

# LSD outbreak in Western Europe : The Impossible Eradication

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## Abstract

The EU mandates the “immediate eradication” of lumpy skin disease (LSD), classified as a Category A disease. Although this is never explicitly stated, the goal is to eradicate the causative agent: the LSD virus (LSDV). This goal is unattainable because it would require the global eradication of the virus, and the EU is the only entity demanding it: the virus persists and circulates in Africa and Asia and has an animal reservoir in Africa’s wildlife.

The potential consequences of eradicating viral diseases in general are discussed in this text. Regarding LSD, experts agree that the vaccine prevents the eradication of the virus because it allows it to circulate silently. Only unvaccinated animals serve as sentinels for this circulation. This would justify questioning the vaccination requirement in infected areas.

French authorities hope for the rapid development of DIVA vaccines and serological tests that would distinguish natural antibodies (induced by infection) from vaccine-induced antibodies in healthy animals. PCR-DIVA tests already allow for distinguishing infected animals from vaccinated ones when they exhibit clinical signs.

The value of DIVA serology is purely political and economic, aimed at maintaining the disease-free status of a region or the entire country. From a biological standpoint, healthy seropositive animals are cured and therefore immune for life: they pose no risk of spreading the virus.

However, they do pose a threat to disease-free status, and their detection will trigger a virological investigation to identify any potentially “asymptomatic” infected animals. Indeed, DIVA serology tests are useless for detecting sick animals. Only PCR-DIVA is useful for confirming a clinical diagnosis. The development of DIVA serology tests is therefore pointless from a public health perspective: why worry about the circulation of a virus if it does not make animals sick, given that it is a benign disease for the French livestock population, as demonstrated by its low morbidity and mortality rates in France since 2025?

The status of LSD is modeled after that of another disease , foot-and-mouth disease : It is therefore time to re-examine these regulations from a public health perspective rather than an economic one.

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## Regulations

Lumpy skin disease (LSD) has been monitored by the European Union as a notifiable disease since at least 2012<sup>1</sup>. The concept of eradicating animal diseases has long been established in European legislation (since at least the late 1970s, according to the directives cited in the 2016 regulation<sup>2</sup>). The 2016 Regulation (2) did not mandate the compulsory culling of herds infected with LSD (among other Category A diseases) but left the choice to the Member State among various measures, including quarantine. The choice depended on the disease profile and the type of infected farm. It is the 2019 regulation, amended in 2023<sup>3</sup>, that currently mandates the culling of all animals on a single premises infected with a Category A disease.

These regulations address the eradication of diseases in domestic animals as well as in wildlife.

## Is the eradication of diseases in domestic animals an achievable and reasonable goal?

At the major international conferences<sup>4</sup> held at the end of the last century on the eradication of infectious diseases, the distinction between the eradication of a disease and that of the infectious agent responsible was never discussed. Eradicating a viral disease means either eradicating the virus responsible or preventing the virus from exerting its pathogenic power. The latter option is theoretically possible with an effective vaccine, but authorities never emphasize that a vaccine alone is incapable of eradicating the pathogen: if it is 100% effective, it can eliminate symptoms but not the virus. However, a vaccine with 100% efficacy does not exist.

According to the definition of eradication provided by the U.S. CDC [4], eradication must be global, with a reduction to zero in the incidence of the disease (and thus in the circulation of the virus).

LSD does not affect wildlife in Europe, but this is not the case in Africa, where the virus certainly spread from wild cattle to domestic cattle at least a century ago.

The EU is the only region that aims to eradicate LSD (this is not a consideration in Africa, where they originated, nor in Asia, Russia, India, etc., where they have spread). Eradication is therefore impossible if we give this word the meaning used in international conferences, where eradication is the « *Permanent reduction to zero of the worldwide incidence of infection caused by a specific agent as a result of deliberate efforts; intervention measures are no longer needed. Example: smallpox.* »

It is possible that the EU gives it a different meaning but never states it explicitly! This would involve eradicating the virus and the disease within the EU alone by combining vaccination with the total culling of affected herds.

Therefore, the use of the word “eradication” is incorrect; it is more a matter of controlling the disease in Europe. According to the U.S. CDC, control means: “*The reduction of disease incidence, prevalence, morbidity or mortality to a locally acceptable level as a result of deliberate efforts; continued intervention measures are required to maintain the reduction. Example: diarrhoeal diseases.*”

It is therefore possible to make the EU “free” of CSF but not to eradicate it, because if the virus and the disease remain present in other parts of the world, they could be reintroduced through animal transport.

There is a contradiction between disease eradication in general and intensive livestock farming. This issue was raised by experts at the symposium held at the Senate on February 20, 2026<sup>5</sup> (in particular by Eric Cardinale, ANSES, Animal Health and Welfare / Scientific Director). Indeed, ,

*host density increases the number of new infections arising from an infected individual and the likelihood that a virus will successfully spread through a population*<sup>6</sup> . *Intensive animal farming, pet ownership, and wildlife reservoirs (e.g., bats, rodents) expand the human-animal interface and facilitate cross-species transmission.* (Mitchell 2025<sup>7</sup> ).

According to Russel<sup>8</sup> , Louis Pasteur stated that “*it is within the power of man to eradicate infection from the earth.*” And Russel adds: “*As the only two infections eradicated to date are viral, it is tempting to assume that viruses are the ideal candidates for eradication.*”

The only two viral infections that have been eradicated are human smallpox and rinderpest. Smallpox was a reasonable target for eradication because the virus had no animal reservoir or latent phase, and the infection produced obvious clinical signs, allowing for effective surveillance of the disease: patients were symptomatic before they became contagious. For a detailed analysis of the methods used to eradicate smallpox, see the articles by B. Guennebaud<sup>9</sup> .

The rinderpest virus could kill up to 100% of cattle populations. It can infect wildlife but is not very contagious among them and dies out spontaneously within those populations because it is highly pathogenic (it kills its host quickly before it can be transmitted). Domestic animals were ultimately the only active reservoir of the virus. Rinderpest was eradicated thanks to a vaccine that remained highly effective over the long term (administered in billions of doses), the isolation of infected herds, and serological surveillance to eliminate the last remaining outbreaks.

## **The Ecological Niche Theory**

As Aristotle once said, “Nature abhors a vacuum.” Every ecological niche will be occupied by a new living organism as soon as it is left vacant. If we apply this to viruses, we can assume that the eradication of one virus will make way for another. Vaccines specific to “multistrain” pathogen strains free up niches that are occupied by replacement strains and alter the epidemiology of the diseases targeted by these vaccines. For bacterial diseases, the typical example is the pneumococcal vaccine, and for viral diseases, the vaccines against human papillomavirus and rotavirus (Lloyd-Smith, 2013<sup>10</sup> ).

This idea has, however, been criticized, and Lloyd-Smith examined this controversy in detail in 2013: regarding the eradication of smallpox, it is not impossible that the ecological niche left vacant was occupied by the monkeypox virus (discovered in 1970 in Africa); but opponents of the vacant niche concept argue that a replacement pathogen will be less well-adapted to its new host and therefore easier to control. Intensive surveillance of monkeypox in Africa has shown that the increase in age groups not vaccinated against smallpox has led to an increase in human monkeypox cases (the smallpox vaccine confers long-lasting immunity against clinical infection with monkeypox).

More recently (2020–2025), for other authors (Durrheim<sup>11</sup> , Mitchell [7 ], Russell [8 ]), the controversy continues, and the law of unintended consequences means that whenever humans alter a factor, a completely unexpected event may occur (Mitchell).

All authors who have recently reflected on disease eradication highlight vaccination as its primary tool (Durrheim, Mitchell, Russell).

With regard to epizootics, the eradication of rinderpest appears to have led to the reemergence of the related morbillivirus responsible for peste des petits ruminants (PPR). The hypothetical eradication of human measles (another morbillivirus) and the potential cessation of vaccination could leave the threat posed by zoonotic morbilliviruses hanging in a post-measles world (Lloyd).

## The vaccine prevents eradication

New outbreaks of LSD were detected in Spain in early 2026 among unvaccinated animals: on January 7 in Catalonia (4 unvaccinated cows from a herd of 106 vaccinated cattle) and on February 28 in Aragon: on a farm with 130 suckler cows located in Fiscal (Huesca) and on a farm near the first one (148 animals). Unions are calling for full vaccination of the region<sup>12</sup>. They emphasize the importance of vaccination to prevent the culling of healthy animals, even though the history of LSD in France shows that this is not the case: vaccinated animals can very well be culled.

At the time the outbreak was discovered in Catalonia in January, vaccination coverage was over 95%<sup>13</sup>. The vaccination rate was 80% in Aragon, but the affected municipality had not yet been vaccinated<sup>14</sup>.

The vaccine does not prevent the silent circulation of the virus (Barbara Dufour (veterinarian and professor emerita at the National Veterinary School of Alfort) during the January 2026 OPECST meeting at the Senate<sup>15</sup>). This clearly confirms that the disease cannot be eradicated through vaccination and that vaccination actually prevents eradication, as highlighted by ANSES expert Eric Cardinale during the Senate symposium on February 20, 2026 (5).

Only unvaccinated animals allow us to track the virus: they serve as sentinels for the virus's silent circulation. This is yet another reason, from an epidemiological standpoint, not to vaccinate 100% of animals. However, this runs counter to the economic—rather than biological—rationale based on maintaining disease-free status at the European level.

## The EFSA report “<sup>16</sup>” (2018) highlights the importance of maintaining unvaccinated animals: sentinel animals

I quote certain passages from the EFSA report that are very clear: the presence of sentinel animals distributed across risk areas allows for monitoring the circulation of the virus, either through the detection of skin lesions or through regular serological testing. These are unvaccinated animals, or calves older than 6 months, or animals from uninfected and unvaccinated areas.

*“if the newly developed ELISA [see below] tests enter into routine use, other approaches, based on serological monitoring of unvaccinated animals (serological negative sentinel herds, newborn animals tested after the period of persistence of antibodies possibly acquired through colostrum or seronegative animals brought from countries where vaccination is not implemented) can be considered.”* Page 26

*“Sentinel-based surveillance implies repeatedly testing (clinically, serologically or virologically) the same susceptible animals with a given frequency. Some animals are deliberately left unvaccinated and recruited as sentinel animals. Firstly, for vector-borne diseases, the geographical distribution of the risk of infection is frequently not homogeneous, as it is influenced by climate and environmental factors. When these conditions are not fully known (as for LSD), the geographical distribution and localisation of sentinel animals may not be optimal for early detection of virus circulation. For these reasons, for diseases transmitted by flying vectors, sentinel systems may work better, whereas for diseases that tend to cluster within herds. For LSD, finally, the presence of characteristic skin lesions in a good percentage of infected animals offers a valid (and less expensive) alternative to the sentinel system, when a sufficient number of susceptible animals are available.”* Page 40.

The EFSA Terrestrial Code of 2018 (updated in 2024 [17]) specifies the methods for serological surveillance of LSD: “The target population for a serological survey must be representative of the at-risk population in the country or zone and must be limited to unvaccinated susceptible animals.”

These EFSA recommendations could serve as grounds for the EU to reconsider mandatory vaccination of 100% of the livestock population. But there is a risk: these sentinel animals would be under particularly close surveillance, and therefore, if the virus were detected, they would be the first to be culled, even if they were healthy, recovered, or in the process of recovering.

## **The report from the "flash" mission by three female members of Congress<sup>18</sup>**

This report was published following the OPECST reports [15] and the Senate Economic Affairs Committee's report on the LSD crisis<sup>19</sup>. Analysis of the OPECST report<sup>20</sup> has already confirmed the criticism of the government's handling of the LSD crisis that we began publishing in August 2026: this response is political and economic, not health-related. The lawmakers' "Mission-flash" report strongly emphasizes the need to develop a DIVA vaccine and tests capable of distinguishing vaccinated animals from infected ones. This need had already been expressed in the OPECST report, but this emphasis prompted me to delve deeper into the subject and its implications for "eradication."

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### **Distinguishing between infected and vaccinated animals**

The report notes that the vaccine may *"have residual pathogenicity in approximately 0.1% of cases, with transient and mild side effects (smaller, non-ulcerated nodules)."* This is not exactly what the literature indicates: adverse reactions to the vaccine are more frequent and sometimes severe (ranging up to abortions and death)<sup>21</sup>. Furthermore, reports from farmers in the Southwest, whose animals received recently manufactured batches of Merck's Lumpyvax-Bovilis vaccine—possibly in excessive doses [21]—indicate more severe and frequent adverse effects. Farmers are reluctant to report these adverse effects because they fear a health inspection that could result in the culling of their entire herd. Members of Parliament were therefore unaware of these adverse effects, which are officially classified as mild and rare [15].

The lawmakers state that *"the vaccines currently used in France do not allow vaccinated animals to be distinguished from infected animals using current diagnostic tools, which complicates disease management in the context of eradication."* This statement does not specify which diagnostic tools are being referred to. However, PCR tests performed on sick animals (those showing symptoms such as nodules, fever, or any other change in general health) do in fact allow for the differentiation between the wild-type virus and the vaccine virus.

It is the PCR-DIVA test, whose reagents—validated by European experts—are used by departmental laboratories that perform LSD diagnostics. This test is essential because the vaccine can cause symptoms identical to the disease, most frequently in an attenuated form. The vaccine is, in fact, a live attenuated LSD virus.

The following sentences in the report still do not specify which diagnostic tool is being referred to :

*"However, the implementation of this recommendation [vaccination] would be safer if a vaccine and tests were available to distinguish infected animals, even asymptomatic ones, from vaccinated animals."*

*"The solution also lies in the development of vaccines and tests capable of distinguishing between a vaccine reaction and natural infection (see below, recommendation No. 8)"*

*"Indeed, with regard to LSD, it is currently impossible, using standard diagnostic tools, to definitively distinguish a vaccinated animal from an asymptomatic infected animal."*

*"This technical limitation affects the proportionality of culling, the acceptability of the measures, and international trade. This situation could change with the development of DIVA (differentiating infected from vaccinated animals) vaccines and the companion tests associated with them."*

*"One of the objectives is to be able to identify the virus during the incubation phase and in asymptomatic animals, as well as to develop new tests and a DIVA vaccine."*

Once again, PCR-DIVA tests make it possible to differentiate between the two viruses (vaccine and wild-type). It is never specified what type of test is involved: detection of the viral genome via PCR or detection of virus-specific antibodies (serology)?

## **Mission entrusted to CIRAD**

CIRAD in Montpellier is the reference laboratory in France for the LSD virus (LSDV) and, consequently, for PCR tests, serological tests, and sequencing<sup>22</sup>. As early as December 24, 2025<sup>23</sup>, the government had tasked CIRAD with developing diagnostic tools and new vaccines to better track the development of immunity in the animal's blood. CIRAD's press release of February 19, 2026, sheds light on this<sup>24</sup>. It states: *"Regarding unvaccinated animals that appear healthy, government support will enable the continuation and expansion of scientific research aimed at improving the reliability of tests to detect the disease in animal blood."* Note the phrase "that appear healthy."

An animal's state of health is defined by clinical criteria: if it shows no symptoms of disease, it is healthy. Yet the government is seeking tests to detect the "disease" in healthy animals. From a scientific standpoint, this is therefore inconsistent. One could, at a stretch, look for the virus in a healthy animal, but not the disease!

Two main types of blood tests are used in the diagnosis of infectious diseases.

PCR detects fragments of a virus's genome and was designed to confirm or rule out a clinical diagnosis in a sick individual. These viral traces persist for only a short time, so PCR is generally used to diagnose acute disease.

Serological tests detect antibodies in the blood (serum) against all kinds of diseases; antibodies generally appear during recovery from an acute illness and persist for several months or years. Serology is therefore a retrospective diagnostic tool.

The government's request to CIRAD concerns healthy animals (without symptoms).

The value of PCR is therefore questionable *at first glance*: if the result is positive, PCR detects traces of the genome of a virus encountered previously and which the animal has overcome, since it is healthy and therefore cured. It is absolutely impossible to infer from this the presence of a complete virus capable of being transmitted and infecting another animal.

Serology (typically the ELISA technique), if positive, detects antibodies that are evidence of exposure to the circulating wild-type virus or that are induced by vaccination.

In both cases, a healthy animal that tests positive for traces of the virus's genome and/or antibodies is either a recovered animal or a vaccinated animal (in the latter case, a positive serological test confirms that the vaccine was indeed administered and induced antibody production).

In both cases, the goal is therefore to detect traces of a virus and not the disease itself; indeed, the farmer and the veterinarian are fully capable of distinguishing a sick animal from a healthy one based on clinical criteria.

Here is the real purpose of these tests, of which there are two types: the existing PCR-DIVA tests and the ELISA-DIVA tests currently under development. DIVA stands for "differentiate infected from vaccinated animal": to distinguish a vaccinated animal from an infected one.

The PCR-DIVA test determines whether an animal showing signs of LSD is infected with the wild-type virus (LSDV) or, if vaccinated, whether it is experiencing a vaccine-induced effect capable of

causing attenuated symptoms of the disease. Its purpose is therefore to confirm the clinical diagnosis of LSD or, potentially, to avoid the culling of a vaccinated animal as well as the herd to which it belongs (or the “epidemiological unit,” to use the established term). If the PCR-DIVA detects the vaccine virus and not the wild-type virus, the clinical signs are therefore due to the vaccine, and culling is not justified.

Serological differentiation between previously infected and vaccinated animals is currently impossible in routine practice. The most commonly performed serological tests in all clinical laboratories are ELISA tests, which cannot distinguish between antibodies induced by the current vaccine and those produced following natural infection with the wild-type virus.

The ELISA-DIVA is not commercially available for current vaccines.

According to Haegeman, antibodies are detectable by ELISA starting 15–17 days after experimental (laboratory) infection and starting 4–6 days after infection using the IPMA technique (Immunoperoxidase Monolayer Assay, a more sensitive test)<sup>25</sup>. According to Möller<sup>26</sup>, the ELISA test used in France (ID Screen Capripox DA by ID.vet) becomes positive 14 days after experimental infection, and nearly all infected animals test positive after 28 days. These timeframes observed in a laboratory following experimental inoculation of the virus can theoretically be extrapolated to natural infection. A positive serology result in a healthy animal in an unvaccinated area therefore indicates that the animal has been in contact with the wild-type virus and has recovered; it is thus immune for life<sup>27</sup>. A negative serology result, however, does not rule out protection against the disease in an unvaccinated animal or in a healthy vaccinated animal<sup>28</sup>. Indeed, circulating antibodies are short-lived (no more than a few months).

Serology is therefore useful in the days to months following vaccination or infection to verify an animal’s recovered or vaccinated status, but it does not provide a 100% reliable result. Immunity against LSD is primarily cellular and can be robust even when antibodies cannot be detected.

In summary, PCR-DIVA is limited to active (clinical) or recent (convalescent and recently recovered) cases; ELISA-DIVA would make it possible to distinguish between animals that have been infected and those that have been vaccinated (and to identify those that have been both vaccinated and infected), even after the virus has been cleared from the body (antibodies persist for a long time).

We have seen that PCR already makes it possible to avoid culling vaccinated animals that are not infected with the wild-type virus.

But what would be the point of an ELISA-DIVA serology test on a healthy animal? The currently available ELISA test (non-DIVA) already makes it possible to determine whether an animal is recovered or vaccinated and therefore unable to transmit a virus it has defeated or against which it is protected.

## **Disease-free status**

According to the WOHA [29], a country (or region) is considered free of LSD only if there is no circulation of the virus (no active or recent outbreaks) and no ongoing vaccination against the disease. In 2025, livestock farmers and French professional organizations (FNB, FNPL, JA, etc.) strongly advocated for preserving or regaining this disease-free status, as its loss causes significant economic damage (export difficulties, restrictions on animal movements, and embargoes on certain products such as raw milk cheeses). According to EU regulations, when an area or a country is declared infected with lumpy skin disease, cattle may no longer be exported to a Member State unless an exemption is granted (quarantine and negative PCR tests). Similarly, vaccinated animals from a non-free zone (or a zone where vaccination is practiced) cannot be moved to a free zone or Member State without vaccination, except in very specific cases. To regain the status of a disease-free zone or Member State according to the OIE, a complete cessation of all vaccination is required,

along with a surveillance period free of outbreaks for at least 14 months following the date of the last vaccination administered, and enhanced active surveillance: regular clinical examinations, and virological and serological testing on a statistically representative sample of the cattle herd. At the European level, disease-free status is managed by zone: former vaccination or regulated zones temporarily lose their “disease-free” status but regain it 14 months after vaccination ceases if no outbreaks are detected. The revaccination of previously vaccinated zones, decided upon in early 2026, will delay the restoration of disease-free status until mid-2027 at the earliest. Regarding preventive vaccination in non-infected zones, the timeframe for regaining disease-free status is 8 months, and these zones are not subject to revaccination. However, there may be bilateral negotiations within the EU or EU negotiations with third countries, even if national “disease-free” status is lost according to WOHA rules. A bilateral agreement has been signed with Italy to allow the export of vaccinated cattle and calves born to vaccinated mothers starting December 8, 2025 [30] It is therefore possible to bypass European regulations ! Export to Switzerland is also authorized starting December 8, 2025, under certain conditions<sup>31</sup>.

To get an idea of the complexity resulting from these rules regarding the movement of cattle, semen and embryos, hides and skins, and manure—and this is only at the national and EU levels—one should consult a document from the DGAL (Directorate General for Food at the Ministry of Agriculture) dated January 2026<sup>32</sup>. Do the officials who draft these rules have any idea how many hours livestock farmers, veterinarians, and traders must spend trying to figure out how to stay in compliance with the law?

These economic constraints partly explain the authorities’ decisions to carry out a total cull and limit vaccination to affected areas in order to contain the disease and safeguard France’s live cattle export capacity. There is also a technical constraint on vaccinating the entire herd: it is impossible to rapidly manufacture 17 million doses of live attenuated vaccines for the entire French herd (see the call for bids for the manufacture of 17 million vaccine doses, which does not specify the timeframe within which these doses must be supplied, as the agreement is concluded for a maximum duration of 4 years<sup>33</sup>).

## **The ELISA-DIVA test:**

The justifications provided by the authorities imply that the purpose of the test is to maintain the “disease-free” status of France or its regions. This test would therefore serve only biosecurity purposes, not public health ones.

The discussion in the Berguido 2023 article<sup>34</sup> confirms this point. This is a study in which CIRAD participated (along with Austria, Ethiopia, China, Macedonia, Germany, and Serbia). This study describes the development of a test that would allow infected animals to be distinguished from vaccinated animals using ELISA serology. “The availability of a DIVA vaccine is essential for better management of LSD. Indeed, a DIVA strategy is critical to track field virus circulation in a vaccinated population and facilitate the transition from “infected with vaccination” to “disease-free with vaccination” by demonstrating that the antibodies present are not those raised against the wildtype virus. The capripox wts-DIVA iELISA could, for example, rule out infection when a country implements vaccination with a live-attenuated vaccine or when the disease occurs in a vaccinated herd.”

This shows that “experts” pay little attention to natural immunity: only vaccine-induced immunity matters. A healthy animal carrying antibodies against the virus—and thus immune for life—could cause a country to lose its disease-free status, whereas animals carrying only vaccine-induced

antibodies—and having therefore never encountered the virus—do not enjoy lifelong immunity. Yet these animals do not compromise the “disease-free” status.

This is why the WHO has repeatedly modified the definition of immunity by removing natural immunity in favor of vaccine-induced immunity. Currently, the WHO page<sup>35</sup> dedicated to how vaccines work mentions herd immunity but excludes natural immunity from its contribution. It claims that only mass vaccination can protect a population. How did humanity and life in general survive before the advent of vaccines?

According to the Association for the Study of the Epidemiology of Animal Diseases<sup>36</sup> (AEEMA, based at the Maisons-Alfort Veterinary School), there is also no mention of natural immunity’s role in the development of herd immunity within an animal population. According to the 2025 WOHA report on global animal health<sup>37</sup>, the only mention of natural immunity is negative. It interferes with the vaccination of calves: “*Vaccination must also be planned to minimize interference from maternal immunity—that is, the natural immunity transmitted by the mother to her young.*” The OMSA overlooks the fact that for certain diseases, immunity acquired after natural infection lasts a lifetime, unlike vaccine-induced immunity, which is always less robust and less durable (e.g., measles<sup>38</sup> in humans).

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## How can we explain this desire to eliminate all biological traces of the disease from a given area?

One must look to the history of foot-and-mouth disease to understand the origin of this obsession with erasing all traces. According to Regulation (EU) 2016/429 (Animal Health Law), Article 4 and Annex II: *foot-and-mouth disease is classified as a Category A disease, which therefore requires immediate and mandatory eradication in the event of an outbreak.* According to Delegated Regulation (EU) 2020/689 (Chapter 2 and Annex II), to obtain or regain disease-free status, *post-eradication surveillance must demonstrate the total absence of past exposure.* Seropositive animals (carriers of natural antibodies, even if clinically healthy and unvaccinated) are considered evidence of past exposure and therefore prevent the restoration of disease-free status for the establishment or zone. These animals must be culled due to the possibility of chronic carriage of the foot-and-mouth disease virus.

With regard to CDN, the 2024 edition of the WOHA Terrestrial Animal Health Code [17] specifies that regaining disease-free status requires surveillance demonstrating the absence of infection (including through serological testing to detect residual circulation). However, since the LSD virus does not persist in recovered animals, there is no requirement to cull naturally seropositive asymptomatic animals. If an Elisa-Diva test were developed, regaining disease-free status would require statistical sampling of unvaccinated sentinel herds, calves born after vaccination, in at-risk areas, and at slaughterhouses for post-mortem inspections to verify the absence of viral circulation. The objective is to prove the absence of residual circulation: if isolated naturally seropositive animals were detected during the 14-month surveillance period, they would generally trigger a virological and epidemiological investigation to rule out active infection; targeted culling could be decided on a case-by-case basis if residual infection is suspected.

The value of DIVA serology lies solely in political and economic considerations for maintaining the disease-free status of a region or the entire country. From a biological standpoint, healthy seropositive animals are cured and therefore have lifelong immunity: they pose no risk of spreading the virus.

However, they do pose a threat to disease-free status, and their detection will trigger a virological

investigation to identify any potentially “asymptomatic” infected animals. Indeed, DIVA serology tests are useless for detecting sick animals. Only DIVA PCR is useful for confirming a clinical diagnosis. The development of DIVA serology tests is therefore unnecessary from a public health perspective: why worry about the circulation of a virus if it does not make animals sick, given that it is a benign disease for the French livestock population, as demonstrated by its low morbidity and mortality rates in France since 2025 [20].

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## Another benefit of the DIVA-ELISA test: the detection of a possible reversion of the vaccine virus to a wild-type phenotype

The current vaccine, based on the Neethling strain, has a major deletion (loss) compared to circulating wild-type strains of the LSD virus. This deletion makes it possible to develop these tests: the virus’s B22R protein is either truncated or absent in the vaccines. These deletions in the B22R gene are associated with the attenuated phenotype of the vaccines and are therefore certainly responsible for the virus’s attenuation. The portion present in wild-type viruses and absent in the vaccines is the target of the antibodies detected by ELISA. The sensitivity and specificity of the DIVA iELISA test are >99%. The retrospective study (Berguido [34]) conducted on samples preserved since the 2016 outbreak in North Macedonia validated the technique. However, it also revealed the possible reversion of the Neethling vaccine strain to a more virulent wild-type phenotype, possibly through recombination between the wild-type virus and the vaccine virus, since vaccination had taken place in the midst of the outbreak. It is also known that recombination occurred in Asia with a defective vaccine, and this is a possibility considered by experts<sup>39</sup> for the vaccine currently used in Europe.

This possible reversion to a more virulent phenotype should alert us to a potential harmful consequence of mass vaccination.

The authors of the Berguido-CIRAD article also fear that vaccines could become sources of disease transmission due to an insufficient dosage—resulting in partial protection—or due to insufficient attenuation, which could lead to the spread of the vaccine virus. This possibility of transmission and spread of the vaccine virus is also raised by the European expert, Eeva Tuppurainen<sup>40</sup>; indeed, live virus capable of replicating has been found in the skin lesions of animals experiencing severe adverse reactions to the vaccine.

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## Why has nothing been published since 2023 on the subject of vaccines and DIVA serological tests?

It can be assumed that CIRAD is currently conducting ELISA-DIVA tests in France on animals in vaccination zones. (But not in disease-free zones?)

However, if recombination or reversion of the vaccine virus occurs, the test will likely become ineffective. The ELISA-DIVA (B22R Berguido) has not been tested on the recombinant LSDV strains circulating in Asia (and perhaps elsewhere). The B22R approach could therefore be affected by circulating recombinant LSDV strains that are already complicating PCR-DIVA testing.

In India, a DIVA-ELISA based on the local Ranchi strain<sup>41</sup>, which has an 801-nucleotide deletion affecting ORF003/ORF154, was developed in 2025 (sensitivity 95.8%, specificity 95.4%). The mRNA “vaccine” prototypes developed through Australia-U.S. collaboration are also reportedly

more versatile than the B22R vaccine in terms of DIVA detection, but they are not a priority in the event of an epidemic, according to the Australian government<sup>42</sup> No efficacy trials have yet been conducted in endemic areas for these mRNAs.

## Conclusion

France's management of the LSD crisis is based on its implementation of European regulations, with a focus on maximizing biosecurity. These regulations are grounded in scientific studies by European experts and have economic implications. As French experts themselves have repeatedly stated, we fully understand that the rationale behind this approach is entirely economic, not health-related. In fact, the goal is to maintain disease-free status so as not to hinder exports. These regulations and this disease-free status were established for officially "serious" diseases such as foot-and-mouth disease and were subsequently applied to FMD, which is a milder disease. It is possible that the severity of foot-and-mouth disease has also been exaggerated by the EU: the French Ministry of Agriculture<sup>43</sup> and the WOHA<sup>44</sup> remind us that it is a highly contagious disease, benign for adults, potentially fatal in calves, and whose morbidity depends on age, breed, inoculum, and diet. These two diseases (LSD and foot-and-mouth disease) are classified as Category A and therefore subject to immediate eradication. How, indeed, can one justify the culling of herds when a single animal has been identified as sick and is most often cured by the time the culling takes place? Similarly, how can one justify mandatory vaccination on farms in vaccination zones while prohibiting vaccination on farms that are sometimes only a few hundred meters away but located in disease-free zones?

In 2016–2017, LSD affected countries whose livestock sector is far less involved in international trade than the French sector, and we are bound by the regulations that were in effect at the time and have since been tightened to become even more restrictive.

It is therefore time to revisit these regulations from a public health perspective rather than an economic one.

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