

Animal Disease Surveillance: Perspectives and Issues

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Abstract

India, with over 536 million livestock, holds the world's highest livestock population, including 300 million cattle and buffaloes and 851 million poultry. This significant animal population supports millions of rural families' livelihoods. India ranks first in livestock population and milk production, third in egg production, and eighth in meat production, contributing substantially to global demands. Despite occupying only 2.4% of the world's land area, India maintains 10.71% of the global livestock. The global livestock demand is projected to reach \$20 billion by 2026, presenting India with an opportunity to meet this demand. However, pandemics and zoonotic diseases pose significant threats, emphasizing the need for a comprehensive zoonotic disease surveillance system. Such a system would detect disease emergence early, minimizing transmission and spread. India's membership in the World Organization for Animal Health mandates disease surveillance and reporting, which is crucial for early detection and international trade. The Department of Animal Husbandry & Dairying has implemented surveillance programmes to detect disease events early, assess intervention measures, and determine disease-free areas, aiding national disease control and eradication efforts.

Keywords: Zoonotic disease, Surveillance, Animal health

Introduction

India is home to the world's highest livestock population, with around over 536 million livestock¹ including 300 million² cattle & buffaloes and 851 million poultry. This vast animal population is significant to the country, as it supports the livelihood of millions of rural families who depend on them for their daily needs. We rank 1st in livestock population¹, 1st in milk production², 3rd in egg production³, 8th in meat production contributing 15%, 23%, 18% and 3%, respectively, towards global demands. Furthermore, with only 2.4% of the land area of the world, India is maintaining about 10.71% of the world's livestock⁴. As the global demand for livestock is estimated to reach \$20 bn by 2026⁵ (with livestock production anticipated to hit ~2 bn), it gives India an opportunity to fill the void in demand-supply.

Pandemics impact society, economy, and life both human and animal hence it must not be overlooked. India faced livestock diseases like LSD and ASF causing significant loss to farmers. Zoonotic diseases are a major concern, with 60% of human pathogens being zoonotic and 75% of emerging pathogens are also zoonotic⁶. Food-borne diseases and antimicrobial resistance burden the nation's health system and economy. Given recent experiences with rapidly spreading global outbreaks crossing borders and continents, it is crucial to establish a comprehensive and global zoonotic disease surveillance system. This system should be capable of detecting disease emergence in human or animal populations anywhere in the world as early as possible. A zoonotic disease

surveillance system still offers significant benefits by providing critical data to inform evidence-based responses. This, in turn, minimizes the opportunities for zoonotic disease emergence, transmission, and spread in both human and animal populations (National Research Council, USA)

Importance of Animal Disease Surveillance & Reporting

Disease Surveillance and Reporting plays a major role in disease prevention and control. Further India being a member country of the World Organization for Animal Health (WOAH, formerly known as OIE) reporting of animal health situation becomes mandatory. Disease surveillance and reporting becomes utmost essential as it helps in early detection of diseases and facilitates international trade. To tackle these challenges, the Department of Animal Husbandry & Dairying (DAHD) has implemented livestock disease surveillance with specific objectives, including early detection of disease events, assessing intervention measures' effectiveness, and determining disease-free areas. The data obtained from such surveillance programmes helps in evaluating national disease control and eradication efforts.

Initiatives by the Department

To make the livestock sector more dynamic and vibrant, the Department has realigned/revised the schemes, viz., Rashtriya Gokul Mission, National Programme for Dairy Development, Livestock Health & Disease Control Programme, National Livestock Mission and

Livestock Census and Integrated Sample Survey to further boost the livestock sector growth and promote entrepreneurship thus making animal husbandry more remunerative to the crores of farmers engaged in this sector. The world's largest vaccination programme for livestock in form of National Animal Disease Control Programme (NADCP) for control of FMD and Brucellosis was initiated in 2019 with a budget allocation of ₹13343 crore⁷. The programme targeted for vaccination coverage of 300 million cattle and buffalo, 225 million sheep and goat and 10 million pigs including traceability with unique Pashu Aadhar. Further vaccination against PPR and CSF is also carried out with 100% support from Central Government.

To provide last mile doorstep veterinary service delivery, Mobile Veterinary Units have been supported by the Department with a dedicated vehicle with Call centre (@ 1962) for every 1 lakh livestock population⁸. Under this till date, 4340 Mobile Veterinary Units (MVUs) have been sanctioned to different States/UTs out of which 1805 have started providing doorstep service delivery to the farmers.

Additionally, disease diagnostic laboratories at the State and district levels, along with Central and Regional Disease Diagnostic Laboratories (CDDLs & RDDLs) for diagnostic services, are pivotal in the country's animal disease diagnosis and control activities. Furthermore, besides the government-run diagnostic laboratories, private animal disease diagnostic laboratories also operate across the country. Currently the diseases monitored on priority includes Foot and Mouth Disease, Peste des Petits Ruminants, African Swine Fever, Lumpy Skin Disease, Avian Influenza, Rabies, Brucellosis, Classical Swine Fever, and New Castle Disease.

The effective livestock surveillance measures and control programmes in India have led to attainment of WoAH disease-free status for several diseases Contagious Bovine Pleuro-pneumonia (CBPP), Bovine Spongiform Encephalopathy (BSE) and African Horse Sickness (AHS). Further, Rinderpest has been eradicated globally with continuous efforts through disease surveillance monitoring and vaccination. India has two WoAH reference laboratories, i.e ICAR-National Institute of High Security Animal Diseases (NIHSAD, Bhopal) for Avian Influenza and the Veterinary College, Bangalore, for Rabies which have been instrumental in keeping the two major diseases of global concern under the radar. Similarly, there are other National Reference Laboratories for specific diseases i.e ICAR-NIFMD in Bhubaneswar for Foot and Mouth Disease (FMD), ICAR-NRCE in Hisar for Equine diseases, and ICAR-NIVEDI in Bangalore specializing in surveillance and epidemiology, etc.

The Department is carrying out active surveillance for livestock diseases like Foot and Mouth Disease, Brucellosis, Peste des Petits Ruminants (PPR) and Highly Pathogenic Avian Influenza Virus (AIV). The surveillance plan has been designed based on multistage stratified/cluster random sampling. Active surveillance for avian influenza is conducted in at-risk populations based on detecting exposure to (antibody detection by serology) or the presence of (virus or antigen detection through swabs) the AIV. The veterinary authorities visit commercial poultry farms, backyard poultry, and live bird markets (LBMs) for clinical examinations and collection of samples etc. Surveillances are carried out with multistage stratified / cluster random sampling. The following sampling frame has been constructed with the assumption of a conserved prevalence rate of 2%; cluster level prevalence of 10% of 2% of animal prevalence; 90% test sensitivity; 50% Herd level sensitivity for detection of disease and 95% confidence interval. The active surveillance plan is detailed in the National Action Plan for Preparedness Control and Containment of Avian Influenza 2021.

Passive Surveillance is carried out to detect any unusual mortality for which the Animal Disease Surveillance Report is followed which included all notifiable diseases scheduled in the 'The Prevention and Control of Infectious & Contagious Diseases in Animals Act 2009'. All States and UTs submit a monthly ADS report to the department which helps in the evaluation of the disease scenario in country and devise an effective control strategy.

Disease Reporting to WOA

As a member country, India submits Animal Health Information to WOA under the World Animal Health Information System (WAHIS) platform. In this, India submits the information related to the endemic diseases under the six-monthly report, whereas the emergent and exotic disease are reported under immediate notification. Under WAHIS there is also provision for reporting of diseases in wildlife.

National Animal Disease Referral Expert System (NADRES)

The ICAR- NIVEDI has developed an advanced software application called National Animal Disease Referral Expert System version (NADRES)⁹. This system serves as an early warning mechanism, providing livestock disease forewarning and climate-associated disease risk factors to stakeholders. It enables timely implementation of prevention and control measures, reducing disease incidence and minimizing morbidity and mortality. NADRES relies on nationwide disease surveillance, reporting, and epidemiological investigations, supported by a geographical information

system (GIS) for data integration and analysis. By combining animal health data with information like livestock population, land use, meteorological, and remote sensing data, dynamic and static livestock disease precipitating factors are identified. It utilizes climate and meteorological data, along with other risk parameters, to forecast disease outbreaks up to two months in advance at the district level. The unique forewarning methodology combines 24 parameters at the village level, aggregated to the district level for analysis. It has the potential to serve as a valuable tool for farmers, veterinarians, policymakers, and other visitors.

National Animal Disease Epidemiology Network (NADEN)

From April 2021, AICRP-ADMAS centres were renamed as the National Animal Disease Epidemiology Network (NADEN), which currently consists of thirty-one centres. NADEN aims to serve the following mandate:

- a. Conducting sero-monitoring of animal diseases using a sample frame.
- b. Investigating endemic, emerging, and re-emerging animal disease outbreaks with innovative technologies.
- c. Strengthening the National Livestock Serum Repository.
- d. Effectively updating NADRES with active disease data and climatic and non-climatic risk factors.
- e. Conducting surveillance of diseases/pathogens in companion, laboratory, and wild animals.
- f. Analyzing economic losses due to animal diseases and evaluating the effectiveness of control measures implemented for their management.

National Digital Livestock Mission (NDLM)

The National Digital Livestock Mission (NDLM) is an initiative by the Department aimed at transforming India's livestock sector into a farmer-centric, technology-driven ecosystem. The livestock sector plays a significant role in rural livelihoods but remains untapped. To achieve this, the NDLM has outlined several key objectives, including establishing a "farmer-centric system," building a mechanism for Direct Benefit Transfer programmes, encouraging greater participation of the private sector, implementing robust closed-loop breeding systems and disease surveillance/control programmes, and promoting better alignment and coordination among various national and state programmes.

The key building blocks of the NDLM are unique animal identification, enhanced mobile applications (e-Gopala), and well-designed backend IT systems. The NDLM emphasizes better analytics through high-quality data generation and utilization of Artificial Intelligence and Machine Learning (AI/ML) to enhance disease

prediction, diagnostics, animal management, and product traceability. To ensure the sustainable management of the digital architecture, NDLM proposes the creation of a dedicated entity aligned with the Ministry's mission. This entity will serve as a technical resource and data analytics hub.

The basic digital applications like Information Network for Animal Productivity and Health (INAPH) have been implemented, gathering feedback for continuous improvement. Disease reporting systems, such as the National Animal Disease Reporting System (NADRS), have also been incorporated, refining reporting methods based on field input. The NDLM is a formidable undertaking, drawing inspiration from successful nation-scale programmes and seeking to capitalize on India's technological capabilities and resilience, aiming to unleash the full potential of the livestock sector. Recognizing the importance of controlling diseases that impact animals and humans, the mission aims to build robust disease surveillance and control programmes.

One-Health Initiatives

The urgency to address animal pandemics cannot be understated. Collaboration among Indian government institutions, private organizations, and states is crucial to ensure a comprehensive programme's success. Moreover, global community involvement is necessary due to the transboundary nature of infectious diseases. The Department of Animal Husbandry & Dairying (DAHD) is actively engaged in the proposed National One Health Mission, which aims to link databases and enhance disaster resilience. Meeting these global challenges demands collaborative efforts across sectors, borders, and disciplines. It is imperative that organizations and countries unite, sharing information and providing support, to foster a stronger and more resilient global community.

To prepare for future disease outbreaks, the Department of Animal Husbandry and Dairying (DAHD) has launched the Animal Pandemic Preparedness Initiative (APPI) on April 2023, the first of its kind worldwide. Under the APPI, several key activities are being undertaken. This includes the establishment of joint investigation and outbreak response teams (national and state), the development of an integrated disease surveillance system based on the National Digital Livestock Mission¹⁰, strengthening the regulatory system (e.g. NANDI-NOC for approval of new drug and inoculation system online portal)¹¹, creating disease modeling algorithms and early warning systems, collaborating with the National Disaster Management Authority (NDMA) for disease mitigation strategies, initiating targeted research and development for priority diseases, and building genomic and surveillance

capacity for timely disease detection.

Recognizing the challenges posed by zoonotic diseases and exotic animal diseases of economic significance, Department of Animal Husbandry & Dairying (DAHD), Government of India took initiatives to address the emerging infections through One-Health approach wherein the focus of activities revolves around intersectoral coordination, capacity building, reporting, information sharing across sectors and outreach. One Health Support Unit (OHSU) was established by DAHD with funding support from BMGF and CII as implementing agency¹². To pilot the proposed interventions, two states (Uttarakhand and Karnataka) were selected using various ranking indices, including operational and non-operational parameters. The interventions encompass the strengthening of field and diagnostic capacities, networking of laboratories, digital disease reporting and response, and strengthening of biosafety and biosecurity in farm settings towards achieving the “Predict-Prevent-Detect-Respond” doctrine.

The Department is initiating a programme for Animal Health System Support for Improved One Health (AHSSOH) with World Bank support wherein animal health infrastructure and capacities would be strengthened for effective implementation of One Health at the national level¹³. The project would target integrated disease surveillance for zoonotic diseases linking to human and wildlife systems, thereby creating a truly integrated system. The AHSSOH project will be piloted in five states, viz., Assam, Karnataka, Maharashtra, Madhya Pradesh, and Odisha. The primary goal of this project is to enhance the quality and accessibility of animal health services for livestock farmers and promote better coordination between animal and human health sectors in these focus states. The project would target integrated disease surveillance for zoonotic diseases linking to human and wildlife systems, thereby creating a truly integrated system. The project would cover 151 districts across the five participating states, with plans to upgrade 75 district/regional laboratories and strengthen 300 veterinary hospitals/dispensaries. Additionally, the project aims to train 9000 para-veterinarians/diagnostic professionals and 5500 veterinary professionals. It will also launch an awareness campaign on the prevention of zoonotic diseases and pandemic preparedness at the community level by reaching out to six lakh households.

Hence, the APPI, AHSSOH and One Health pilot initiatives aim to strengthen India's readiness to address future animal health emergencies. This ensures the well-being of livestock, farmers, and the overall economy.

Future plans

To enhance animal health management and disease control, a strong focus on strengthening Integrated Disease Surveillance and early warning systems is crucial. These systems play a critical role in timely detecting, monitoring, and responding to infectious and zoonotic animal diseases.

The approach involves various measures such as routine passive surveillance, environmental genomic surveillance, laboratory management information systems, and AI/ML-based data analytics to achieve comprehensive One Health surveillance. Strengthening disease surveillance systems helps authorities proactively identify disease outbreaks, assess their severity, and respond promptly, minimizing their impact on animal and public health and the economy.

Further focus on environmental genomic surveillance becomes essential to connect environmental data to early warning systems, detecting potential disease vectors or reservoirs to implement preventive measures.

Establishment of a laboratory management information system (LMIS) is the need of the hour to ensure efficient tracking of samples and results, aiding disease confirmation and guiding control strategies.

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Conflicts of Interest

No conflict of interest.

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