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Control of Infectious Diseases in Livestock Farms: Strategies to be Adopted Under Indian Perspective - Review

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ABSTRACT

Livestock farming is livelihood to nearly 80% population generating employment to about 8.8% of total population in India. Of the factors, diseases play major role in economic sustainability of livestock enterprises. Many factors predispose diseases in animal farms. While adopting strategies for control and eradication of livestock diseases, a holistic approach is required with technical and financial supports from government organisations, and government with active involvement of farmers.

Key Words: Infectious disease, Livestock, Control strategy, Holistic approach

INTRODUCTION

Livestock farming is important for livelihood to nearly 80% of the rural population in India. Livestock keeping is also a tradition in rural India and regarded as the pride as well as prestige by some tribal communities particularly of hilly states. Livestock related economic activities are generally affordable, successful and sustainable for rural poor farmers throughout India. Of the total animal population in India, livestock and poultry comprises of 512.06 and 729.2 million, respectively. With 37.28% cattle, 21.23% buffaloes, 12.71% sheep, 26.40% goats, 2.01% pigs and 0.37 % of mithun, yaks, horses, ponies, mules, donkeys and camels of total livestock, this sector contributes 14% of income of rural households and provides employment to about 8.8 % of the population in India. Livestock sector also ensures 4.11% GDP and 25.6% of the total agriculture GDP of the country [13].

Livestock production is affected by many factors. Of which diseases play major role in decreasing immunity, reproduction, feed efficiency etc. adversely affecting productivity. In recent years, occurrence of emerging and re-emerging diseases is causing havoc in livestock production. Numerous cases of vector-borne and other zoonotic diseases have been emerged or re-emerged with major health issues [9] resulting in great economic losses to the farmer. Emerging livestock diseases are those diseases which are newly identified because they are previously not known as infectious [17]. The emerging diseases cause a good number of public health problems either locally or internationally. Whereas, the re-emerging disease are those diseases which have been known for sometimes, but for low incidence levels they are no longer considered as public health problems, but presently they are showing upward trends in incidence or prevalence. Highly contagious diseases of livestock, for their wide host range, plurality of immunological types, and short duration of immunity, may cause severe economic losses.

Effective bio-security and managemental practices can play a major role for control and elimination of livestock diseases under Indian farming situation.

FACTORS PREDISPOSING DISEASES IN RURAL INDIA

One of the major predisposing factors for occurrence of diseases in livestock is improper feeding management without any scientific standards. This invariably leads to per-acute nutritional deficiencies and in long run results in immune

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suppression increasing susceptibility to diseases. Improper housing, inappropriate floor space, improper bio-security measures, inadequate health management and sanitary interventions cause occurrence of diseases in farm animals. In spite of vaccinations, animals suffer for inappropriate time, dose, and method of vaccination. Unavailability of vaccine at proper time and improper storage facility are also responsible for vaccination failure. Besides and more importantly, farmers in the rural areas usually follow the traditional treatment methods instead of consulting a veterinarian. But, when the condition of the animal severely deteriorates, they approach a veterinarian for whom it is too late to revive the animal.

Another ignored aspect of livestock rearing in rural India is farm waste management and disposal. Animal excreta are good sources of nutrients for the plants and can be utilised for generation of energy. However, the disposal of these wastes continues to be a challenge from the standpoints of cost, environmental safety, and bio-security [15]. In rural areas, there is no proper drainage system and it is also becoming a great concern for polluting the environment for improper disposal of farm wastes. It adversely affects the health of the animals and results diseases or makes the animals more susceptible to diseases.

BIO-SECURITY FOR DISEASE PREVENTION

Bio-security helps in effective control of infectious diseases of animals. Bio-security practices are to be designed in such a way that it effectively prevents the entry and spread of disease-causing agents into and from a livestock and poultry farm. Bio-security reduces the risk associated with the management of poultry and livestock farming. Eradication of pathogenic agents is the safest way to prevent the occurrence of infectious diseases. Effective tool for eradication process is based upon good monitoring and surveillance systems, reliable diagnostic techniques, good diagnostic laboratory facilities with adequate technical infrastructure [3].

There are three main elements of bio-security protocol – Segregation and traffic control, cleaning and disinfection [18].

Potentially infected animals should be quarantined to prevent pathogenic agents from entering into the farm and contaminated objects such as clothing, foot wares, vehicles, equipments etc. should be kept away from healthy poultry and livestock flocks. This can be done by the following ways.

- Locking the entry and exist point, providing fence & gate at distance.
- Time break in between farm's visits.
- Washing hands and feet, changing foot wares and outer clothes, vehicles kept off the farm.

Risks of disease transmission can be minimised by preventing unauthorized people from entering into the farm premises.

Screened walls and windows are very essential to prevent contact of poultry and livestock of farm with wild and domestic animals and birds of the outside.

- Workers or visitors must clean hands and feet with sanitizer or disinfectant before entering the farm premises.
- It should be mandatory for workers or visitors to change clothes and foot wares before entering into the farm. They should have different neat and clean wares for the farm.
- It is essential for workers or visitors to clean and disinfect foot wares between sheds in foot-bath or change foot wares.
- Farm workers should be prevented to contact outsiders and only the essential visitors such as veterinarian and service man should be allowed to enter into the farm.

INNOVATIONS IN ANIMAL HEALTH STRATEGY FOR CONTROL OF INFECTIOUS DISEASES

With the emergence and re-emergence of fatal animal diseases, it becomes pivotal for the veterinary health sector to adopt new disease preventing strategies. Treatment strategies or protocols generated in veterinary clinics can be shared among clinics and researchers. It will help in finding out the common diseases of a particular area or region and to adopt appropriate prevention strategies for them. Veterinarian can also make animal owners aware about the dates for vaccination or advance medications and provide instructions for healthy feeding regimes. It is very much essential particularly during the natural calamity and thereafter.

The human and animal health sectors should work in cohesive manner for increased transfer of knowledge both ways avoiding slow regulatory processes or communication hindrance. As animal health directly affects human health, there should be deeper collaborations and the animal health sector needs to explain and emphasise the channels through which diseases transmits from animals to human beings and vice versa. Many zoonotic and vector-borne diseases may emerge as a result of changing social habits, habitat modification, exotic vector introduction and climate change. In recent times, rapid movement of people and transportation of goods have resulted in the introduction and establishment of several novel vector species not previously prevalent in some areas (e.g. Porcine reproductive and respiratory syndrome (PRRS) in swine and Nipah infection in recent times in some parts of India). There are significant concerns of impacts on public health and economics of farmers which necessitates collaboration between the animal and human health sectors in preparing for emergencies.

RELATIONSHIP BETWEEN CLIMATIC CONDITIONS AND EMERGENCE OF INFECTIOUS DISEASES

Infectious animal diseases significantly lower animal productivity thereby causing financial losses to the farmers. It also has significant impact on environment, affect human health, and tend to increase poverty particularly in developing countries. Livestock sector, as the economic avenue, is extremely important for the rural livelihood and national economy. The burden of animal diseases is extremely high in developing countries like India and is responsible for losses of around 20% of ruminants and more than 50% of poultry every year. Climate change is one of the important factors which affect the occurrence of infectious diseases in livestock and out of 65 important animal diseases, 58% are found to be highly climate sensitive to climate change [8].

The weather patterns define the climate change of a particular geographical area. This change has been found to extend for millions of years or over a period of time in a particular geographical location which can be identified by using different statistical tests [2].The changes in the mean and/or variability of its properties over a period of time can be used to identify the climate change. For an infectious disease to occur, a relation between host environment and the infectious agent or pathogen has to exist. This relationship is termed as the disease triangle or epidemiological triad. The role of the environment becomes more pronounced to those organisms which have to spend some time period outside the host in the environment, in the form of spore, vegetative organism, larvae or as a developmental stage in the intermediate host. Diseases which are transmitted by vectors and introduced into other susceptible hosts are highly influenced by climatic factors. The spores of *Bacillus anthracis,* causing Anthrax, a highly fatal disease, survive outside the host [16]. Environmental factors such as suitable temperature, humidity and moisture play definite role in successful germination of the spores. Certain bacteria, such as *Dermatophilus congolensis* (causative agent of *Dermatophilosis*) and *Pasteurella multocida* (*Haemorrhagic septicaemia* in bovines) survive well outside the host in moist environment. Occurrence of both the diseases is associated with high humidity and rainy seasons [6]. On the other hand, rinderpest virus survives best at extremely low or high humidity and least at humidity between 50-60% [1]. Similarly, trematodes like *Fasciola* requires environmental conditions suitable for its intermediate host, the snails, which include very moist & wet conditions of pasture and soil. Vector-borne infectious diseases like blue tongue, African horse sickness, Rift valley fever etc. require suitable environment conducive for their vectors including mosquitoes, midges, flies, ticks etc. to thrive and multiply the organisms and complete the external incubation period (EIP) successfully, with EIP lengthening in the colder periods and shortening in the high temperatures [12].

HOW CLIMATE PREDISPOSES THE DISEASE OCCURRENCE?

The climate of a particular region/state has both the direct and indirect influences on the transmission of diseases affecting either occurrence of an outbreak or the intensity of an outbreak. Thus, there are temporary linkages between occurrence of infectious diseases and their geographical distribution in human and animals. Ecosystem can be linked with disease transmission through its biodiversity. Many arthropod vectors require warm weather and thus they are noticed during summer season. Lengthening of the warm season may increase or decrease the number of cycles of infection within a year. Heavy rainfall, primarily following drought, can increase insect population by enhancing larval habitats. Flood may increase water-borne diseases (cholera or leptospirosis). Storms can increase transport of waste water to groundwater thereby pollutes the environment. Water contamination following heavy rains may result many diseases (particularly of giardia and *E. coli* infestations).The outbreaks of a number of viral diseases is linked to unusual rainfall patterns and disruption of seasonal rainfall patterns. Increased rodent population is also known for increasing rodent-borne diseases [2].

The disease transmission between livestock and wildlife and also between livestock and human has been found to be greatly influenced by drought conditions. Due to limited water resources, livestock and wildlife tend to congregate resulting in pathogen transmission [10]. Proliferation of bovine tuberculosis occurs in such a manner. Restricted food availability due to limited vegetation growth leads to stress and thereby immune-suppression which predisposes diseases of different kinds in animals. Forced migration of animals also increases the probability of introduction of novel pathogens. The increased and random movement of animals during drought in search of food also plays an important role in disease transmission. The water resources and vegetation cover are highly dependent on climate change and are subsequently altered due to changing climate patterns, thus forcing animals to migrate to different geographical locations.

Host distributions are altered due to climate change. Increased exposure of hosts to harmful UV-radiations for ozone depletion may cause immune suppression increasing susceptibility to infectious diseases [4].High temperature and humidity may reduce restrictions on insect distribution, thereby allowing them to flourish in areas previously not fit for them to survive. Temperature changes may also affect vectors by altering biting rates or alter the length of transmission period. Arthropod vectors are more active at higher temperatures. Therefore, they feed more regularly to sustain the increase of their metabolic functions enhancing chances of infections being transmitted between hosts. Small changes in vector characteristics can also produce substantial changes in disease pattern [19].

The climate of India varies from region to region and from season to season within a region. India is having varied topography from below mean sea level to more than 3000 m above mean sea level. It precipitates a wide range of weather conditions throughout India. This significantly affect the natural ecosystems and thereby flora and fauna. The annual mean surface temperature of India will rise from 2.5^0 C to 5^0 C by the end of the century. The rate of warming is more pronounced in the northern parts of India [11]. More than about 20% rise in summer monsoon rainfall is projected over all states except Punjab, Rajasthan and Tamil Nadu. The maximum temperature range in any one season is predicted to be varied more widely (27°C - 44°C to 26°C - 45°C). The variations in minimum temperature are also expected to increase in the same way. The hydrological cycle is likely to be altered and intensity of droughts and floods in various parts of India is likely to increase. Under such circumstances, there is every likelihood for abrupt climatic changes which may affect the physiology of the every livestock species, their immune status and thereby leading them vulnerable to many infectious diseases.

DISEASE SITUATION IN INDIA

During 1992-2009, at least 11 pathogens have emerged or re-emerged in India and majority of them are of animal origin. In recent years, incidence of new/unknown etiologic animal diseases are increasing at an alarming rate in India (Bird flu/avian influenza, swine flu/swine influenza virus, PRRS, nipah virus infection etc.). The outbreak of Crimean Congo hemorrhagic fever was occurred in Gujarat and Ahmadabad during 2011. Vector borne diseases like Japanese encephalitis, Dengue, West Nile virus, Kyasanur Forest Disease (KFD) etc. are also spreading to much wider rates in different states/regions of India. After a long gap of 20 years, chikungunya fever reappeared in several countries including India. KFD is a tick-borne *Flavi* virus infection in which monkeys act as reservoir/amplifier and it has been reported from certain parts of Karnataka [2]. An outbreak of leptospirosis was also reported in Mumbai in the year 2002 because of the prolonged water logging due to heavy rainfall [5].

The first report of Avian Influenza (H5N1) outbreaks were reported in the South East Asian region in the year 2003.Sporadic outbreaks are still continuing in many countries including in Bangladesh (2007), India (2006-2007) and Indonesia (2004-2007). The swine flu (H1N1) is a viral infection that originates from pigs and was first isolated during 1930s.The recent outbreak of swine flu were reported from many parts of India including Jammu and Kashmir [14].

CONTROL AND ERADICATION OF PRIORITY DISEASES

Total eradication of diseases is one of the toughest jobs and it requires holistic approach as well as huge financial supports. However, developed nations can overcome these constraints and attain total control over diseases by adopting proper treatment, vaccination, timely culling and most importantly by reducing transmission of diseases. There are many control technologies which are potential to improve the control of climatic conditions to prevent climate sensitive disease, mainly of multiple vector borne diseases. There are some vaccines which are effective against multiple diseases (*Multivalent vaccines*), which can confer immunity to multiple infections. Similarly, '*Thermo-tolerant vaccines*' which do not require any cold-chain facility can effectively be helpful under rural conditions and situations without any storage facility. Insecticides like pyrethroids which are effective against several multiple vectors can be utilised to control vector borne diseases. For the improvement of the resilience of livestock production systems, the following changes in livestock production practices are the needs of hour to help livestock farmers.

- Diversification of livestock and livelihood.
- Integrating livestock farming with agriculture.
- Identifying and improving the breeds for better adoptability to harsh environment and less susceptible to diseases.
- Adopting farming practices that limit greenhouse gas emissions i.e. better manure management; replacing fertilizers with biological/nitrogen fixing legumes, soil conservation tillage etc.

Another important tool for combating any future disease is its prediction and forecasting. Since traditional knowledge is no longer reliable for these purposes, more stress has to be given for better linking between human, animal and environmental health (*One Health and Eco health*).

MITIGATION APPROACHES

Rural livestock farmers of India are very poor. They try to utilise the available resources (including locally available unconventional feed resources) to manage their animals. For lack of knowledge and/or unawareness on their parts, they usually ignore the important aspects of animal management like sanitation and hygienicity of the farm, scientific feeding of the animals, disease preventive measures and proper disposal of manure etc. These are responsible for deterioration of immunity and health of the animals increasing susceptibility to infections manifold. Thus, the extension personnel of different organisations still have much to do towards sustainability of livestock enterprises and profitability. In this regards, extensive awareness programmes are required with

financial as well as technical supports from the government and government organisations.

The mitigation approaches should aim at reducing the agents/factors that tend to increase the phenomenon of climate change. This requires international agreements and commitments for implementation of environmental policies by respective nations. These may include -

- Reducing fossil fuel consumption, especially of coal to lessen the release of greenhouse gases.
- Promotion of biodegradation and recycling procedures.
- Saving of energy and utilization of alternative energy resources/methods like energy saving stoves, hydroelectric power, wind energy, solar energy, biogas energy etc.

CONCLUSION

The emerging and re-emerging diseases are becoming the major threats towards livestock productivity in recent decades. Unscientific managemental practices, lack of awareness regarding effective bio-security and disease control measures results quick spread of the diseases causing tremendous morbidity and mortality of farm animals. Finding out cost-effective control strategies based on history of occurrence of diseases, climatic conditions of the region should be the priorities. A holistic approach with active involvement of farming communities supported by technical and financial avenues from government organisations and government can ensure economic sustainability of livestock farming/enterprises in India.

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