One Health Approaches and the Impact of Transboundary Diseases in Livestock Productivity

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One Health Approaches and the Impact of Transboundary Diseases

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Abstract

India holds huge livestock population which provides income, food, employment social security etc. Our animal husbandry sector is rapidly growing and moving towards to attain self-sufficiency in the production of livestock products. The animal husbandry sector is a major contributor to the Indian economy and overall contribution is 28-32% in agricultural GDP and 4 to 6% of the national GDP. However, livestock population of India is imperiled by diverse endemic infectious diseases (bacterial, viral, and parasitic), which jointly causes significant economic losses to the poor farming community. Infectious diseases inflict economic losses by causing mortality, morbidity, decreased production (meat, milk, eggs, wool etc.), decreased feed conversion ratio which further affects the weight gain, productivity, draught power and fertility. Besides, economic burden is also due to the treatment costs, prevention and control costs, abortions, market disturbances, consequences on internal livestock movement, germplasm and international trade. FMD is prevalent almost throughout the country, throughout the year, making it the most important disease for the country to control. The annual loss due to the disease in the country is estimated at around Rs.140-Rs.200 billion. Mastitis ranks high among the diseases that cause severe economic losses to the dairy farmers throughout the world. In India, the losses estimated due to mastitis (both clinical and subclinical) in 2001 was around Rs. 6100 crore per annum. Interestingly, it also showed that 70% of the losses (Rs. 4400 crore) were due to

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subclinical mastitis (SCM). These losses may increase further with the increase in the number of high yielding animals.

Indeterminate agrarian climate, unpredictable weather, drought, floods, migration of livestock, scarcity of fodders, and unhygienic zoo-sanitary and healthcare practices have collectively resulted in endemicity of diseases ultimately leading to more incidence and prevalence of livestock and poultry diseases throughout the year. In India, with limited feed resources and inferior genetic makeup of a sizeable number of animals already dogging the livestock sector, a further decline in productivity due to poor health of these animals only adds to the miseries of the farmer, which is not good for the animal husbandry sector. Moreover, some of the diseases are zoonotic and inflicts substantial impact on public health.

1. One Health and Disease Complexity in Livestock Value Chains

Livestock systems in India operate within complex socioecological networks where pathogens can emerge, circulate and amplify. Approximately 75% of emerging infectious diseases are zoonotic, and India has repeatedly faced outbreaks of avian influenza, Nipah, leptospirosis, brucellosis and swine influenza. Past avian influenza events resulted in millions of bird culling’s, causing economic shocks and temporary protein shortages. The COVID-19 pandemic further revealed the fragility of global and national supply chains to zoonotic spill overs.

High-density production clusters, informal live markets, repeated species mixing, wildlife interfaces, contaminated water sources and climate variability collectively increase pathogen transmission. Addressing these interconnected risks requires a One Health framework that links veterinary science, public health, ecology and social sciences to design interventions that strengthen food safety and ensure protein resilience.

2. Public health concern for trans-boundary animal disease

The livestock sector plays a vital role in economics of our country. It provides food in form of animal protein, income, employment. For low income producers, livestock also serve as a wealth, draught, transport, organic fertilizer for crop production. Introduction of new livestock disease cause serious implication to the animal husbandry of the state in term of animal and production losses and many a time if the new disease had potential public health implication than it further affect both human population and in tern the control startegies by governement may sometime involve mass culling of animal as happened in the case of bird flu resulting in huge loss to the animal husbandry.

3. Definition of transboundary animal disease

Those that are of significant economic, trade and /or food security importance for a considerable number of countries, which can easily spread to other countries and reach epidemic proportions; and where control/ management, including exclusion, requires cooporation between several countries (FAO, 2004). As per FAO, 2004 the significant tranboundary animal disease (TBAD) includes FMD, rinderpest, contagious bovine pleuropnemonia, bovine spongiform encephalopathy, rift valley fever, PPR, Classical swine fever, African swine fever, New Castle disease (NCD), Avain influenza. Out of these important TBAD, FMD and NCD possess minor treat to human being but avian influnza is of major public health concern.

Transboundary animal diseases are permanent threat to livestock owners. They have major economic implications on farmers level and also to large livestock industry sector.

Since times immemorial, animals have been the source of infectious disease to humans. Resource-poor developing countries will become increasingly vulnerable to emergencies caused by the growing prevalence of infectious diseases, especially transboundary animal diseases (TADs). A complicating factor is that more than 60% of the TADs are zoonotic diseases; of a total of 1405 infectious diseases that affect human beings, approximately 58% (817) are zoonotic in nature; and out of 177 infections that are emerging or re-emerging, about 73% (130) are Zoonoses (Woolhouse and Gowtage-Sequeria, 2005). An estimated 30 per cent of livestock production is lost in developing countries due to livestock disease.

In India, about 40 important public health concerned animal disease have been frequently reported, which include swine flu, bird flu, brucellosis, Japanese encephalitis, dengue, chikungunya, anthrax, plague, Toxoplasma gondii. To this existing list many more emerging, reemerging zoonotic diseases are pounding every year. Beside natural transmission of pathogen; legal and illegal trading of animals across the border possesses a serious threat for introduction of new diseases which presently re not seen in our country but our neighbouring countries are endemic for those as recent introductions of Nipah virus in West Bengal from Bangladesh poses a serious human health threat.

This movement of diseases of animals across boundaries have given rise to global threats to food security and related trade and created global concern on public health. Our country also is sharing border with many countries like Bangladesh, Nepal, China, Burma, Bhutan, Pakistan, China and Sri Lanka. North Eastern part of our country shares the maximum number of international boundary and many of these borders are very porous and there is regular mixing of human and livestock population in this area, hence, is prone to many animal transboundary diseases having zoonotic importance which includes ‘Bird Flu’, ‘Swine flu’, Nipah virus encephalitis, poxviruses, FMD, Q fever, Chikungunya, SARS, Bovine spongiform encephalopathy (BSE), Variant Creutzfeldt-Jakob disease (vCJD), Japanese encephalitis, Crimean-Congo haemorrhagic fever, Anthrax, leptospirosis, Plague etc.

3.1 Factors that contribute to Livestock Disease Prevalence

In addition to biological and environmental factors of animal diseases, there are certain other factors that contribute to increasing occurrence of animal diseases. These factors include infrastructure, manpower, etc.

3.2 Unregulated movement of livestock:

The region has very long and porous international boundary which is often covered in forests. Through these borders illegal and unregulated movements of livestock often takes place. Since there is lack of checks in such movements, there remains a perpetual risk of exotic animal diseases coming into the state.

3.3 Animal disease reporting system

If availability of updated data on animal diseases may be deemed as indicator, the lack thereof suggests some weaknesses. Lack of reliable animal disease data impedes effective policy planning for containment of animal diseases.

3.4 Vaccination coverage:

Vaccination of animals against common diseases is a timetested prevention strategy. As per available report of 201718, the preventive vaccination coverage for bovines was approximately 22% of the total cattle population. For the same period, preventive vaccination for pigs was just 9.5% which are too low to have a meaningful impact. For a sustainable livestock health strategy vaccination coverage needs to be increased by folds for better economic return on the costs of vaccination.

4. Economic Impact of diseases

Animal diseases are costly. They cost farmers as individuals, and also affect state economy. In fact, economic impacts of animal diseases are perceived at many different levels (Figure 2).

4.1 Disease effect:

Mortality and production loss caused by animal diseases.

4.2 Market effect:

This results from consumer disdain and fears, or happens due to shortage of supply leading to price rise, and occasional restriction on trade (national and international).

4.3 Control measures:

This involves costs of control measures at different levels including farmers, authorities, and industry.

4.4 After effects:

These effects involve effects and economic losses outside the livestock sector and include human health effects, diminishing tourism, effects on wildlife, etc.

4.5 Losses due to animal diseases

Actual monetary estimation of losses due to animal diseases are difficult to obtain not only for the state of West Bengal, but for the whole country too. However, available data revealed that cystic echinococcosis (a parasitic disease) caused a total annual median loss of Rs. 11.47 billion (approx. US $ 212.35 million) for the country. Similarly, bovine brucellosis (a bacterial disease) has been estimated to cause a median loss of US $ 3.4 billion annually for the country. As similar data are unavailable for West Bengal it would be imperative to assess the losses due to animal diseases for the state for prioritization control measures.

Although data regarding the extent of economic losses due to livestock diseases is scanty and sectorial in nature, it is emphasized that only a few disease have been analyzed for the overall economic impact and losses caused in the Indian context. Some of the data are as shown below

Foot and Mouth Disease (FMD) - The annual loss due to the disease in the country is estimated at around Rs.140Rs.200 billion. (Saminathan et.al, 2016).

Figure 2. Economic impacts of animal diseases

Mastitis - In India, the losses estimated due to mastitis (both clinical and subclinical) in 2001 was around Rs. 6100 crore per annum. Interestingly, it also showed that 70% of the losses (Rs. 4400 crore) were due to subclinical mastitis (SCM). (NDDB, 2020, Dua. 2001).

Brucellosis- An analysis revealed that brucellosis in livestock is responsible for a median loss of US $ 3.4 billion. The disease is responsible for a loss of US $ 6.8 per cattle, US$18.2 per buffalo, US $ 0.7 per sheep, US $ 0.5 per goat and US $ 0.6 per pig. These losses are additional to the economic and social consequences of the disease in humans. (Singh et.al, 2015).

Hemorrhagic Septicemia (HS) - The total economic loss per infected animal due to Haemorrhagic Septicaemia has been estimated as ‘ 6816 in case of cattle and ‘ 10901 in buffalo. These losses when scaledup at the national level have indicated a loss of ‘ 5255 crore. The direct losses contribute 80.3 per cent and indirect losses contributed 19.7 per cent to the total economic loss. (Singh et.al, 2014)

5. Potential approaches for mitigation

5.1 One Health approaches for animal diseases:

Since diseases of animals are multi-factorial and affects multiple stake holders it would be imperative to take a ‘One Health’ approach for control of animal diseases.

‘One Health’ concept as summarized by OIE (2020) involves the fact human health and animal health are interdependent and bound to the health of the ecosystems. Therefore, an interdependent systems approach is necessary. One health approach not only helps curb animal diseases but also helps in detecting possible human health threats from animal diseases. Therefore, mainstreaming of ‘One Health’ in the control of animal diseases

will be beneficial.

5.2 Early detection of animal diseases and outbreaks

An early detection of any animal diseases help in timely intervention and containment of the disease. Due to dispersed nature of the animal production system in the state this requires early reporting through formal and informal channels. This will help timely action from all stakeholders as well as minimization of the loss due to a disease. However, this needs to be supported by proper technological backstopping by the relevant authorities including ICAR.

5.3 Control animal diseases at source:

Once detected controlling diseases at local level are always beneficial. If diseases are contained in a rather smaller geographical area more resources can be diverted towards monitoring the situation. Once a disease escapes its place of origin and if it is contagious, often situation goes beyond control and causes massive economic losses which are often underestimated.

6. Monitoring and surveillance

Keeping a constant vigil on livestock diseases is a major step for overall control and containment of animal diseases. Surveillance and monitoring can be undertaken both at state government level and in case of difficult to detect infection help from central agencies such as ICAR may be taken up. For an effective surveillance and monitoring mechanism several requirements are needed to be fulfilled. Among these are the followings.

6.1. Sourcing of disease information from all

stakeholders: Mechanisms should be established for early warning regarding possible animal diseases from all quarters. For these informal channels may be enabled so that information from difficult to reach areas may also reach veterinary department for early intervention.

6.2. Orientation human resources: Deploying all

veterinary doctors for clinical/dispensary duties need to be revisited. There should be proper balance of manpower deployment in clinical and preventive veterinary practices. If there are unmet training needs central agencies such as ICAR may be of great help.

6.3. Strengthening of existing laboratory systems:

There is an urgent need to upgrade and strengthen laboratories of the state for rapid diagnosis of various livestock diseases. The upgradation should not only include infrastructure development, these laboratories need to suitably manned and appropriately oriented with clear job responsibilities.

6.4. Optimal usage of resources: Usage of resources

available in the state, e.g. ICAR laboratories need to be formalized through administrative instruments to enable reasonable usage of resources for the benefit of the state.

7. Vaccination:

There is a clear need to enhance vaccination coverage of the animal population in Meghalaya. For achieving proper coverage, vaccination for animal diseases may be taken up in a PPP mode. For this various NGOs and unemployed

youths may be involved which in turn will lead to greater vaccine coverage benefitting farmers and creation of employments for youths.

8. Biosecurity:

Biosecurity is a set of measures that aim to prevent animal diseases to enter into the farm and also creates barriers for animal diseases to escape and spread from the affected farm. While all stakeholders usually understand its needs, its implementation at farmers' level is difficult and requires long term campaigning for suitable behavior change. Therefore, there is need for long and enhanced campaign highlighting the benefits of biosecurity measures at the farm level.

9. Identification and animal traceability:

Identification of infected animal and consequent traceability of the animals from the outbreak zone is a major concern. Animals from infected zones are prone to be transported to various places through legal and illegal means. This creates further complexities in the control animal outbreaks. Keeping in view the importance of animal traceability and identification, a long-term plan, proceeded by a pilot study need to be undertaken for its implementation. This will not only aid in control of animal diseases, the benefits will also be felt in estimating

vaccine coverage, food traceability, insurance settlements among many others.

10. Descaling & Containment of Animal Diseases

The recommendations regarding descaling and containment of diseases would be appraised to the state governments; however, implementation of the same is a jurisdictional matter of the state government and DAHDF, Govt of India.

A number of basic approaches may be used to control and eliminate epidemic livestock diseases. They are usually used in combination. The weighting that is given to the different approaches will be determined by the nature of the disease in question, the epidemiological circumstances and their acceptability and cost. The approaches to be used are summarized below.

11. Denial of access of the disease agent to susceptible host animals

This may be achieved by:

 Applying good hygiene and sanitary practices when handling livestock. This includes disinfection of all personnel and equipment. In this context, veterinary services should note that there have been several well-documented cases of highly contagious diseases such as FMD being spread from farm to farm by veterinarians on their rounds.

 Removing potentially contaminated materials from the environment, by disinfection, destruction and/ or safe disposal. This includes cleaning and disinfection of premises that have housed infected animals, destruction of contaminated feedstuffs and other materials and burial or burning of the carcasses of infected animals.

 Preventing the feeding of contaminated materials to livestock. Many diseases can be transmitted in this way. The classical example in recent years has been bovine spongiform encephalopathy (BSE). However, entry into the food chain is an important method of perpetuation and spread of other important animal pathogens, particularly by swill feeding. These include FMD, African swine fever, hog cholera (classical swine fever) and swine vesicular disease. These diseases have spread not only from farm to farm but from continent to continent. Controls on swill feeding by either enforcing strict bans on swill feeding of animal tissues to animals or allowing only the feeding of heat-treated swill to animals should be an integral part of the prevention and eradication of a number of epidemic livestock diseases including those mentioned above. Swill feeding is a common source of transmission of animal diseases.

While the other approaches to be described could be considered as subsets of denying access of the disease agent to susceptible hosts, they are conveniently considered separately.

12. Avoiding contact between infected and

susceptible animals

This is one of the most important approaches and may be

achieved by:

 Quarantining of infected or potentially infected

farms or areas.

A ban or appropriate animal health restrictions

are placed on the movement of susceptible species

animals into or out of the quarantined area until

infection is considered to have been removed.

Restrictions may also be placed on the movement

of people, potentially contaminated animal

products and other materials.

 Imposing livestock movement controls. These are

usually imposed over a wider area around the

immediate quarantined or infected area, as part

of a zoning policy (for example, within surveillance

or control zones). With such controls the

movement of susceptible species is only permitted under strict, designated conditions when it is deemed safe.

This may include the transport of livestock direct to abattoirs for immediate slaughter for those diseases that are not transmitted by meat or other animal products. There may also be bans or restrictions placed upon congregations of susceptible animals such as at livestock markets or race meetings.

 In some cases, through erecting large-scale fencing or other physical barriers. However, potential adverse effects, such as disruption of wildlife habitats and of traditional movements of people and their animals, should first be evaluated.

12.1 Removing infected and potentially infected animals

This is often referred to as an eradication policy. Susceptible species on infected farms or in designated infected areas are immediately slaughtered on site and their carcasses disposed of safely, usually by burial or burning. It is often combined with cleaning and disinfection procedures for the infected premises. Because of the rapid spread of epidemic diseases, all susceptible animals are slaughtered, whether obviously infected or not. For some infectious disease control programmes, such as for brucellosis and tuberculosis, it is possible only to slaughter animals that have been tested positive, but this is not appropriate for rapidly contagious epidemic diseases.

A component of an eradication policy may also be selective reduction of susceptible wild and/or feral animal populations in infected areas, but before embarking on such a programme a careful evaluation should be made.

12.2 Reducing the number of susceptible animals

This is an important approach used in many countries. In emergency disease control it is usually achieved by vaccination of susceptible animals. Vaccination may be done selectively (for example as “ring vaccination” around infected areas) or as “blanket” vaccination programmes in susceptible animal populations. Depending on the nature of the disease and of available vaccines, it may be possible to eliminate infection completely. More usually vaccination is used to reduce the level of infection in animal populations to an acceptably low level where other disease elimination policies are more feasible. In fact, in some cases routine vaccination may mask underlying infection in animal populations.

12.3 Reducing access of vectors to susceptible animals

This may be appropriate for insect-borne diseases and, in some cases, may be achieved by reducing vector numbers in an area by treatment and/or elimination of potential breeding sites. Large-scale insecticide spraying is generally too costly, ineffective in the long term, and/or

environmentally unacceptable. Other approaches might be to treat susceptible animals with long-acting insecticides during critical periods or remove animals from high-activity insect vector areas either continuously or during times of the day or year when insect vectors are most active.

12.4 Biological control

To date, there has been only one emergency disease situation for which biological control has proved effective. This has been for the New World screwworm fly (Cochliomyiahominovorax) in the Americas and North Africa using the sterile insect release method (SIRM). SIRM techniques are also currently under evaluation for the Old-World screwworm fly (Chrysomiabezziana).

13. Epilogue

Animal disease control is a complex problem which requires close coordination by multiple stake holders. In the times of post Covid-19 pandemic the situation is even more delicate where farmers are facing huge economic

consequences and available machineries of state and central government are not able to function properly due to covid-19 related restrictions. In this backdrop it is necessary to work under a clear strategic plan to rationally allocate resources where it is needed most. Moreover, graded listing of animal diseases will help in prioritizing control and surveillance measures. Finally, the need for collaboration among various government agencies (state and central) cannot be over emphasized.

If a robust disease diagnostic plan along with systematic surveillance is implemented it would ensure the following benefits to various stake holders as shown below :

13.1 State Animal Husbandry Departments

a) Real time disease data generation. b) Establishing full-fledged core and peripheral labs

within the state. c) Competence in handling disease identification and

containing outbreaks in a much shorter time.

13.2 Disease investigation centres (Nodal and Regional)

a) Access to accurate, low-cost indigenous diagnostic kits both molecular and serological. b) Creation of a platform for gathering real time disease data within a specific defined area at regular intervals. c) Monitoring disease incidence regularly in the North- Eastern region that is both fragile and sensitive to incursion of exotic diseases.

13.3 NIVEDI (for disease forecasting/ modelling/ database build-up)

a) Already a partner in the north eastern region, however data generated would help in realistic disease forecasting and also in epidemiological decision making. b) Would help in convergence of all disease monitoring nodes through IOT/cloud computing. c) Would help in exotic disease watch/ sentinel surveillance with an alert mechanism.

13.4 Ministry of Livestock, Dairying and fisheries (Health component)

a) Would help in gathering relevant data through NERDDLs regarding disease Snapshot of NER. b) Would help in better deployment of funds under the disease monitoring and data gathering scheme like ASCAD valid at the state levels. c) Could use the battery of diagnostic tests developed indigenously in the region for a widerreach i.e. in region other than NER.

13.5 NADRES (National Animal Disease Research and Surveillance network)

a) Data entry facilitation by using realistic diagnostic test results. Hence a clearer picture can be obtained.

b) Regular disease monitoring by NADRES nodes would help in more efficient out-break surveillance. c) Value-addition in terms of real-time data vs. passive data would be a great advantage to the NADRES framework.

13.6 Policy Planners

a) More informed decision-making ability regarding disease control and outbreak surveillance. b) Data generation from the point of view of livestock product trade. Export requirements of disease incidence can be fulfilled from countries having a requirement for such data. c) Better control and containment abilities for endemic and exotic diseases leading to scaleup of livestock productivity and minimizing public health hazards.

13.7 Start-up Entrepreneurs/ prospective Techno Start-up Incubators

a) Identifying suitable technology recipients for producing the kits/ assays / biological under guidance from experts preferably at an IIT basedTechnology incubation center. b) Set up GMP and GLP infrastructure and provide it on lease to the graduated technology incubators. c) Market assurance/ sale of the technologies could be a two-way commitment between Government users and techno-entrepreneur to ensure steady demand-supply balance and equilibrium.

The overall aim should be at reducing the incidence of the diseases, both exotic and emerging, against which a vaccine is available viz, FMD, CSF, PPR, PCV and Brucella by 15% over a 5 year period. The diseases that require bio containment and biosecurity, viz, PRRS, ASF and JEV can be controlled through effective testing and phasing out thus attempting maximal eradication. Apart from the above diseases like Nipah, Influenza and AMR organisms require enhanced surveillance and monitoring

and ensuring adequate preparedness. This would lead to development of an effective strategy in achieving livestock disease control and reduction in the north eastern region.

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