



## **Review on Transboundary animal diseases and their impacts on international trade**

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### **Abstract**

Trans-boundary animal diseases (TADs) are highly contagious diseases of livestock in the world. They have importance in the international trade of animals and animal products. With rapidly increasing globalization, an associated risk of trans-boundary disease is emerging. They reduce production and productivity, disrupt local and national economies, and also threaten human health (zoonosis). Trans-boundary animal disease are a concern globally, cumulative effort is needed at international level to minimize the spread of infectious diseases across the borders. But for sub-Saharan African countries more particularly, eradication of most Trans-boundary animal diseases is impossible due to a various technical, financial and logistical reasons such as increased outbreaks of trans-boundary animal diseases droughts and market issue. In Ethiopia Trans-boundary animal diseases are endemic livestock diseases which cause market limit. This imposes far-reaching challenges for agricultural scientists on the critically important need to improve technologies in animal production and health in order to ensure food security, poverty alleviation and to aid economic growth. Considering that livestock rearing constitutes a significant share in the national economy of a developing country like ours, it is imperative to take up disease control initiatives. Measures are required to safeguard the livestock industry from epidemics of infectious diseases and to uphold safe international trade of livestock and their products. In this regard, it is essential to develop scientific and risk-based standards that facilitate the international trade in animal commodities.

**Keywords:** Ethiopia, International trade, Trans-boundary Animal Diseases, zoonotic

### **1. Introduction**

Trans-boundary livestock diseases are 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 co-operation between several countries. Trans-boundary diseases are highly

contagious and have the potential for rapid spread, irrespective of national borders, causing serious socioeconomic consequences. All trans-boundary animal diseases have the potential to kill affected animals, but the severity of the disease will vary depending on factors such as species and breed of animal, age, nutrition, disease agent etc. Many TADs have 50 to 90 percent mortality rates in susceptible animals (Otte *et al.*, 2004).

Traditionally, trade, traffic and travel have been instruments of disease spread. Now, changing climate across the globe is adding to the misery. Climate change is creating new ecological platform for the entry and establishment of pests and diseases from one geographical region to another (FAO, 2008).

Several new trans boundary diseases emerge, and old diseases reemerge, exhibiting increased chances for unexpected spread to new regions, often over great distances. Livestock enterprises and animal production contribute significantly to the world economy, provide household source of income, food security, source of energy, draft power for crop cultivation, high quality animal proteins and vitamins (meat, milk), manure, raw materials (hides and skins) and bride price (Bonnet *et al.*, 2011), and generate a livelihood for 1.0 billion poor people in the world (Naqvi and Sejian, 2011).

Zoonotic diseases among TAD's include diseases like West Nile virus (WNV), Rift Valley fever (RVF), Mad Cow Disease (MCD), bovine tuberculosis, and highly pathogenic avian influenza (HPAI). Other important TADs are foot and mouth disease (FMD), contagious bovine pleuropneumonia (CBPP), lumpy skin disease (LSD), African swine fever (ASF) and Newcastle disease (ND). They have the potential for very rapid spread, irrespective of national borders and these diseases can cause serious socio-economic and possibly public health consequences (FAO, 1999). From a considerable number of countries trans-boundary animal disease spread to other countries and reach epidemic proportions where control and management requires cooperation between several countries (Otte *et al.*, 2004). They cause most serious impact on animal and human livelihood as these have the potential to threaten food security, proper livelihood of livestock owners & workers and rural economy which in certain instances could lead to political and social unrest in people. Due to the global distribution and persistence of TADs world animal agriculture, food security and international trade are being very badly affected (Domenech *et al.*, 2006).

Trans-boundary animal diseases have a multi casual origin; some factors associated with this process include: Trade and international travel (increased frequency and speed of local and international travel, fostered by the globalization process promotes the spread of microorganisms on a global scale), changes of agricultural practices (animal domestication was one of the main promoters of microbial evolution by

facilitating the availability of new susceptible hosts at high densities, due to the intensification of livestock systems), climate change (which causes changes in eco-geographical distribution of vectors), reduction of habitat and increased contact with wild animals and introduction of immature wild and domestic animals to new geographic areas where the disease is endemic and immunologically unknown for them (Brown, 2010; Chomel *et al.*, 2007; Daszackp *et al.*, 2007).

Therefore the objectives of this paper are:-

- To review the trans-boundary diseases of animals.
- To highlight the distribution way of trans-boundary animal disease.
- To review the impacts of trans-boundary animal disease on international trade.

## 2. Literature Review

### 2.1 Trans boundary Animal Diseases

Trans-boundary livestock diseases are 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 co-operation between several countries. Trans-boundary diseases are highly contagious and have the potential for rapid spread, irrespective of national borders, causing serious socioeconomic consequences. All trans-boundary animal diseases have the potential to kill affected animals, but the severity of the disease will vary depending on factors such as species and breed of animal, age, nutrition, disease agent etc. Many TADs have 50 to 90 percent mortality rates in susceptible animals (Otte *et al.*, 2004).

A characteristic of trans-boundary animal diseases (TADs) is that they themselves can be the cause of national emergencies and their significance often transcends national boundaries. They are particular importance to food security and sustained economic development and trade for many countries. TADs are economic importance non tariffs barriers to the export of animals and their products. They are highly contagious and feared diseases of livestock in the world and of economic importance and a major constraint in international trade (Otte *et al.*, 2004).

Several infectious zoonotic diseases have recently emerged, causing devastating economic losses in the

countries affected. These have a wide ranging impact on the livelihoods of farmers, and on regional and international trade, food safety, public health and international travel and tourism. Disease pathogens continue to evolve and adapt themselves to animals and humans alike. Disease investigation indicates that many of these new diseases emerge in response to number of critical factors, such as changes in climate, ecosystems, animal production systems and land use, all of which alter the interactions between pathogens and various hosts thus the number of developed countries have been declared free from these diseases and they prevent introduction of the diseases to their countries by banning imports from infected developing countries due to the unrestricted importation of animals from infected countries and poor veterinary services (FAO, 2002).

**2.1.1 Office International Des Epizooties lists trans-boundary animal disease**

The World Trade Organization as the international reference body in the field of animal diseases and

zoonoses recognizes the World Animal Health Organization (OIE). OIE lists diseases that are considered to be of such significance because of their impact on animal populations, ability to spread and threat to human health that the Veterinary Authorities of member countries are required to notify OIE about changes to the situation regarding these diseases in the country (FAO, 2004).

OIE listed diseases were formally classified into list A and B where the list A diseases are similar by definition to TADs. OIE list A diseases are transmissible diseases that have the potential for very serious and rapid spread, irrespective of national borders, that are of serious socio-economic or public health consequence and that are of major importance in the international trade of animals and animal products. Some of the most important trans-boundary diseases are: FMD, ASF, CBPP, RVF, avian influenza (AI), ND, Classical swine fever (CSF) and Peste des petits ruminants (PPR) (Otte *et al.*, 2004; FAO/OIE, 2004).

**Table 1: Major Trans-boundary Animal Diseases**

Disease	Animals affected	Regions with major incidence
Foot-and-mouth disease (FMD)	Cattle, buffalo, sheep, goats and pigs	Parts of Africa, Middle East and Asia
Peste des petits ruminants (PPR)	Sheep and goats	Africa, Middle East and Asia
Classical swine fever (CSF)	Pigs	South and South-East Asia
African swine fever (ASF)	Pigs	Sub-Saharan Africa, West Africa, parts of Europe and Latin America
Blue tongue (BT)	Sheep, cattle	Australia, USA, Africa, Middle East, Asia and Europe
Rift Valley Fever (RVF)	Sheep, cattle and goats	Africa
Contagious bovine pleuropneumonia (CBPP)	Cattle	Eastern, Southern and West Africa, parts of Asia
Lumpy skin disease (LSD)	Cattle	Africa
Bovine spongiform encephalopathy (BSE)	Cattle	UK and other parts of Europe
Newcastle disease (ND)	Poultry	Asia and Africa
Highly pathogenic avian influenza (HPAI)	Poultry	Asia, Europe and Africa

Source: ( FAO, 2004).

## **Distribution of major trans-boundary animal disease in the world**

TADs are easily transmitted from one country to another, due to the rapid globalization including the increase of international trade in domestic and wild animals and animal products, to the expansion of human population, global climate changes, changes of agricultural production systems, and to microbiological adaptation. The common ways of introduction of animal diseases to a new geographical location are through entry of live diseased animals and contaminated animal products. Other introductions result from the importation of contaminated biological products such as vaccines or germ plasm or via entry of infected people (in case of zoonotic diseases). Even migration of animals and birds, or natural spreading by insect vectors or wind currents, could also spread diseases across geographical borders (FAO, 2008).

International trade in live animals and animal products offers opportunities for pathogens and vectors to be transported across oceans and continents. However, with the exception of a few documented examples, such as, the multiplicity of routes of introduction, including active and passive dispersal of vectors, infected human, animal movements and migration, transportation of goods and biological invasions such as, introduction, initial dispersal, establishment and spread, the specific contribution of globalization to disease emergence is inherently difficult to quantify (Lanciot *et al.*, 2004).

## **Prevention and control of TADs**

The whole purpose of veterinary services is to prevent, control and eradicate livestock diseases so that the health and productivity of the livestock resource is reliably protected and the socio-economic loss they incur is effectively minimized. For any disease that is known to be present in a country, the ultimate aim of the control programme should be defined from the outset. Although eradication has traditionally been the goal for many disease control programmes, it may not always be achievable within a reasonable timeframe or at an acceptable cost. For some diseases, especially for TADs eradication may not be economically or practically feasible, and options for sustained mitigation of disease impacts may be needed (McLeod and Leslie, 2000).

The primary goals of any control programme against trans-boundary disease are to establish the 'optimal' level of disease presence to meet a country's goals, and then choose the most cost-effective way to achieve that level of control. For instance, a policy of disease freedom is a high standard that can impose significant costs on a country. The 'optimal' level of control can vary from one country to another, depending on the results of analysis and will change over time as production systems and control options evolve. The primary responsibility to control the spread of animal disease belongs to both the country of origin and the receiving country. Both face burden of elaborate quarantine systems, as well as a risk of production losses and worse if introductions occur. The majority of control measures are aimed at preventing the entry and/or spread of a disease agent when a human action such as trade or travel or natural contagion can carry an organism into a previously unaffected location (McLeod and Leslie, 2000).

Prevention is the best policy for avoiding the occurrence of disease whenever and wherever this is possible. However, some diseases do not have reliable means of preventing as their mode of transmission and spread is either unknown or difficult to control. Although there is apparent control and check for International Animal Health Certificate and International Sanitary Certificate at legal entry points for avoiding the incursion of exotic diseases, the possibility of clandestine entry of animals and animal products across the long borders of the country cannot, at least at the moment, be guaranteed as border control for TADs is also not very strong in this large country with rugged terrain (Domenech *et al.*, 2006).

When control of animal movement is used as one of the arms of an effective control of TADs, it should be implemented in a very careful and strict manner. The major arm of disease prevention and control in Ethiopia for some time to come, therefore, is applying quarantine measures whenever a TAD of internal or external origin is detected and ring immunization/vaccination supported by other sanitary and bio-security measures, implying the necessity of emergency planning and preparedness for tackling such events. The National Veterinary Institute (NVI) is, therefore, responsible for producing most of vaccines for animal diseases required for any emergency and for regular local consumption and has the capacity for producing surplus for export (EAHY, 2010).

Disease control in Ethiopia is also dominated by prophylaxis, but chemoprophylaxis and chemotherapy have wider roles. While selected diseases are planned and coordinated by the Federal Government with collaboration and support of Regional Authorities, the bulk of animal disease and other animal health problem control activities are performed by local public veterinary clinics with nationally planned and executed disease control activities (Gulima, 2010).

### Challenges in dealing with TAD

TADs are permanent threat for livestock keepers. They have major economic implications: both through the private and public costs of the outbreak, and through the cost of the measures taken at individual, collective and international levels in order to prevent or control infection and disease outbreaks. Several challenges confront the strategies to combat TADs (FAO, 2008; Hitchcock *et al.*, 2007). The major ones are presented below:

- Requirement of novel systems having capacity of real-time surveillance of emerging diseases For this, need driven research and service oriented scientific technology are a necessary at regional levels. Research emphasis has to be on specific detection and identification of the infectious agents;
- Need for epidemiological methods to assess the dynamics of infections in the self and neighboring countries/regions. These methods should be of real-time utility;
- Need for research and development of disease diagnostic reagents those do not need refrigeration (cold chain). More importantly, they should be readily available as well as affordable, for use in pen-side test format;
- There are many diseases for which there is inadequate supply of vaccines or there are no vaccines available. Insufficient or lack of vaccine hampers the disease control programs. Need to build up vaccine banks for stockpiling the important vaccines to implement timely vaccination;
- Required availability of cost-effective intervention or disease control strategies. Even if a technology is available, it has to be cheaper to adopt at the point of use;
- Need for ensuring public awareness of epidemic animal diseases. Many farmers are unaware of the emerging diseases. As such, unless reported to concerned regional authority, an emerging disease may go unnoticed;

- Shortage of government and private funding for research on emerging animal disease problems. Government as well as industries dealing with animal health should take initiative and appropriate sponsorship in this regard, and;
- Inadequate regulatory standards for safe international trade of livestock and livestock products. Otherwise, there would be a compromised situation in disease control strategies

### Trans-boundary animal diseases in sub-Saharan Africa

Livestock plays a key role in the agricultural economy of many countries in sub-Saharan Africa, contributing over a quarter of the total value of agricultural production. In addition to providing food, income, employment and foreign exchange earnings, livestock serves as a source of wealth and supplier of inputs and services such as draught power, manure and transportation. Despite these important roles, the growth in livestock productivity in sub-Saharan Africa has been below that of other developing region (Tambi *et al.*, 2000; Otte *et al.*, 2004).

The present international approach to management of trans-boundary animal diseases (TADs) is based on the assumption that most can be eradicated; consequently, that is the usual objective adopted by international organizations concerned with animal health (Thomson *et al.*, 2003). However, for sub-Saharan Africa and southern Africa more particularly, eradication of most TADs is impossible due to a various technical, financial and logistical reasons such as increased outbreaks of trans-boundary animal diseases (TADs), droughts and market issue (Thomson, 2009).

### Distribution of major trans-boundary animal disease in Ethiopia

With over 43 million head of cattle, Ethiopia has the largest herd in Africa. Livestock is central to the Ethiopian economy, contributing for 20% of the GDP, supporting the livelihoods of 70% of the population and generating about 11% of annual export earnings (SPS-LMM, 2010). In Ethiopia there are numerous records of the presence of major TADs. Rinderpest has been eradicated and many other endemic diseases are put under considerable control, there are still some serious trans-boundary animal diseases (TADs), such as CBPP, CCPP, FMD, LSD, AHS, PPR and ND which are limiting the productivity and international trade of livestock and their products (FAO, 2008).

Disease such as PPR, Marek's disease, Gumboro and Maedi-visna were exotic to the country until some 15 years ago but now common finding in indigenous livestock population (FAO/OIE, 2004). FMD is one of the major diseases in Ethiopia that hampering export of livestock and livestock products to the Middle East and African countries; the Egyptian trade ban of 2005/2006, in which Ethiopia lost more than US\$14 million (Leforban, 2005).

Ethiopia set a target to increase exports of meat products to 30,000 tons by 2008 and eventually to 80,000 tons, most of which will need to be derived from cattle. However, Ethiopia has many endemic livestock diseases, including FMD that limit market access. Nonetheless, there is increased discussion in policy circles about developing appropriate certification systems to facilitate meat exports, particularly beef. While proposed certification systems would both comply with the minimal disease risk principles advocated in commodity based trade (CBT) circles and credibly deliver disease-free products that meet current trading standards, they might also limit competitiveness in international markets by virtue of high feeding costs associated with improving quality. Indeed, with or without certification systems, Ethiopia remains in the "murky middle" from the standpoint of competitiveness in third markets. At present, Ethiopia is neither cost-competitive with low value suppliers to African markets such as India and Brazil nor is it competitive (with an SPS-certified, higher quality product) in higher value markets in the Middle East (Rich *et al.*, 2009).

### **Trade and economic impacts of trans-boundary animal disease**

TADs impose major social and economic costs and risks to infected countries, their neighbors, and trading partners. The varying impact of TADs among stakeholders and the threat to existing and potential trade in wealthier countries complicates the question of appropriate control. For all livestock producers, the threat of TADs increases the risk of lost production and impacts on livelihood, increasing vulnerability to poverty particularly for small-scale producers. Foot and Mouth Disease (FMD) is one of the major endemic trans-boundary livestock diseases of socio-economic importance in Ethiopia and in other parts of the globe. The impact of foot and mouth disease (FMD) in Asia in 1996 in terms of loss of feed sales alone has been estimated at more than USD 500 million; persistent contagious bovine

pleuropneumonia and African swine fever continue to cause high economic damage to ruminant producers in Sub-Saharan Africa. The impact of TADs and of their control varies depending on the pathogenicity of disease, number of animals at risk, dependency on livestock for livelihood, and method of control (Otte *et al.*, 2004).

The socio-economic significance of PPR is a result of heavy losses at production level and market effects along the value chain. It is estimated that 10% of the total impact of the disease is on trade and public expenditure and 90% on herd productivity (DFID, 2001-2002).

In Nigeria, an outbreak that occurred in 1979 killed 10-20% of the national small ruminant flock that was estimated at US\$ 75 million (Wakhusama *et al.*, 2011). In Ethiopia, FAO estimated that losses associated with PPR reached an average of US\$ 375 per flock per year with an average of 143 small ruminants per flock (an average loss of more than US\$ 2 per animal) (Wakhusama *et al.*, 2011). They reduce productivity on a clinical and sub-clinical level. They cause production losses such as reduced weight gains, impairing growth, lowered milk and meat production, high veterinary costs and mortalities, especially in the young (Swai *et al.*, 2009).

Livestock and livestock products export trade with Middle East and North Africa (MENA) countries are important source of foreign exchange earnings for Ethiopia. In Africa, rinderpest occurred largely in pastoral settings, where value chains are dispersed over large areas and replete with many informal sector actors and market transactions. The implication is that market impacts associated with rinderpest are potentially quite complex and nuanced, with a multitude of small, low-income informal service providers affected. The presence of Rift Valley fever in neighboring countries and the widespread distribution of FMD in the country are threatening the trade. The 2001/2002 outbreak of Rift Valley fever (RVF) in Saudi Arabia resulted in a ban on livestock imports from the Horn of Africa to the entire Arabian Peninsula (Admassu, 2009; Davis, 2006). The ban was lifted in 2007 after extensive efforts by national, regional and international institutions succeeded in building capacity for the flow of livestock, with the necessary measures for the exclusion of known trans-boundary animal diseases (Yehia, 2009).

### **Economic impacts**

Trans-boundary animal diseases (TADs) cause significant economic losses throughout the world. But producers in less developed countries (LDCs) are at particular risk because livestock provide not only income and an asset base, but also food, draught power and various social functions (Rich and Perry, 2011). Trans-boundary diseases threaten food security, affect livelihoods of rural communities and disrupt local and international trade (Otte *et al.*, 2004).

As a result of the emergence and re-emergence of various animal diseases, such as bovine spongiform encephalopathy (BSE), the annual growth of meat products decreased 2% in the late 1990s (Morgan and Prakash, 2006). Therefore, the cost of trans-boundary animal diseases relates to agricultural products, to the country's economy and international markets are massive. Thus, it is very important to create public policies focused to assure countries' food security (especially in developing nations) to avoid negative economic impacts caused by TADs, especially on the more susceptible social stratus. The World Bank has estimated that zoonotic disease outbreaks in the past 10 years have cost worldwide more than \$US200 billion due to loss of trade, tourism and tax revenues (Okello *et al.*, 2011).

Pests and animal diseases cause the loss of more than 40% in the global food supply, being a clear threat to the residual economies of developing countries and food security of its inhabitants (FAO, 2009). Many economic impacts are difficult to quantify, and valuation also may be problematic. Such factors as animal welfare, human health, and the environment are of obvious importance, but do not have market values, and different people have different perceptions of their value. It is therefore impossible to provide objective assessments of the total cost of most animal diseases, especially the most serious ones that have wide-ranging effects. But the cost of animal disease can be enormous (Paarlberg *et al.*, 2007).

### **Public health significance**

Nearly 75% of infectious human diseases had their origins in animals. Many of them have adapted in humans with efficient human to human transmission, while others still remained zoonotic with frequent transmission from animals to humans. Such zoonotic transmission of diseases have increased in recent years, perhaps due to increasingly intensive livestock

production in areas of proximity to human populations and loss of habitats of wildlife. Most of these are considered as emerging pandemic threat. An emerging zoonotic disease may affect humans accidentally and sporadically, but also may adapt sufficiently to human host to cause a deadly epidemic or pandemic in the immature human host population (Anand and Hanson, 2006).

Apart from public health concern the economic consequence of a human pandemic could be huge. Public health authorities in industrialized countries have been faced with an increasing number of food safety problems. The situation is equally serious in developing countries. In addition to known food-borne diseases, public health communities are being challenged by the emergence of new or newly recognized types of food-borne illnesses, often with serious health and economic consequences (Cutler *et al.*, 2010).

The exports of smuggled wildlife products and derivatives have an alarming effect on the introduction of many trans-boundary diseases, also affecting human beings and the entire ecosystem. Among these, the diseases of viral and prion origins like Avian flu and monkey pox are prominent having tremendous zoonotic potential. The disability-adjusted life years (DALYs) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death. Infectious diseases also lead to compromised health and disability, accounting for nearly 30% of all DALYs worldwide (Fauci *et al.*, 2005).

## **3 Conclusion and Recommendation**

Trans-boundary animal diseases (TADs) are highly contagious and transmissible diseases of livestock in the world, which have the potential for very serious and rapid spread, irrespective of national borders. Trans-boundary animal disease has serious socio-economic or public health consequence and they are important disease in the international trade of animals and animal products.' TADs includes those that are zoonotic (infective to humans) such as Rift Valley fever, bovine sponge form encephalopathy, bovine tuberculosis, and highly pathogenic avian Influenza and other important disease such as foot and mouth disease, contagious bovine pleuropneumonia, lumpy skin disease, African swine fever and Newcastle disease. Those diseases are spread easily due to the rapid globalization including the increase of

international trade in domestic and wild animals and animal products, to the expansion of human population, global climate changes, changes of agricultural production systems, but commonly they transmitted through entry of live diseased animals and contaminated animal products. Trans-boundary animal disease are challenging disease to dealing with, due to absence of driven oriented research, absence of vaccination programs, lack of farmers awareness about those disease and inadequate regulatory standards for safe international trade of livestock and livestock products.

Based on the above conclusions, the following recommendations are forwarded:-

- Reducing man-made disasters that have adverse implications on global warming and climate change since they are likely to predispose the animal population to newer infections.
- Controlling disease transmitting vectors, minimizing the movement of animals across the borders and prompt practice of quarantine are necessary to prevent the spread of those diseases.
- Establishing regional biosecurity arrangement with capacity for early disease warning system for surveillance, monitoring and diagnosis of emerging disease.
- Strengthening government policies to enhance agricultural/animal research and training.

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There is no any conflict of interest among the authors.

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