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Emergency Preparedness for Prevention of Transboundary Infectious Diseases in Indian Livestock and Poultry

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Preface

India is rich in livestock resource in terms of its number as well as species diversity. However, livestock are plagued by low productivity because of several operational constraints, including the poor genetic merit, scarcity of feed & fodder, and frequent occurrence of diseases. Infectious diseases do not recognize the spatial boundaries and, if not managed at the source of origin, can cause morbidity and mortality, reducing the production and reproduction potential and contaminating food and the environment. Their impacts will also transmit vertically along the supply chain, influencing the availability and quality of animal-source foods and their prices.

In India, animal husbandry is a rural activity practiced by about two-thirds of the households, mainly by small landholders. Any adverse shock to animal health will be felt more by them. There are several diseases, such as the Foot and Mouth Disease, *peste des petits ruminants (PPR)*, Classical Swine Fever, Lumpy Skin Disease, and African Swine Fever, which, if not controlled, can spread across the states and beyond the national boundaries. To control FMD and Brucella nationally and also to contain the regional spread of these two diseases (FMD & Brucella); the Government of India has initiated National Animal Disease Control Program (NADCP) since 2019. Further, the diseases like PPR, Lumpy Skin Disease, classical swine fever, and African Swine fever also are a serious risk of transboundary nature and hence vaccination for PPR and CSF is also encouraged by the Government of India. However, the effectiveness of such programmes would highly depend on the national and regional multisectoral collaboration and cooperation across geographical boundaries which entails embracing One Health approach. Very rightly, the Department of Animal Husbandry & Dairying (DAHD), Government of India – along with ICAR as its Technical Partner – has initiated One Health program since 2020 and is currently implementing the pilot program in Uttarakhand and Karnataka.

The NAAS organized a brainstorming to deliberate upon emergency preparedness to prevent transboundary infectious diseases. This document suggests a roadmap for their management. I sincerely acknowledge the contribution of Dr Parimal Roy for convening this session and synthesizing the viewpoints of different stakeholders in this document. I thank all the participants for their valuable suggestions. My thanks are also due to Dr P.S. Birthal and Dr Malavika Dadlani for their editorial support.

August 2022
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(Trilochan Mohapatra)
President

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1. INTRODUCTION

India's livestock sector is one of the largest in the world. In population, it ranks first in bovines, second in ovines and fifth in poultry. India is also the largest producer of milk and the third-largest producer of eggs. It contributes over 27% to the agricultural gross domestic product and engages about 8% of the agricultural workforce.

Smallholders dominate Indian agriculture, and for most of them, animal husbandry is an important source of food, nutrition and income and a means of escaping poverty. In the past decade, the livestock sector has experienced unparalleled growth in its economic contribution, making it an engine of agricultural growth. Several factors, including the improvements in the genetic potential, feed supplies, market access and support services, have contributed to this.

Nevertheless, Indian livestock are low-producing due to several constraints, including their frequent exposure to epidemic diseases like the Foot and Mouth Disease (FMD), *Peste des petits ruminants* (PPR), Classical Swine fever, Newcastle disease and the highly pathogenic avian influenza (HPAI); the zoonotic diseases like anthrax, brucellosis and tuberculosis that can transmit from animals to humans; and the endemic diseases like mastitis and pneumonia. These reduce the production and reproduction potential of animals, adversely affecting farmers, traders, transporters, processors and exporters; and contaminate the food and environment, leading to human health hazards. The FMD has been reported to cause an annual loss of Rs 12,000-14,000 crores (Singh et al., 2013), the PPR of US$ 660 million (Bardhan et al., 2017) and the *haemorrhagic septicaemia* Rs 12,700 crores (Bardhan et al., 2020). Besides, the diseases strain the fiscal resources required to prevent and control them.

Zoonosis poses a significant threat to human health. The transmission of the germs/infectious agents from animals to humans can occur through direct contact, indirect contact (food and water) and bites of ticks. About 60% of the infectious agents are zoonotic (Taylor et al., 2001; Jones et al., 2008), and 75% of the 'new' human pathogens reported in the recent past have originated from animals (King et al., 2006). Around 80% of the pathogens infecting animals are "multi-host", transmitting to different animal hosts (Cleaveland *et al*., 2001) and occasionally to humans (UNEP, 2020). An example of this is the highly pathogenic avian influenza (HPAI), an important economic disease of domestic poultry, which evolves from the low-pathogenic viruses that circulate in the environment and wild birds. In some countries, endemic zoonotic diseases are also important. The "neglected zoonoses" such as anthrax, brucellosis, bovine tuberculosis, Q fever, rabies, cysticercosis are prevalent in several developing countries. Most of these are in domestic animals and occasionally in wildlife. These diseases remain undiagnosed in wildlife, damaging the wildlife itself, domestic animals, and humans. The neglected zoonotic diseases are often associated with unhygienic habitation, poor sanitation, poverty, lack of awareness, social negligence and political instability. The food-borne diseases are commonly occurring endemic zoonoses. The emerging zoonoses are more important because of their widespread occurrences, affecting large numbers of animals and humans and causing epidemic or pandemic outbreaks. Coronavirus zoonoses are good examples.

2. TRANSBOUNDARY ANIMAL DISEASES (TADs)

Transboundary animal diseases (TADs) are those epidemic diseases that are highly contagious or transmissible and have the potential for rapid spread across geographic boundaries, leading to severe socio-economic impact and public health hazards.

TADs can (i) cause direct economic loss reducing animals' production and reproduction potential, (ii) adversely affect food safety, human health and livelihoods, (iii) threaten food and nutrition security, (iv) increase incidence of poverty among the communities with a high dependence on livestock, (v) restrict opportunities for upgrading production potential of local livestock industries, (vi) add to cost of livestock production, (vii) disrupt or inhibit trade in livestock and livestock products, and (viii) cause public health hazards in the case of transboundary zoonotic animal diseases.

3. POSSIBLE SOURCES OF TADs

TADs are introduced to new locations through the entry of live or diseased animals and contaminated animal products.

Migration of animals: The disease is transferred through the movement of live animals from one location to another when they are in the incubation stage of infection or are asymptomatic carriers. For example, classical swine fever (CSF) spread from the Netherlands to Italy and Spain through the infected piglets from an export collection centre (Elbers *et al*., 1999; Greiser-Wilke *et al*., 2000).

Migration of birds: Many diseases spread through the wild migratory birds. For example, the Iberian peninsula in southwestern Europe is an important meeting and breeding place for the birds that migrate seasonally between western Africa and Europe. Many migratory birds use the Europe–western Africa flyway in the spring to reach the northern breeding grounds, and in the autumn, they reach the wintering areas in the south. Around 3 billion birds of 338 species migrate between Africa and Europe (Bosch *et al*., 2013). The Crimean Congo haemorrhagic fever (CCHF) outbreaks in Europe were due to migratory birds carrying CCHF infected ticks (Bosch et al., 2013) from Africa. Hyalomma ticks are the principal vectors of the CCHF virus (CCHFv), causing human diseases in the Mediterranean basin, Africa and Asia (Ergonul, 2006). These ticks are common parasites of wild and domestic ungulates, medium-sized mammals, and ground-feeding birds. The migratory birds have been repeatedly recognized as dispersants of immature Hyalomma ticks (Hoogstraal et al., 1961; 1963). Engorged nymphs are introduced into new areas by migratory birds. In 1996-1997, the highly pathogenic avian influenza (HPAI) A virus identified as the H5N1 subtype in Hong Kong (*Li et al*., 2004; Zhou *et al*., 1999) spread to several countries in Asia and Europe (Fauci, 2006) and Africa (Enserink, 2006). The virus was found in domestic fowls, migratory and resident birds of several orders (mainly Anseriformes), pigs, civets, house cats, tigers, leopards, and humans (Fauci, 2006). The geographical spread of H5N1 from 1996 to 2006 is shown in Table 1.

Table 1. Geographic spread of highly pathogenic avian influenza H5N1 subtype since 1996

Year	Disease Prevelance	Reference
1996	Domestic geese, southern China	Xu et al. (1999)
1997–1998	Chickens, Hong Kong; 18 humans (6 deaths)	Morris and Jackson (2005)
1999	Geese, Hong Kong	Sims et al. (2003)
2001	Geese from China in Vietnam	Nguyen et al. (2005)
November 2002	Hong Kong: poultry & other bird species in or near zoological parks	Sims et al. (2003)
February 2003	Human travellers from Fujian Province, China	Ng et al. (2005)
2003–2005	Poultry (mainly chickens) and humans: South Korea, Vietnam, Thailand, Hong Kong, Cambodia, Laos, Indonesia, China, and Malaysia	Morris and Jackson (2005)
January 2004	Wild birds: Hong Kong	Ellis et al. (2004)
February 2004	Birds in a zoo collection: Cambodia	Ellis et al. (2004)
March 2004	Wild bird: South Korea	Ellis et al. (2004)
October 2004	Bird smuggled from Thailand into Belgium	Van Borm et al. (2005)
April–June 2005	Migratory birds: Qinghai Lake and Xinjiang Province, China	Chen et al. (2005)
July–October 2005	Poultry and wild waterfowl: Novosibirsk, Altai, Kurgansk, Omsk, and Tyumen regions, Asian Russia	WHO (2005); Brown et al. (2005)
August 2005	Geese and other poultry: northern Kazakhstan, Tibet	WHO (2005)
August 2005	Migratory waterfowl: northern Mongolia	OIE (2006)
August–October 2005	Poultry and pigeons: Ural Territory, Russia	WHO (2005)
August 2005	Wild waterfowl: Kalmykia, European Russia	WHO (2005)
October 2005	Domestic turkeys: Western Asian turkey	WHO (2005)
October–November 2005	Poultry and wild migratory birds: Romania, Ukraine	WHO (2005)
October 2005	Wild birds: Thailand	OIE (2006)
October–November 2005	Poultry, wild birds, some humans: 7 Chinese provinces	OIE (2006)
October 2005	Migratory waterfowl: Croatia	WHO (2005)
October 2005	Poultry: Tula and Tambov regions, Europe including Russia	Brown et al. (2005)

Year	Disease Prevelance	Reference
October 2005	Quarantined birds from Taiwan in the United Kingdom	DEFRA (2006)
January 2006	Humans: Iraq	OIE (2006)
January 2006	Poultry: Nigeria, India (Maharashtra)	OIE (2006)
February 2006	Migratory waterfowl: Bulgaria, Greece, Italy, Slovenia, Bosnia, Azerbaijan, Iran, Georgia, Germany, Switzerland, Austria, Hungary, France, Croatia, Slovakia, Bosnia	OIE (2006)
February 2006	Poultry: Egypt, Cameroon, Niger, Ethiopia	OIE (2006)
March 2006	Migratory birds: Sweden, Denmark, Serbia, Poland, Czech Republic	OIE (2006)
March 2006	Poultry: Afghanistan, Pakistan, Albania, Israel, Jordan, Lebanon	OIE (2006)
April 2006	Poultry: Burkina Faso, Côte d'Ivoire, Myanmar, Nigeria, Palestinian Autonomous Territories	OIE (2006)
May 2006	Poultry: Sudan; migratory birds: United Kingdom	OIE (2006)

Source: Rappole and Hubálek (2006)

Natural spread by insect vector or wind: A few TADs have been transmitted through insect vectors or wind currents from one country to another. In the case of the bluetongue virus (BTV), the virus is transmitted between its ruminant hosts through biting midges of the genus Culicoides. These are small (3mm) haematophagous insects found in all the inhabited continents and breed in various semi-aquatic conditions, including tree holes, rotting vegetation, pond margins, damp soils, and herbivore dung. Culicoides are biological vectors of BTV and, as such, the ingested virus must infect the insect midgut cells, replicate in them, escape into the body cavity of the insect (haemocoel) and infect and replicate in salivary glands before it can be transmitted to a new host through biting (Wilson and Mellor, 2009). Culicoides are typically capable of actively flying over short distances (1–2 km), but they can also be blown passively along the wind to long distances. The transport of BTV-infected Culicoides via wind, particularly over water bodies, has been identified as the likely source of several introductions of BTV (Sellers *et al*.,1978; 1979). The spread of BTV to islands (e.g. from Anatolian Turkey to several Greek islands) in the absence of correlated livestock movements strongly suggests that several of these events are due to aerial movement of the infected Culicoides. A strain of BTV-4 in the eastern Mediterranean basin also apparently spread from North Africa to Spain, Portugal and Corsica in 2003–2005 (Wilson and Mellor, 2009).

Contaminated animal products: The primary hazard associated with trade in pork and pork products is their contamination by viruses of FMD, CSF, ASF and swine vesicular disease (SVD) (Farez and Morley, 1997)**.** The pathogens are particularly problematic due to their prolonged infectiousness in meat products (Adkin *et al*., 2004). This is exemplified by the repeated detection of the ASF viral DNA in pork products imported into the Russian Federation from Belarus (FSVPS

News, 2014). Although the export of pigs or pork products to most countries from Belarus is restricted, both countries belong to the Eurasian Economic Union (EEU), which hinders the implementation of the border controls on crossing the infected products (Beltran-Alcrudo *et al*., 2019).

Food waste from international aircraft or ships: Catering waste from ships, aeroplanes, trains or buses, which need to be destroyed or appropriately disposed of, are instead dumped and/or illegally sold and utilized as swill. There are numerous examples of such incursions (Beltran-Alcrudo *et al*., 2019). The 1968 ASF outbreak in the Italian island of Sardinia was probably caused by the introduction of contaminated waste from the port of Cagliari or the military airport used to feed pigs (Mur *et al.,* 2016). In 2007, the ASF entered Georgia through contaminated catering waste from an international cargo ship originating from Southeast Africa (Beltran-Alcrudo *et al.* 2008; Rowlands *et al*., 2007). The ASF spread throughout Eastern and Central Europe (Beltran-Alcrudo *et al.,* 2019).

Import of contaminated biologicals and germplasms: Even manufactured products like vaccines with live pathogens could act as a vehicle for disease spread. This happened in Brazil when the crystal violet vaccine for CSF was manufactured from the samples of CSF-diseased animals instead of ASF-infected animals (Andrade and Rodrigues, 1982). Other swine products can also cause disease spread through legal movements; for example, PRRS into Switzerland in 2001 was traced back to boar semen imported from Germany despite routine testing (Nathues *et al*., 2016).

Climate change and microbial distribution: Rising temperatures in the northern hemisphere are likely to shift the distribution of insect vectors of bluetongue, African horse sickness, Rift Valley fever and similar vector-borne diseases. For example, the bluetongue virus (BTV) has many serotypes across the world. Bluetongue was never reported from northern Europe until 2006. The sudden incursions of some serotypes into Spain, Italy, Greece, Portugal, the Balkan countries and Germany since 1998 and the recent emergence of the BTV serotype 8 in the Netherlands, Germany and Belgium are believed to be due to rising temperature in Europe. BTV serotype 8 is closest to the Nigerian strain. The incursion is believed to have been caused by importing an infected zoo animal or an infected midge. An upsurge in the Rift Valley fever in East and West Africa is also attributed to climatic change (Yadav et al., 2020; Wilson and Mellor, 2009)

Infected people: TADs can spread to farm animals from infected humans. Once into a new area, the disease spread has been linked to the movement of live birds and poultry products, people and equipment, contaminated food and water, and contact with other animals (Alexander, 2009)**.**

Illegal trafficking of animals: The Indian state of West Bengal and Bangladesh have similar cultures, lifestyles, production systems and food habits. The international border is prone to illegal smuggling of animals. There is a possibility of transmission of diseases through the smuggled animals. Other international borders are also prone to illicit traffic of animals to India and from India.

4. INDIA'S PRONENESS TO TADs

India has a land border of 15,106.7 km and a coastline of 7,516.6 km. India shares its border with nine countries, the land border with seven and the sea border with two (Table 2).

Table 2. India's neighbours

Neighbouring	Border length (Km)	Bordering states
Afghanistan	106	Jammu and Kashmir
Bangladesh	4096.7	West Bengal, Mizoram, Meghalaya, Tripura, and Assam
Bhutan	699	Arunachal Pradesh, Assam, Sikkim, and West Bengal
China	3488	Jammu and Kashmir, Himachal Pradesh, Uttrakhand, Sikkim, and Arunachal Pradesh
Myanmar	1643	Arunachal Pradesh, Manipur, Mizoram, and Nagaland
Nepal	1751	Sikkim, West Bengal, Bihar, Uttar Pradesh, and Uttrakhand
Pakistan	3323	Jammu and Kashmir, Punjab, Gujarat, and Rajasthan
Sri Lanka	Sea border	Separated from India by Gulf of Mannar
Maldives	Sea border	The south-west part of the Indian Ocean below the Lakshadweep Island

India is prone to TADs from the neighbouring countries. Even the disease control policy in India may be very effective; it is still challenging to control the existing and emerging TADs unless the regulation of animal traffic through international boundaries is made stringent.

5. FAO's INITIATIVE ON EMERGENCY PREVENTION SYSTEM (EMPRES)

The FAO, in 1994, established a priority programme - the Emergency Prevention System (EMPRES) for the transboundary animal and plant pests and diseases with a vision "to promote the effective containment and control of the most serious epidemic livestock diseases as well as newly emerging diseases by progressive elimination on a regional and global basis through international co-operation involving early warning, early/ rapid reaction, enabling research and coordination".

There is a Global Early Warning and Response System (GLEWS) for major animal diseases, which is a joint initiative of the FAO, OIE and WHO to detect the newly introduced TADs and their sudden upsurge. It is based on disease surveillance, reporting and epidemiological analysis, leading to an increase in the awareness and knowledge of the distributional behaviour of the disease outbreaks and forecasting and monitoring of the disease control campaigns (http://www.fao.org/3/W3737E/W3737E04.htm). The newly developed EMPRES Global Animal Disease Information System (EMPRES-***i***) is a web-based application designed to support national veterinary epidemiologists and facilitate regional and global information sharing and collaboration in progressive control and eradication of major TADs. EMPRES-***i*** provides updated information on the global animal disease distribution, current threats, and emergency responses. It also provides access to training materials and resources for veterinary epidemiologists. The EMPRES-***i*** concept is an initiative conceived in

response to the growing demand of users for a model, one-touch disease information gathering and sharing formula. The system is currently under development, and when fully operational, it will accommodate animal health information systems across the world, help in the forecasting of major epizootics, develop risk map of priority diseases, and provide alert and response for effective control of infection (http://www.fao.org/3/Y3931E/y3931e04.htm)

The EMPRES Bulletin also includes reports on TADs, their risk implications and progress in their control. The control of TADs is an outcome of the EMPRES-livestock program, and the EMPRES Bulletin informs countries on these critical issues.

EMPRESTOOLS - Surveillance Evaluation Tool (SET): The SET is a tool that allows comprehensive and comparative assessment of a country's surveillance system for animal diseases, including zoonoses. The objectives are to: (i) evaluate a country's animal disease surveillance system to support the development of a locally-relevant action plan for improvement, and (ii) use a standardized and reproducible tool to monitor the system's progress.

6. PREVENTION AND CONTROL OF TADs

In India, agriculture, including animal husbandry, is a state subject. Hence, the responsibility of prevention and control of TADs lies with the animal husbandry departments of the states and also with the central government on issues related to external trade in animals and animal products.

Rapid response team (RRT): The RRT is formed by the animal husbandry departments (AHDs) for emergency operations during disease outbreaks. The team provides technical and operational assistance, assesses epidemiological situations, diagnoses transboundary animal disease (TAD) outbreaks and suggests immediate measures to prevent disease spread.

Contingency planning: The purpose of the contingency plan is to help the organization to return to its normal operations as quickly as possible after the outbreak. For example, an FMD contingency plan should be a well-designed strategy document with defined actions to be taken in an FMD emergency. It should contain details of the resources needed to meet such an emergency as well as an action plan for efficient and rapid deployment of staff with amenities for rapid containment of the disease and elimination of infection. The plan also includes prevention of disease spread, biosafety and biosecurity measures, emergency vaccination, sanitization of premises and animal houses with suitable disinfectants, safe carcass disposal in case of death, and tracing out the source of infection.

Competent veterinary services: An organisation can better prepare for disease diagnosis, control and eradication programmes with a direct command, well-trained personnel, and immediate access to financial and other resources for prompt action. In India, this issue is handled by the Livestock Health Division in the Department of Animal Husbandry and Dairying (DAHD) of the Ministry of Fisheries, Dairying and Animal Husbandry. Vaccination, surveillance and disease reporting are taken care of by the state and central governments.

The DAHD, from time to time, also provides notifications or advice for the control of TADs. A few examples are:

- Advisories to states on outbreaks of exotic diseases, such as Lumpy Skin Disease (LSD), African Swine Fever (ASF), PRRS (Porcine Reproductive Respiratory Syndrome) in recent years.

- The Prevention and Control of Infectious & Contagious Diseases in Animal Rules, 2010
- Notification dated 24-08-09 for the Prevention and Control of Infectious and Contagious Diseases in Animals
- The Prevention and Control of Infectious and Contagious Diseases in Animals Act, 2009
- Amendment to sections 2 and 38 of the Prevention and Control of Infection and Contagious Diseases in Animals Act, 2009

Their details are available at https://dahd.nic.in.

Awareness and dissemination of information and preventive measures: Awareness is critical for timely control of infectious disease without further spreading and avoiding mortality. It helps strengthen biosecurity, disinfection, vaccination, sero-monitoring and surveillance to secure optimum animal health. This will also alert other regions and neighbouring countries to take preventive measures to avoid the occurrence of the disease.

Early warning: The Indian Council of Agricultural Research – National Institute of Veterinary Epidemiology and Disease Informatics (ICAR–NIVEDI) has an early warning system (NADRES **-** National Animal Disease Referral Expert System) for important livestock diseases (13 endemic diseases), and has the capacity for surveillance through the AICRP (*All India Coordinated Research Projects)* centres. These centres collect monthly animal disease information, which is collated and updated regularly. The meteorological & remote sensing parameters are extracted and forecasted using the Auto Regressive Integrated Moving Average (ARIMA) models. The disease outbreaks are further modelled through an Artificial Intelligence system of algorithms to predict the risk of diseases with reasonable accuracy with a lead time of 2 months in advance to enable stakeholders for better preparedness and response. The predicted risks are classified as no risk, very low risk, low risk, moderate risk, high risk, and very high risk. The predicted risk maps of the disease are generated using R software and regularly communicated to the central and state governments. Forewarning of the disease is based on the concept that it can help prevent possible disease outbreaks through precautionary measures. The feedback is also collected regularly from the AICRP centres.

Animal diseases management networks: Countries should cooperate to manage transboundary diseases through networks of organizations. Their border areas have similar agro-climatic conditions and production systems, and the disease risk profiles are likely to be similar. An unrestricted movement of animals may transmit the disease across geographic boundaries. To prevent TADs, there is a need to collaborate on illegal trade in animals and their production, vaccination, and quarantine.

Livestock disease management has two key components: (i) prevention (biosecurity and good management practice) in susceptible herds, and (ii) prompt control in the case of disease or once the infection occurs. Climate change has an accelerating effect on the occurrence of diseases. Heat stress, drought and flood favour the spread of vector-borne diseases and macro-parasites and the emergence of new diseases. Livestock disease management can reduce the disease burden through improved animal husbandry practices. Biosecurity measures such as controlled entry into farms, adherence to hygienic practices (i.e., cleaning and disinfection of premises, hands, shoes

and attire of the farm workers), quarantine of sick and newly purchased animals and movement restrictions, efficient provision of veterinary services, proper disposal of carcasses, evaluation of ethno-therapeutic options, health monitoring and screening of animals for suspected diseases, vaccination against existing endemic and epizootic diseases, training of livestock handlers and veterinary staff, and careful planning of day to day events can help prevent the spread of diseases.

International coordination: Preventing the spread of infectious diseases through global movements is one of the objectives of the World Organization for Animal Health (OIE). One of the means to achieve this is to publish international standards and guidelines to prevent the imports of pathogens that are dangerous to animals and humans and to strengthen veterinary services for better surveillance and response systems. The OIE works in close partnership with the FAO, and together they have created a joint initiative - the Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs). Compliance with standards greatly depends on the political willingness and the successful transfer of resources to developing countries supporting good governance and policy implementation. The United Nations Resolution obliging its member countries to implement OIE standards could prove invaluable in this respect (Vallat *et al*., 2006). The FAO is working to control and eradicate TADs through international cooperation. It has played a significant role in eradicating rinderpest (cattle plague) in the past. It was possible due to the concerted efforts of the national authorities, support of reference laboratories for confirmatory diagnosis or vaccine development, and quality control. Investment by the international community in establishing regional networks of laboratories and epidemiological units is essential for eradicating TADs. The FAO has several animal disease emergency response mechanisms: The FAO Emergency Prevention System (EMPRES) monitors disease occurrence and provides early warning to prevent animal diseases. The Emergency Centre for Transboundary Animal Diseases (ECTAD) is the FAO's corporate centre for planning and delivering veterinary assistance to FAO member countries in the case of the threat of transboundary animal diseases. The Emergency Management Centre for Animal Health (EMC-AH) is FAO's rapid response unit for animal disease emergencies. Eradication of TADs is possible through close international cooperation in sharing information and working together.

LSD in India inspite of warning? : The lumpy skin disease (LSD) in ruminants was first reported in Zambia in 1929, spreading to Botswana in 1943 and then into South Africa. In 1957, it entered Kenya, associated with an outbreak of sheep pox. In 1970, it spread to Sudan, in 1974 to Nigeria, and in 1977 to Mauritania, Mali, Ghana and Liberia. Another epizootic of LSD between 1981 and 1986 was reported from Tanzania, Kenya, Zimbabwe, Somalia and Cameroon, with a mortality rate of 20% in the affected cattle. The occurrence of LSD north of the Sahara Desert and outside the African continent was confirmed in Egypt in 1988 and in Israel in 1989, and again in 2006. LSD occurrences have been reported in the Middle Eastern, European and West Asian regions (OIE, 2020). Since 2015, the disease has spread to most Balkan countries, the Caucasus and the Russian Federation.

The first known introduction of LSD into South Asia was reported from Bangladesh in July 2019 (OIE, 2020a). In August 2019, the disease appeared in India (OIE, 2020a; Sudhakar *et al*., 2020) and the Xinjiang Uyghur Autonomous Region of China bordering Kazakhstan (Liu *et al*., 2020).

7. GAPS IN THE INDIAN LIVESTOCK HEALTH SYSTEM

- Lack of surveillance along international borders
- Poor disease diagnostic laboratory facilities in border states
- Inadequate check posts and quarantine facilities
- Lack of regular vaccination and monitoring based on epidemiology
- Poor vector control strategy considering the climate change
- Poor caracass disposal to avoid the spread of the disease
- Lack of information sharing mechanisms on diseases in neighbouring countries for a coordinated approach to control TADs
- The illicit trafficking of animals
- Synchronization of vaccination schedule- national and adjoining countries
- Lack of a forewarning system

8. RECOMMENDATIONS

The recommendations emerging from the deliberations in the brainstorming session are:

(i) Strengthen infrastructure for diagnosis of TADs in the states along the international borders (Action: DAHD, GoI; Animal Husbandry Departments of States).

(ii) Create adequate quarantine infrastructure at international borders (Action: DAHD, GoI)

(iii) Review the national disease surveillance mechanism for further improvement, especially in the light of the COVID-19 pandemic, LSD in cattle, and PRRS and ASF in pig in the border areas (Action: DAHD, GoI; ICAR; ICAR-IVRI; ICAR-NIVEDI; ICAR-NIHSAD-Bhopal; ICAR-NRCE).

(iv) Targeted surveillance in border areas (Action: DAHD, GoI; Animal Husbandry Departments of States sharing international borders)

(v) Training of field veterinarians in animal disease investigation and surveillance (Action: DAHD, GoI; ICAR; ICAR-IVRI; ICAR-NIVEDI; ICAR-NRCE).

(vi) Development of potent, safe and cost-effective DIVA vaccines and animal diagnostics (Action: ICAR; ICAR-IVRI; ICAR-NIVEDI; ICAR-NIHSAD-Bhopal; ICAR-NRCE).

(vii) International collaboration to control and eradicate TADs (Action: ICAR; ICAR-IVRI; ICAR-NIVEDI; DAHD; GoI; ICAR-NIHSAD-Bhopal; ICAR-NRCE).

(viii) Develop a robust National Animal Disease Diagnostic Laboratory Network involving the Central & Regional Diagnostic Laboratories (Action: DAHD, GoI; State AHDs; ICAR; ICAR-IVRI; ICAR-NIVEDI; ICAR-NIHSAD-Bhopal; ICAR-NRCE).

(ix) Harmonization of SOPs and guidelines for emergency preparedness to prevent the spread of TADs (Action: DAHD, GoI; State AHDs; ICAR; ICAR-IVRI; ICAR-NIVEDI; ICAR-NIHSAD-Bhopal; ICAR-NRCE).

(x) Emergency funding support for research (Action: DAHD; GoI; ICAR; DBT; DST and other relevant funding agencies).

(xi) Establish a National Bio-security Authority to deal with animal, poultry and fish bio-security (Action: DAHD, GoI; ICAR; DBT; DST and other relevant agencies).

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