaragi village

Table 2. Livestock census of Hyati Mundaragi Village

Livestock population			
Cow	**Buffalo**	**Sheep**	**Goat**
463 Total= 929	169	202	95

Table 3. Ecology details of Hyati Mundaragi village

Average annual Temperature	32.8 °C
Average annual Rainfall	587 mm
Average annual Rainfall days	30-40 days
Average annual wind speed	6.85 mt/sec
Average annual pressure	1010 mb

2.2 Analyzing Patterns, Risk Factors, and Community Responses to Sheep Anthrax in Hyati Mundaragi Village

In a survey conducted in Hyati Mundaragi village, sheep anthrax cases were recorded among various farmers (Table 4 & Fig. 2). The analysis of anthrax incidence among sheep farmers revealed varying outbreak years. In 2023, anthrax outbreaks were noted, with several farmers reporting infected or deceased sheep. The total number of infected sheep in this year was 147 out of 600. In 2018, outbreaks occurred, affecting 22 out of 250 sheep. Further, in 2015-2016, anthrax was reported, with a total of 250 infected out of 1,230 sheep.

The questionnaire responses showed that most farmers strongly agreed on the influence of socio-economic factors in anthrax incidence (Likert Scale: 5). Additionally, farmers generally acknowledged the significance of Risk and Emergency Management Behaviour (REMB) in anthrax prevention (Likert Scale: 4-5). However, there was variability in responses regarding the relevance of migration patterns (Likert Scale: 1-5).

Table 4. Data of anthrax of sheep at Hyati Mundaragi village

Sl No.	Farmers Name	Total No of Sheep's	Death	Year in which anthrax occurred/ not occurred	Questionnaire # (Likert Scale: 5 = strongly agree, 4= agree, 3 = neutral, 2 = disagree, and 1 = strongly disagree)							
					Socio-economic		REMB		Migration		Preparedness	
					I	II	I	II	I	II	I	II
1.	MP	150	NIL	2023	5	5	5	5	5	5	5	5
2.	MM	100	10	2018	1	5	5	4	5	4	5	5
3.	HM	100	12	2023	5	4	5	4	5	5	5	5
4.	RP	20	NIL	2023	5	4	5	5	5	4	5	5
5.	KP	100	NIL	2023	5	5	5	5	5	5	5	5
6.	GP	80	15	2018	2	4	5	5	5	4	5	5
7.	GYN	60	10	2015-16	2	5	5	5	5	4	5	5
8.	BV	170	80	2015-16	1	5	5	5	5	5	5	5
9.	AN	200		2015-16	1	4	5	5	4	5	5	5
10.	MS	110	20	2015-16	1	4	5	5	5	5	5	5
11.	MKP	70	40	2022	1	4	5	5	4	5	5	5
12.	HCR	116	40	2015-16	1	4	5	5	5	5	5	5
13.	SP	100	70	2015-2016	1	4	5	5	5	5	5	5
14.	NJ	100	40	2016-18	1	1	5	5	5	5	5	5
15.	SK	170	75	2016-18	1	1	5	5	5	5	5	5
16.	VP	80	20	2015-16	1	1	5	5	5	5	5	5
17.	RO	100	10	2015-16	1	1	5	5	5	5	5	5
18.	PI	56	5	2015-16	1	2	5	5	5	5	5	5
19.	NJ	100	50	2016-18	1	2	5	5	5	4	5	5
20.	BK	100	NIL	2023	5	2	5	5	3	4	5	5
21.	HP	10	NIL	2023	5	2	5	5	3	4	5	5

Questionnaire [#]
Socio-economical: I. Do you think you're hesitant to dispose anthrax affected carcass in a way that goes against your religious teachings? **II.** Do you think you avoid social gatherings and public spaces due to fears related to the anthrax outbreak?
Risk Exposure and Mitigation behaviour (REMB): **I.** Do you think anthrax spores can survive in the soil for extended periods, posing a risk to grazing livestock? **II.** Do you think inadequate disease surveillance measures have hindered early detection of anthrax outbreaks?
Migration: I. Do you think unregulated movement of people and livestock can contribute to the spread of anthrax to unaffected areas? **II.**: Do you think shifting of animals or change of grazing area from infected to uninfected area is effective in avoiding occurrence of anthrax?
Preparedness: I. Do you think collecting and analysing data helps identify patterns and trends in anthrax cases? **II.** Do you think prior anthrax outbreak information is important for preparedness?

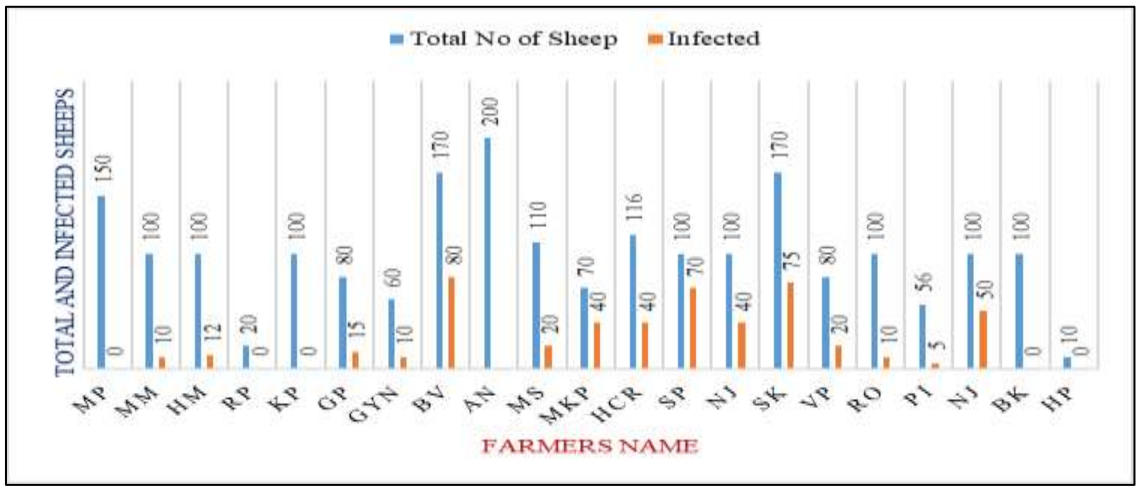

Fig. 2. Data of anthrax of sheep at Hyati Mundaragi village

3. DISCUSSION

Anthrax, a persistent problem in several regions, poses a public health risk due to livestock infections. Field diagnosis relies on clinical signs, such as sudden death with unclotted blood oozing from natural orifices. Several sceientists, Mongoh et al. [8]; Sushma et al. [9]; Bylaiah et al. [10] and Indrabalan et al. [11] identified key clinical indicators as abrupt fatalities and haemorrhaging in affected animals. Anthrax outbreaks typically result from spore ingestion in soil, often linked to prior occurrences and carcass disposal. The current outbreak revealed two infection categories: per-acute, with sudden fatalities and no clinical signs, and acute, with observable symptoms and recoverable cases. Water bodies and sheep migration to the Tungabhadra reservoir contributed to spore transfer, facilitating the outbreak in this village. In Hyati Mundaragi Village, livestock farming and trade are integral to the local economy, but pose disease transmission risks at local markets. Insufficient veterinary oversight and traditional practices exacerbate these risks. Combating disease spread through animal marketing necessitates education, quarantine measures, and collaboration with authorities to safeguard animal and human health (Sushma et al. [12]; K P Suresh et al. [13].

4. CONCLUSION

The case report of the sheep anthrax outbreak in Hyati Mundaragi Village, Koppal, Karnataka, highlights the complex interplay of factors contributing to the disease's emergence. The demographic and ecological characteristics of the region, coupled with traditional livestock trading practices, pose significant challenges in disease prevention and control. To mitigate future outbreaks, it is imperative for the government to take proactive measures. This includes allocating resources for comprehensive disease surveillance, ensuring a consistent supply of anthrax vaccines, conducting regular training sessions for local veterinarians and farmers, and establishing robust early detection and rapid response mechanisms using Artificial intelligence (AI). Engaging with the community, dispelling myths, and fostering trust is crucial, as is collaborating with international organizations to strengthen disease management efforts. Addressing these aspects holistically is essential for safeguarding the health and livelihoods of both the community and their livestock in Hyati Mundaragi Village and similar regions.

CONSENT

We've recorded videos of each farmer with their clear and transparent consent, signifying their willingness to participate in activities involving their land and data, all in adherence to agreements ensuring transparency and respecting their rights and interests.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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