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# Lumpy Skin Disease: The Viral Threat Reshaping India's Dairy Defences

**Gopal Sarkar[1], Amit Kumar[2], Jitendra Singh Gandhar[3], Mousumi Namasudra[1*]**

[1]Veterinary Officer, Department of Animal Husbandry, Government of West Bengal, India
[2]Scientist, ICAR–Indian Institute of Agricultural Biotechnology, Ranchi, Jharkhand, India
[3]Assistant Professor, Department of Veterinary Medicine, Uttar Pradesh Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura, Uttar Pradesh, India



*Corresponding Author
**Mousumi Namasudra***

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## INTRODUCTION

The name 'lumpy skin disease' sounds almost cosmetic. The reality is very different. Lumpy skin disease (LSD) is a systemic viral infection of cattle that can produce high fever, painful skin nodules, enlarged lymph nodes, swollen limbs, mastitis, pneumonia, infertility, abortion and a prolonged fall in milk production. Mortality is usually lower than morbidity, yet the disease can still be devastating because surviving animals may need weeks or months to regain condition and productivity. LSD does not infect people. Its importance lies instead in animal welfare and economics: sick cattle eat less, produce less milk, lose body weight and may suffer permanent damage to the skin and reproductive system. At farm level, the result is lost daily income and increased spending on veterinary care. At national level, repeated outbreaks can disrupt livestock movement, dairy supply chains and trade. The stakes are especially high in India. Official statistics place national milk production at 247.87 million tonnes in 2024–25, the highest in the world. Much of this milk comes from small and marginal households for whom one or two animals function as a living bank account. A disease that removes even a few litres of milk per day can therefore become a household financial emergency.

### The virus behind the lumps

LSD is caused by lumpy skin disease virus (LSDV), a large, enveloped, double-stranded DNA virus in the genus Capripoxvirus. Its close relatives cause sheeppox and goatpox. The virus primarily affects cattle and can also infect Asian water buffalo, although cattle bear most of the recognised disease burden.

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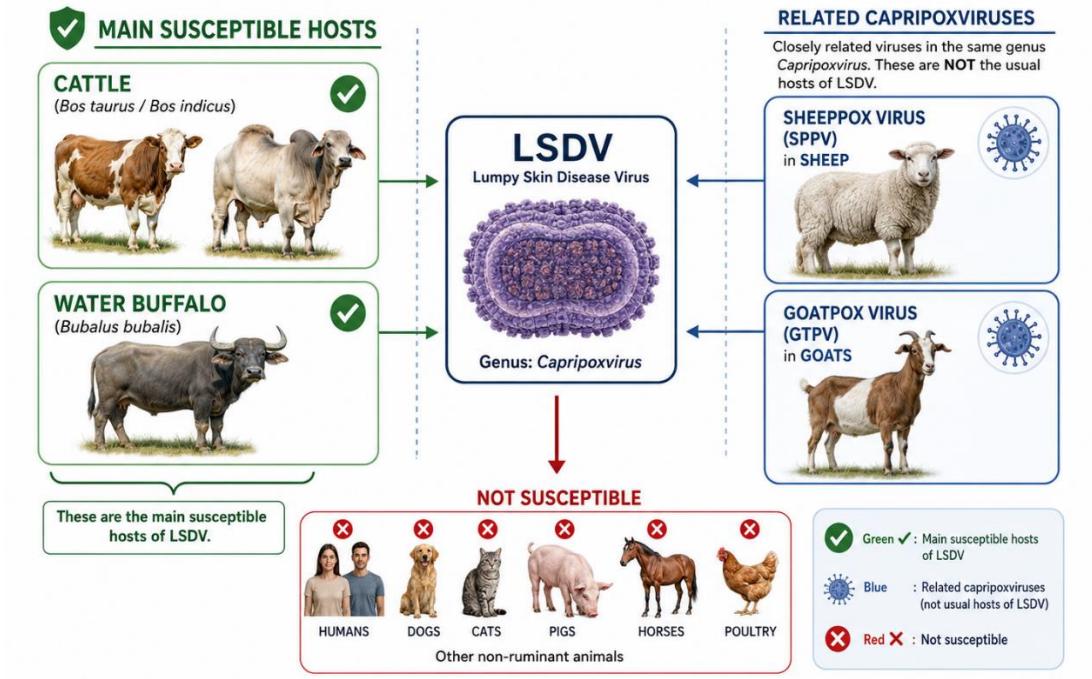


**Figure 1.** Host range of lumpy skin disease virus (LSDV). Cattle and water buffalo are the main susceptible hosts. Sheeppox virus and goatpox virus are closely related capripoxviruses of sheep and goats, while humans are not susceptible; LSD is not a zoonotic disease.

After entering the skin, usually through the bite of a blood-feeding insect, LSDV multiplies locally and in nearby lymph nodes. It then enters the bloodstream and reaches tissues throughout the body. Infection of skin cells and the lining of small blood vessels triggers inflammation, leakage of fluid, clot formation and tissue death. These vascular injuries explain why the characteristic nodules are firm, deep and sometimes necrotic rather than being a superficial rash. Like other poxviruses, LSDV is physically resilient. Infectious virus can persist in dried scabs and necrotic skin material, particularly in cool or shaded conditions. This persistence does not make indirect transmission the main route, but it increases the importance of removing contaminated material, cleaning equipment and maintaining farm hygiene. DNA viruses generally change more slowly than many RNA viruses, but 'slowly' does not mean 'never'. Whole-genome sequencing has revealed genetically distinct lineages and recombinant viruses in parts of Eurasia. For disease-control programmes, this makes continued genomic surveillance important: it can reveal introductions, trace transmission routes and show whether circulating strains are changing in ways that deserve further investigation.

**From Africa to India**

The disease was first described in southern Africa in the early twentieth century and remained largely African for decades. From the late 1980s onward it moved into the Middle East, and during the 2010s it expanded across southeastern Europe and Eurasia. Asia experienced a major epidemiological turning point in 2019, when outbreaks were reported in Bangladesh, China and India. India confirmed its first outbreak in Odisha in August 2019. Molecular studies showed that the Indian virus was closely related to older field strains rather than to the vaccine-like recombinant viruses then attracting attention elsewhere. Sporadic outbreaks followed, but the scale changed dramatically in 2022, when

disease spread across multiple regions and exposed major gaps in preparedness, vaccine availability, movement control and vector management. The epidemic also demonstrated a central feature of transboundary animal disease: a virus does not need to kill a large proportion of animals to cause a national crisis. A combination of widespread illness, lower milk yield, reproductive losses, damaged hides, treatment costs and disrupted markets can generate an economic burden far beyond the mortality count.

**India today: a smaller epidemic, but not a vanished threat**

India's 2022 epidemic was much larger than early news reports suggested. Government data compiled as of 20 December 2022 recorded 3,085,854 affected cattle across 22 reporting States/UTs, 168,526 deaths and 2,717,991 recoveries. A later parliamentary consolidation revised the 2022 death total to 174,768 and recorded a further 27,218 deaths in 2023. These figures are date-stamped and were revised as state reports were updated; totals from different reporting dates should therefore not be combined.

| Indicator | Best available national evidence |
|---|---|
| **Peak epidemic (20 Dec 2022)** | 3.09 million affected cattle; 168,526 deaths; 22 reporting States/UTs. |
| **Revised mortality** | 174,768 deaths in 2022 and 27,218 deaths in 2023. |
| **2024 circulation** | Disease observed in 12 states; January-June 2024: 167 outbreaks, 4,049 affected bovines and 222 deaths. |
| **Vaccination and recovery** | 8.54 crore cattle vaccinated during 2024-25; 95% recovery; more than 27.21 crore cumulative vaccinations/revaccinations by January 2025. |
| **Estimated farm-level loss** | US$2.44 billion (about Rs 20,254 crore) during 2022-23 in a national stochastic model. |

The 12 states named in the Department of Animal Husbandry and Dairying Annual Report 2024-25 were West Bengal, Tamil Nadu, Gujarat, Andhra Pradesh, Rajasthan, Karnataka, Goa, Madhya Pradesh, Odisha, Sikkim, Kerala and Maharashtra. Basic Animal Husbandry Statistics 2025 reports 167 outbreaks, 4,049 affected bovines and 222 deaths during January-June 2024. This represents a sharp reduction from the 2022 peak, but it also shows that LSD had not disappeared. The disease was still circulating in geographically separated regions, which is why annual vaccination, vector control and rapid reporting remain necessary. There is no official all-India account of farmers' actual financial losses: the Department of Animal Husbandry and Dairying has stated that it does not maintain such data. The best national estimate currently available comes from a 2025 Scientific Reports study based on 2,351 farms in seven states and stochastic extrapolation to India. It estimated short-term losses during 2022-23 at US$2.44 billion (about Rs 20,254 crore). Mortality accounted for 42.5% of the simulated loss, modern treatment for 26.5%, milk loss for 13.7% and labour for 10.8%, with smaller shares from draught-power loss, traditional treatment and vector control. Because this is a model rather than audited compensation or market data, it should be presented as an estimate, not as an official loss figure. WOAH and FAO treat LSD as a continuing regional priority. WOAH emphasizes that even relatively low mortality can produce serious losses through reduced milk yield, infertility, weight loss, hide damage and trade disruption. In August 2024,

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an FAO-supported prioritization exercise in India ranked LSD first among ten animal infectious diseases requiring strengthened prevention and control. India's present position is therefore best described as controlled but persistent: the national burden is far below the 2022 emergency, yet surveillance and vaccination cannot be relaxed.

**How does LSD spread?**

The dominant route is mechanical transmission by blood-feeding arthropods. Stable flies, other biting flies and mosquitoes feed on an infected animal and retain virus-contaminated blood on their mouthparts. When feeding is interrupted and the insect quickly moves to another animal, it can deposit infectious material into a fresh bite. In this process, the insect behaves less like a biological incubator and more like a contaminated flying needle. Stable flies are considered particularly important because they feed aggressively and move repeatedly between animals. Mosquitoes can become influential when rainfall creates abundant breeding sites. Experimental work also supports a role for some hard ticks, although their importance varies with species, ecology and local husbandry. Direct animal-to-animal transmission is generally less efficient than vector-borne spread, but it should not be dismissed. Viral material has been detected in saliva, nasal and ocular secretions, milk and semen. Contaminated needles or instruments can bypass natural barriers and transmit infection between animals. Long-distance cattle movement adds another layer of risk because animals in the incubation period, or those with mild disease, may be transported before the problem is recognized. India provides many opportunities for these routes to interact. Warm temperatures and seasonal rainfall support large insect populations. Cattle from different households often share grazing areas, water points, markets and transport. Dense peri-urban dairies can place many susceptible animals close together. Once infection enters such a network, vectors drive local spread while livestock movement carries the virus to new locations.

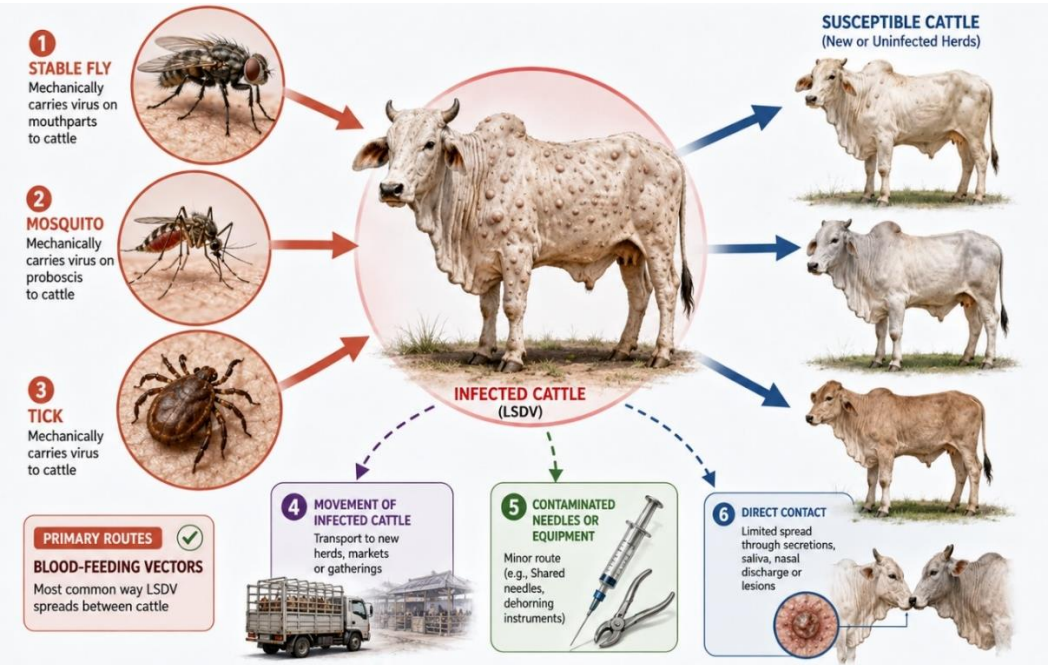


**Figure 2.** The principal transmission route of lumpy skin disease is mechanical transfer by blood-feeding insects. Animal movement and poor equipment hygiene amplify spread between farms and regions.

**From vector bite to visible disease**

Clinical signs often appear within one to two weeks of infection, although timing varies. The first clues may be easy to miss: fever, reduced appetite, dullness, watery eyes, nasal discharge, enlarged superficial lymph nodes and an unexplained fall in milk yield. Firm nodules then develop over the head, neck, trunk, udder, perineum and limbs. Some animals have only a few lesions; others are covered with them. The nodules extend through the full thickness of the skin and may become painful and necrotic. When a central plug of dead tissue separates, it leaves a deep wound known as a 'sitfast'. These wounds heal slowly and are vulnerable to bacterial infection and fly strike. Swelling of the legs and brisket can make movement difficult, while lesions in the mouth and respiratory tract interfere with eating and breathing. The disease can also reach the mammary and reproductive systems. Mastitis and systemic illness reduce milk yield, sometimes long after the fever has resolved. Bulls may develop inflammation of the testes and temporary infertility; cows may show abortion, delayed return to oestrus or reduced conception. Calves, pregnant animals, high-producing dairy cows and cattle weakened by poor nutrition or concurrent disease are at greater risk of complications. Field observations often suggest that indigenous cattle experience milder disease than some exotic and crossbred dairy animals. Genetics may contribute, but management, nutrition, heat stress, vector exposure and production pressure are tightly intertwined. The observation should therefore not be used to assume that any breed is naturally protected.

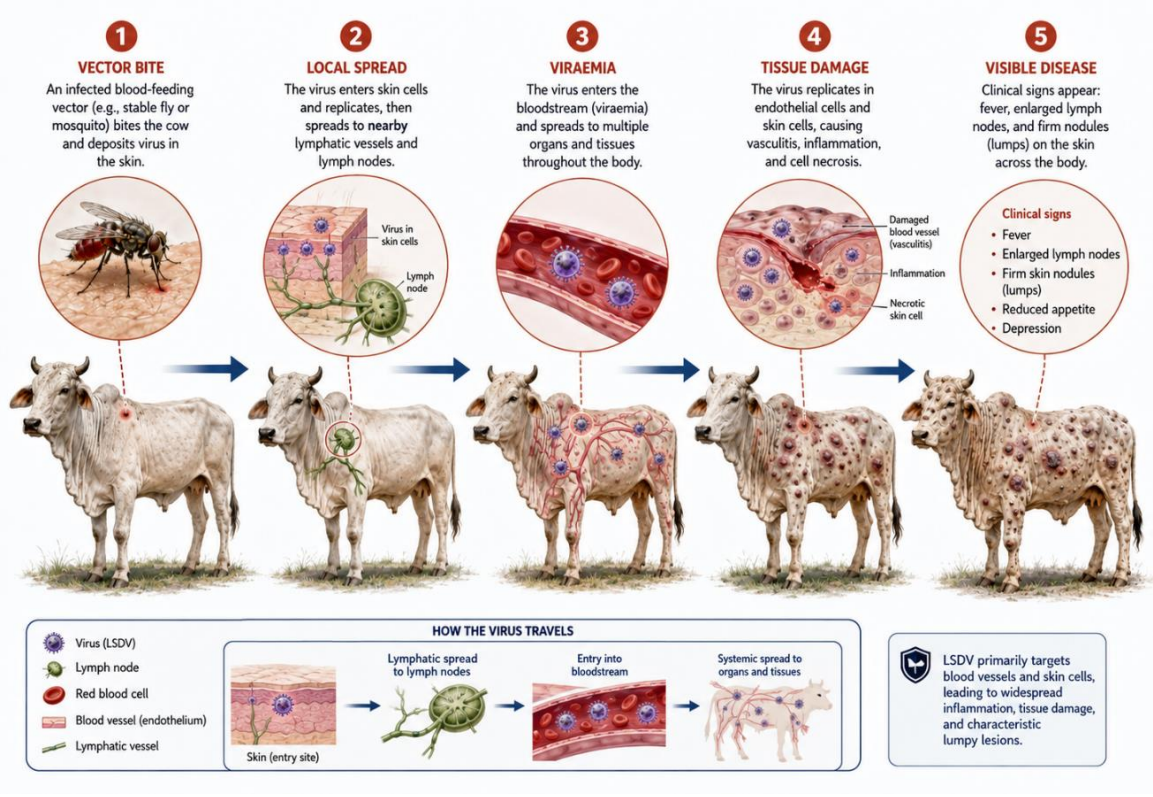


**Figure 3.** From vector bite to visible disease: after inoculation by a blood-feeding vector, LSDV spreads locally to lymphatic tissues, enters the bloodstream (viraemia), damages blood vessels and skin, and finally produces the characteristic fever, lymph-node enlargement and firm cutaneous nodules of lumpy skin disease.

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**Diagnosis: recognising the pattern, confirming the virus**

During an outbreak, the combination of fever, enlarged lymph nodes and widespread deep skin nodules is strongly suggestive. However, several conditions can resemble LSD, including pseudo-lumpy skin disease caused by bovine herpesvirus 2, insect-bite hypersensitivity, dermatophytosis, demodicosis, photosensitisation and other infectious or parasitic skin diseases. Laboratory confirmation is therefore essential, particularly when disease appears in a new area. Skin nodules, scabs and lesion biopsies usually contain the highest concentration of virus and are preferred diagnostic samples. Whole blood is useful during the viraemic phase, while other specimens may be collected for specialised investigations. Real-time polymerase chain reaction (qPCR) is the principal laboratory method because it detects viral DNA rapidly and with high sensitivity and specificity. Virus isolation remains valuable for research and vaccine evaluation but is slower and requires specialised cell-culture facilities. Loop-mediated isothermal amplification and portable PCR systems may bring testing closer to the farm, while nanopore sequencing can provide near-real-time genomic information during outbreak investigations. These tools are promising, but they complement rather than replace sound sampling, veterinary interpretation and quality-controlled laboratories.

**Prevention works best as a system**

There is no specific antiviral treatment routinely available for LSD. Veterinary care is supportive: controlling pain and fever, maintaining hydration and nutrition, treating bacterial complications when present, and protecting wounds from contamination and flies. Because treatment cannot stop area-wide transmission, prevention must remain the priority. Vaccination is the foundation of control. Live attenuated capripoxvirus vaccines generate both antibody and cell-mediated responses, which are important against poxvirus infection. High coverage is crucial: scattered vaccination leaves susceptible pockets in which vectors can continue moving the virus. Vaccination should be planned before periods of high vector activity and conducted under official veterinary programmes, with attention to cold-chain integrity, correct administration and post-vaccination monitoring. Vaccination alone, however, cannot compensate for delayed reporting or unrestricted cattle movement. A suspected case should trigger rapid veterinary examination, sampling and temporary separation of affected animals. Equipment should not be shared between sick and healthy groups unless it has been properly cleaned and disinfected. Needles must never be reused across animals. Movement from affected premises and high-risk markets should be managed according to veterinary authority instructions. Vector reduction is another essential layer. No farm can eliminate every fly or mosquito, but risk can be lowered by removing stagnant water, improving drainage, managing manure, reducing organic waste, protecting wounds and applying approved insect-control measures. Community action is more effective than isolated treatment because insects do not respect farm boundaries. Finally, farmers need clear, trusted information. Confusing LSD with an allergy or ordinary insect bite delays reporting. Rumours about zoonotic risk or vaccine safety can reduce cooperation. Extension messages should therefore explain what the disease looks like, why it does not infect humans, how vaccination protects herds, and when professional veterinary help is needed.


**Figure 4.** Effective LSD prevention is layered. Vaccination is central, but it performs best when linked with surveillance, isolation, movement control, vector reduction, hygiene and veterinary care.

**India's vaccine response**

During the early Indian outbreaks, goatpox vaccine was used as a heterologous emergency measure because a homologous LSDV vaccine was not yet available nationally. The antigenic relationship among capripoxviruses can provide cross-protection, but homologous vaccines generally offer a more direct match to the target virus. A major scientific advance was the development of Lumpi-ProVacInd by ICAR institutions using an attenuated Indian LSDV field isolate. Controlled evaluation reported a favourable safety profile, strong immune responses and protection against experimental challenge. Technology licensing and commercialisation have since expanded, including an additional technology transfer announced by ICAR in April 2026. The vaccine is not a reason for complacency. Manufacturing scale, quality assurance, cold-chain performance, delivery to remote villages and farmer acceptance all determine real-world impact. Vaccination records must also be linked with outbreak surveillance so that authorities can distinguish failures of coverage from unusual epidemiological events and can evaluate how long population immunity is being maintained.

**What science should do next**

The next phase of LSD control will be less about discovering one dramatic cure and more about connecting multiple streams of evidence. Genomic data can identify viral lineages; climate and vector information can indicate when transmission risk is rising; livestock-movement data can reveal routes of geographic spread; and digital reporting can shorten the delay between a farmer seeing lesions and a laboratory receiving samples. Artificial-intelligence models may eventually help recognise lesions or forecast outbreak hotspots, but these systems must be trained on representative data and validated under field conditions. A photograph cannot replace a veterinarian, and a prediction model cannot compensate for weak surveillance. The most useful technologies will be those that strengthen decisions at district and farm level rather than merely producing impressive laboratory results. Vaccine research also continues. Priorities include safer and more stable formulations, longer-lasting immunity, and DIVA strategies that help distinguish infected from vaccinated animals. At the same time, researchers must keep checking whether

emerging viral lineages alter disease severity or vaccine performance. Continuous evaluation is more reliable than assuming that a product that worked once will work equally well under every future condition.

## CONCLUSION

India's encounter with lumpy skin disease is a warning, but it is also a demonstration of scientific capacity. Within a few years of the first confirmed outbreak, the country expanded molecular diagnosis, generated local genomic data and developed an indigenous homologous vaccine. Those gains matter far beyond one disease. The lasting lesson is that transboundary animal diseases are controlled by systems, not single interventions. Vaccination must be supported by early reporting, laboratory confirmation, movement management, vector reduction, farm biosecurity and transparent communication. When these elements are maintained between outbreaks—not assembled after cases explode—the dairy sector becomes more resilient. Protecting cattle from LSD therefore means protecting more than animal health. It safeguards milk production, rural income, food security and the confidence of millions of families whose livelihoods depend on livestock.

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