

Vectors of lumpy skin disease: Their role in disease transmission and management

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Lumpy Skin Disease (LSD) is an important transboundary viral disease affecting cattle, buffaloes and some wild ruminants, caused by the Lumpy Skin Disease Virus (LSDV). Unlike many other viral diseases, LSD spreads mainly through blood-feeding arthropods rather than direct animal-to-animal contact. Stable flies, mosquitoes and ticks act as mechanical carriers of the virus and play a crucial role in disease transmission. Environmental factors such as rainfall, humidity, warm temperature and poor sanitation favour multiplication of these vectors and increase the risk of outbreaks. This article highlights the important arthropod vectors involved in LSD transmission and provides practical measures that can help reduce disease spread under field conditions.

Keywords: Animal health, Arthropod vector, Vaccination, Vector control

LUMPY Skin Disease (LSD) has emerged as one of the most important viral diseases affecting livestock in recent years. The disease is caused by the Lumpy Skin Disease Virus (LSDV), which belongs to the genus *Capripoxvirus* under the family Poxviridae. Initially confined to Africa, LSD has now spread to many countries in the Middle East, Europe and Asia, including India, where large outbreaks have occurred since 2019. Although cattle are the principal hosts of LSDV, the disease has also been reported in buffaloes and several wild bovids under natural and experimental conditions. Infection causes considerable economic losses due to reduced milk yield, poor growth, infertility, abortion, damage to hides, restrictions on animal movement and increased expenditure on treatment and disease control. The disease therefore poses a serious challenge to the livestock sector, particularly in countries where dairy farming is an important source of livelihood.

One of the distinguishing

features of LSD is its mode of transmission. Unlike contagious diseases that spread mainly through direct contact, LSD is transmitted predominantly by blood-feeding arthropods. Because these vectors are abundant during warm and humid seasons, disease outbreaks are usually associated with periods of increased insect activity. Understanding the role of arthropod vectors is essential for designing effective disease control programmes. Vector control, combined with vaccination and strict biosecurity measures, can substantially reduce disease transmission and minimise economic losses. This article discusses the major vectors involved in LSD transmission and the practical strategies available for their control under field conditions.

Transmission of lumpy skin disease virus

Lumpy skin disease virus spreads through several routes. Understanding these transmission pathways helps in planning effective

disease prevention and control measures.

Direct contact: Direct transmission between infected and healthy animals occurs less frequently than vector-borne transmission. However, close contact with infected animals may expose susceptible animals to virus present in skin lesions, saliva, nasal discharge, ocular secretions and milk. The risk increases when infected animals remain within the herd during the active stage of disease.

Indirect transmission: The virus may also spread through contaminated equipment, feed troughs, water containers, ropes, needles and vehicles used for transporting animals. Although this route is less significant than vector transmission, maintaining proper hygiene and disinfection helps reduce the possibility of indirect spread. Recent studies have demonstrated that LSDV can be detected in the semen of infected bulls for an extended period after

infection. Consequently, natural mating or the use of contaminated semen for artificial insemination may contribute to disease transmission under certain circumstances. Therefore, semen from infected or suspected bulls should not be used for breeding until the animals are confirmed free from infection.

Vector-borne transmission: Mechanical transmission by arthropod vectors is considered the primary route of spread of LSDV. Stable flies, mosquitoes, Horse flies, and certain tick species can transfer the virus from infected to susceptible animals while feeding on blood. Unlike biological transmission, the virus does not multiply inside these vectors; instead, it survives on contaminated mouthparts and is carried mechanically from one animal to another. Frequent interrupted feeding by these vectors greatly enhances disease spread, especially in densely populated cattle farms.

Stable flies – The most important vector: Among all arthropod vectors, the stable fly is regarded as the most efficient mechanical transmitter of LSDV. Unlike the common housefly, both male and female stable flies feed on blood several times a day. Their painful bites often cause animals to move suddenly before the flies complete feeding. As a result, the flies quickly move to another animal and continue feeding, carrying virus-contaminated blood on their mouthparts.

Stable flies breed in moist organic matter such as cattle manure mixed with straw, decomposing fodder, spilled feed and damp bedding. Poor sanitation around dairy farms therefore provides ideal breeding sites and increases fly populations. Experimental studies have shown that stable flies can retain the virus on their mouthparts for several hours after feeding on infected cattle, allowing them to infect susceptible animals during subsequent blood meals. Because of their frequent interrupted feeding behaviour and abundance around livestock, stable flies play a major role in initiating and sustaining LSD outbreaks.

Table 1. Important arthropod vectors involved in the transmission of LSDV

Vector	Scientific name	Role in transmission
Stable fly	<i>Stomoxys calcitrans</i>	Most important mechanical vector; transmits virus while feeding on multiple animals.
Horse flies	<i>Tabanus</i> spp.	Mechanical transmission through interrupted blood feeding.
Mosquitoes	<i>Aedes</i> , <i>Culex</i> and <i>Anopheles</i> spp.	Mechanical transmission; important during rainy seasons.
Hard ticks	<i>Rhipicephalus</i> (<i>Boophilus</i>) spp., <i>Amblyomma</i> spp.	May maintain and transmit the virus under certain conditions; transstadial and transovarial transmission has been reported experimentally.

Mosquitoes: Mosquitoes are another important group of vectors involved in the spread of LSDV. Species commonly found in cattle-rearing areas become highly abundant during the monsoon and post-monsoon seasons. Female mosquitoes require blood meals for egg development and often feed on several animals during their lifetime. When mosquitoes feed on an infected animal, virus particles may contaminate their mouthparts and be transferred mechanically to healthy cattle during subsequent feeding. Although the virus does not multiply inside mosquitoes, their large population density and wide distribution make them important contributors to disease spread. Mosquito breeding increases in stagnant water accumulated in ponds, drains, discarded tyres, water tanks, irrigation channels and poorly maintained animal sheds.

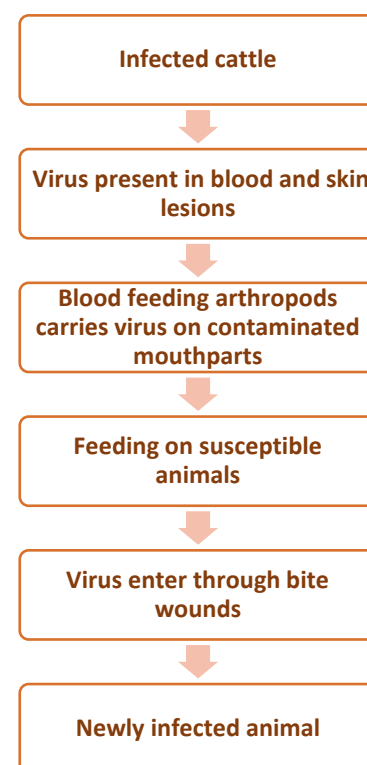
Horse flies and other biting flies: These can also contribute to the spread of LSDV. These insects possess strong mouthparts that inflict painful bites, causing animals to react violently before feeding is completed. Consequently, the flies frequently move between animals while carrying contaminated blood on their mouthparts. Although their role is generally considered less important than that of stable flies, horse flies can facilitate disease transmission during periods of high vector abundance, particularly in grazing animals and pasture-based production systems.

Ticks: Ticks are long-term blood-feeding ectoparasites that may contribute to the epidemiology of LSD under certain conditions. Unlike insects, some tick species may retain the virus

through different developmental stages (transstadial transmission) and, in certain situations, pass the virus from the adult female to her offspring (transovarial transmission). Although ticks are not considered the principal vectors, they may help maintain the virus in endemic areas and contribute to disease persistence.

Vector competence and vectorial capacity

Not all blood-feeding arthropods transmit LSDV with equal efficiency. Their ability to acquire and transmit the virus is known as vector competence, whereas the overall efficiency of disease transmission under field conditions is referred to as vectorial capacity.



Schematic representation of the transmission of Lumpy Skin Disease Virus (LSDV) by blood-feeding arthropods

Feeding behaviour: Vectors feeding repeatedly on different animals have a greater chance of transmitting virus

Vector abundance: Large populations increase the probability of contact between infected and susceptible animals

Survival period: Longer-lived vectors have more opportunities to feed on multiple hosts and spread the virus

Host preference: Feeding on cattle and buffaloes contribute more significantly to disease transmission than those on wildlife

Factors affecting vector competence

Role of animal movement and trade

Although arthropod vectors are the primary mode of LSD transmission, the movement of infected animals plays a major role in introducing the virus into new areas. Animals may carry the virus during the incubation period without showing visible clinical signs. Transporting such animals to livestock markets or new farms can facilitate the spread of infection. Once infected animals enter a new locality, blood-feeding vectors readily transmit the virus to susceptible cattle and buffaloes. Uncontrolled movement of animals across districts, states and international borders has been identified as one of the major reasons for the rapid spread of LSD in recent years. Therefore, strict regulation of animal movement during outbreaks is essential. Quarantine of newly purchased animals for at least 21–28 days, careful clinical examination before transportation and prompt reporting of suspected cases are important biosecurity measures. Livestock owners should also avoid sharing equipment, vehicles and workers between infected and disease-free farms without proper cleaning and disinfection.

Integrated vector management

Since no single control measure can completely prevent LSD transmission, an Integrated Vector Management (IVM) approach is recommended. It combines chemical, biological, environmental and other practices to reduce vector populations while minimising

adverse effects on animals, humans and the environment. The major components of IVM include:

Chemical control: Chemical drugs remain one of the fastest methods for reducing populations of biting flies, mosquitoes and ticks. Commonly used insecticides/acaricides include synthetic pyrethroids, organophosphates and macrocyclic lactones, which may be applied as sprays, pour-on formulations, dips or ear tags depending on local recommendations. Application of insecticides should focus on:

- Animals during periods of high vector activity.
- Animal sheds and surrounding resting sites.
- Manure accumulation areas.
- Walls, roofs and shaded locations where flies rest.

Rotation of insecticides/acaricides having different modes of action is important to delay the development of insecticide resistance. Farmers should always use products recommended by veterinarians and follow label instructions regarding dosage, withdrawal periods and environmental safety.

Environmental management: Environmental sanitation is one of the most economical and sustainable methods for reducing vector populations. Reducing breeding habitats greatly decreases populations of stable flies and mosquitoes.

- Regular removal of manure and organic waste.
- Proper disposal of spoiled feed

and crop residues.

- Maintaining clean and dry animal sheds.
- Repairing leaking water pipelines and drinkers.
- Eliminating stagnant water around farms and improving drainage systems.
- Frequent cleaning of feed and water troughs.

Biological methods: These offer environmentally friendly alternatives for managing vector populations. Natural enemies such as parasitoid wasps (*Muscidifurax* spp. and *Spalangia* spp.) attack the pupae of stable flies and houseflies, thereby reducing fly emergence. Predatory beetles and entomopathogenic fungi may also contribute to suppressing vector populations. Larvivorous fish such as *Gambusia affinis* can be introduced into ponds and water reservoirs to reduce mosquito larvae. Biological methods are particularly useful when integrated with sanitation and limited insecticide use.

Mechanical and physical methods: Mechanical measures reduce the contact between vectors and animals without using chemicals. These include:

- Installation of insect-proof screens on animal sheds.
- Use of mosquito nets for valuable breeding animals.
- Sticky traps for flies.
- Ultraviolet light traps in dairy units.
- Fan-assisted ventilation, which reduces the landing of stable flies and mosquitoes.
- Proper disposal of carcasses and infected materials.

Farm biosecurity: Good biosecurity significantly reduces the introduction and spread of LSD. Farm workers should also be trained to recognise early signs of disease and report suspected cases without delay. Essential biosecurity practices include:

- Isolation of sick animals immediately after detection.
- Restricting visitors during outbreaks.
- Disinfection of vehicles and equipment entering farms.

- Use of dedicated clothing and footwear by farm workers.
- Proper disposal of scabs and contaminated bedding.
- Regular cleaning and disinfection of animal housing.

Vaccination: Vaccination should always be combined with effective vector control and farm biosecurity. It is important to note that only a limited number of homologous LSD vaccines are commercially available worldwide. In many countries, including India, heterologous live attenuated goatpox vaccine has been widely used under emergency vaccination programmes because it provides cross-protection against LSDV. In some regions, sheeppox vaccine has also been used where homologous LSD vaccines are not readily available. More recently, India has developed the indigenous homologous live attenuated LSD vaccine, which provides targeted protection against LSDV and represents an important advancement in national disease control programmes. For successful vaccination programmes:

- Vaccinate all eligible cattle and buffaloes in affected and surrounding areas before the peak vector season whenever possible. Maintain cold-chain conditions during vaccine storage and transportation.
- Avoid vaccinating clinically sick animals.
- Even after vaccination, vector control measures should continue because vaccinated

animals may still be exposed to infected insects before protective immunity develops.

Challenges in controlling vectors

Despite significant advances in the understanding of LSD, controlling its transmission remains a major challenge because the disease is closely associated with blood-feeding arthropod vectors. The abundance of these vectors, together with favourable climatic conditions and extensive movement of livestock, often results in rapid spread of infection.

One of the major challenges is climate variability. Increasing temperatures, high humidity and prolonged rainy seasons favour the breeding and survival of stable flies, mosquitoes and ticks. Climate change may further expand the geographical distribution of these vectors, increasing the risk of LSD outbreaks in previously unaffected areas.

Another important concern is the development of insecticide/acaricide resistance. Continuous and indiscriminate use of the same insecticides/acaricides has resulted in reduced susceptibility among several fly and mosquito populations. This reduces the effectiveness of chemical control programmes and highlights the need for rotation of insecticides with different modes of action and the adoption of integrated vector management practices.

Resource limitations also hamper disease control, particularly

in smallholder farming systems. Regular insecticide application, vaccination, improved housing and farm sanitation require financial investment, which may not always be feasible for resource-poor farmers. In remote areas, inadequate veterinary infrastructure and delayed disease reporting further complicate outbreak management.

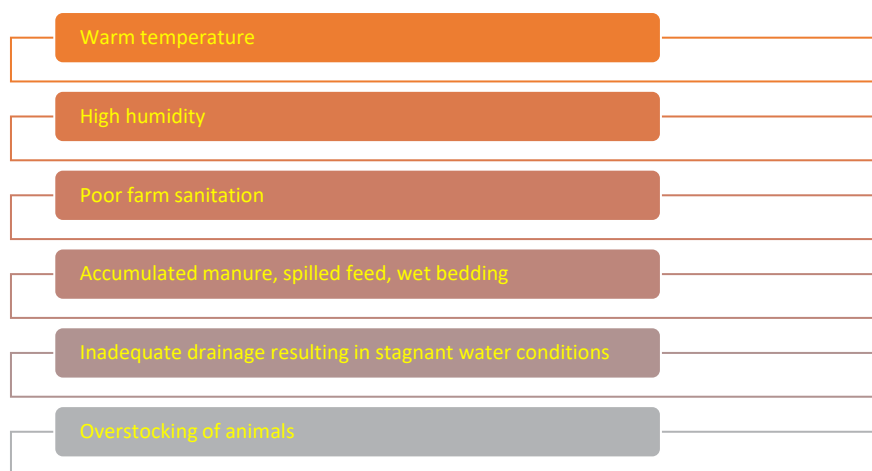
The movement of infected animals before the appearance of clinical signs remains another important obstacle. Livestock markets, fairs and transportation of animals can facilitate long-distance dissemination of the virus if quarantine and movement restrictions are not strictly implemented.

Finally, limited awareness among livestock owners regarding vector control and early disease recognition often delays implementation of preventive measures. Strengthening farmer education and veterinary extension services is therefore essential for successful disease control.

SUMMARY

Lumpy Skin Disease (LSD) is an economically important vector-borne disease of cattle and buffaloes. During the last few years, LSD has spread rapidly across Asia, including India, resulting in heavy economic losses due to reduced milk production, loss of body weight, infertility, abortion, hide damage and mortality. Stable flies, mosquitoes and ticks play a major role in spreading the virus, making effective vector control essential for disease prevention. An integrated approach combining vaccination, vector management, biosecurity, surveillance and farmer awareness is the most effective strategy to reduce disease outbreaks. Continued research and coordinated efforts among veterinarians, researchers, government agencies and livestock farmers will strengthen the control of LSD and protect livestock health and productivity.

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Environmental and farm factors influencing vector populations