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## Animal health information system for international livestock trade and risk quantification: A review

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### Abstract

Animal health information system is the systematic collection, analysis, and reporting of diseases and health-related information. Organized and efficient animal disease surveillance and monitoring systems provide timely and good-quality information for early detection, dissemination of information, and contribute to the planning, implementation, and evaluation of risk mitigation measures. Many diseases having significant economic and public health consequences are the major barriers in the international trade of livestock and animal products. International trade of livestock and their products can contribute to the introduction of transboundary diseases, the maintenance and spread of endemic diseases. Many countries are banned from exporting livestock, meat, and other products to international markets due to the presence and prevalence of different trade-limiting diseases. International animal health standards designed to facilitate safe trade in livestock and livestock products are set by OIE. Risk quantification is a method of evaluating the potential effects of the identified risk (animal disease) associated with international trade and food safety. Animal Health Information System is a basic requirement in defining the probability of occurrence of the disease risk and the magnitude of the consequences. Ethiopian animal health information system is poor, unorganized, and based on a manual system for a long period of time; covering only a few parts of the country. However, currently, the Ethiopian Animal Health Information System shows improvements in that it builds a web-based system of reporting and attempts to employ modern data collection applications, which include Disease Outbreak and Vaccination Activities Report and Animal Disease Notification and Investigation System. The weaknesses in the surveillance and monitoring systems in Ethiopia failed to detect and quantify risks and resulted in different outbreaks of infectious diseases. The country's livestock export is very low due to stringent animal health requirements and repeated bans. Ethiopia shall establish an efficient disease surveillance and monitoring system using more advanced modern technologies to improve disease detection and avoid international trade sanctions. Furthermore, factors limiting disease surveillance and reporting should be identified, evaluated, and managed to establish an efficient animal health information system.

**Keywords:** Animal health information system, Ethiopia, international trade, livestock, surveillance and monitoring

### 1. Introduction

Animal health information systems are systems into which information and data relating to animal health and disease are gathered, collated, and analyzed into meaningful and useful forms which can then be used for disease monitoring, early warning, or decision-making purposes. Animal health data collection and information management systems are essential tools in the control of disease and veterinary services management. Animal health information systems operate at different levels (national, regional, and global) and their principal purpose, inputs, and outputs vary depending on the level at which they are used (OIE, 2018) [20].

International and cross-boundary trade of live animals, animal products, and byproducts can contribute to the introduction of exotic diseases, the maintenance and spread of endemic diseases. International animal trade is conducted between continents and among several countries for marketing different species of animals needed for breeding, fattening, sports, companionship, conservation, and slaughter (Hardstaff *et al.*, 2015) [8]. Every year, millions of live animals and animal products are transported between countries; creating opportunities for communicable diseases to be spread across countries and continents. Animals with sub-clinical infections may go unnoticed, providing an opportunity to transport disease to different regions. Live animal trade complicates tracing the origin of any disease outbreak that may occur due to an infected animal being displaced (Di Nardo *et al.*, 2011) [4].

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Risk quantification is the process of evaluating the potential effects (economic and public health impacts) of animal disease related to international trade and food safety. Animal Health Information System is a key in determining the probability of an adverse event and the magnitude of the consequences (Stark and Salman, 2001) [24]. The effective containment and control of epidemic diseases depends on early notification of disease events or outbreaks, and the capacity to forecast the spread of pathogens to new areas. Early warning of animal disease outbreaks with a known economic and zoonotic potential enables mitigating the effect of the disease on production and health. Surveillance and control programs at the national level are needed for the early detection and control of infectious disease outbreaks (Schirdewahn *et al.*, 2021) [23].

Ethiopian animal health information system is poor, unorganized, and based on a manual system for a long period of time; covering only a few parts of the country. However, currently, the Ethiopian Animal Health Information System shows improvements in that it builds a web-based system of reporting and attempts to employ modern data collection applications. However, the system is inadequate in detecting and quantifying the risk of diseases, which results in sanctioning the country from exporting livestock, meat, and products to international markets (LDMSP, 2007; Jibat *et al.*, 2018) [13, 12]. Timely and good-quality information about disease events is needed in order to understand the disease situation, support decision-making, prevent potential disease incursion, and respond quickly to the occurrence and distribution of diseases by implementing the appropriate disease control measures (Struchen *et al.*, 2015) [26].

There are different methods and tools for collecting information about animal health at national, regional, and global levels that have made significant contributions to the timely reporting of animal disease events, and to analyzing animal disease drivers and patterns of transmission and spread. Animal health information system is the basic foundation for the detection of disease risks, assessment of existing levels of disease, and evaluation of the effectiveness of control measures. Moreover, such systems enable the quantification of risks and assess the consequences of disease risks related to international livestock trade. Therefore, this review is concerned with determining the major contribution of animal health information systems for international livestock trade and risk quantification.

#### **Therefore, the major objective of this paper is:**

1. To review Animal Health Information System for International Livestock Trade and Risk Quantification
2. Specific objectives include
3. To recruit the major significances and applications of animal health information systems for international livestock trade and risk quantification
4. To highlight the status of the Ethiopian animal health information system

## **2. Animal health information system for international livestock trade**

### **2.1 International Livestock Trade**

Livestock trade is an effective way of introducing, maintaining and spreading many infectious animal diseases across countries. As animal diseases continue to spread around the world, they also become a burden to the global economy and even threaten to disrupt food supply chains. It

has been estimate that around 20% of production losses worldwide can be attributed to animal diseases (Di Nardo *et al.*, 2011) [4].

International trade in livestock and livestock products continues to be seriously hindered by epizootic animal diseases, in particular those categorized as, trans-boundary animal diseases" (TADs). These diseases have a substantial impact on the economies or food security of a number of countries, spread rapidly and require cooperation between countries for effective control. Zoonotic potential is a further important factor in the categorization of TADs (Thomson *et al.*, 2003) [28]. Movement of animals with clinically in-apparent infection (latent or asymptomatic infections) enables disease to spread to wherever the animal travels or where the necessary vectors may be present. Particularly in the case of epidemic diseases where the reduction of time from introduction of a hazard to its detection can enable early response and thereby lead to a reduction in intervention costs to contain an outbreak, so that effective surveillance is critical (Howe *et al.*, 2013) [11].

Disease reporting systems are based on reporting of animal health-related events to the Veterinary Authority. Data derived from disease reporting systems can be used in combination with other data sources to substantiate claims of animal health status, to generate data for risk analysis or for early warning and response. Effective laboratory support is an important component of any reporting system. Risk-based methods should be based on a risk assessment and are useful to optimize the use of surveillance resources (Salman, 2003) [22].

### **2.2 Surveillance Systems**

Animal health surveillance includes the systematic, continuous or repeated, measurement, collection, collation, analysis, interpretation and timely dissemination of animal health and welfare related data from defined populations, essential for describing health hazard occurrence and to contribute to the planning, implementation and evaluation of risk mitigation measures (Hoinville *et al.*, 2013; Doherr and Audige, 2001) [10, 5].

Disease surveillance addresses aspects of the occurrence and spread of disease that are pertinent to disease control. Disease surveillance is therefore more focused than surveillance in general, which, for instance, may include recording of the distribution of agent and vectors, and serological 'imprints' of past infection. Monitoring is the routine collection of information on disease, productivity and other characteristics possibly related to them in a population. Surveillance, in contrast, is a more intensive form of data recording than monitoring, and has three distinct elements: gathering, recording and analysis of data; dissemination of information to interested parties, so that: Action can be taken to control disease (Thrusfield, 2005) [30].

Surveillance may be based on many different data sources and can be classified in a number of ways (OIE, 2010) [19], including:

1. The means by which data are collected (active versus passive Surveillance);
2. The disease focus (pathogen-specific versus general Surveillance); and
3. The way in which units for observation are selected (structured surveys versus non-random data sources).

### **2.3 World Animal Health Information System (WAHIS)**

World Animal Health Information System (WAHIS) of the Office International des Epizooties (OIE) ensures the prompt dissemination of information on potentially devastating

outbreaks and facilitates decision making in terms of international trade of animals and animal products by collecting, verifying and publishing official animal health information, following a standardized process, thus providing high quality, reliable data (OIE, 2021) [21]. Animal Health Information System is the proper collection and recording of information on diseases and health attributes so as to identify diseases risks in the respective country, which can be used as the basis for determining diseases risk through international market of live animal and animal products from that country (Thomson *et al.*, 2004) [29].

The OIE-World Animal Health Information System (OIE-WAHIS) which comprises three essential elements (OIE, 2018) [20]:

- An early warning system for the immediate management of alert notices for OIE-listed diseases and emerging diseases.
- A monitoring system to manage six-monthly information updates on all OIE-listed diseases.
- Further information provided by National Authorities through annual reports on animal diseases affecting human populations; animal populations and Veterinary Service capacities, such as personnel, laboratory capacity and vaccine production.

### 3. Animal health information system for risk quantification

#### 3.1 Risk Quantification

Risk quantification in veterinary medicine is the process of evaluating the disease risks that have been identified and developing the relevant data that will be needed for making decisions for the management of the disease; evaluating disease risks and risk interactions to assess the range of possible outcomes. Each risk must be quantified to determine the probability that the disease will occur, and to measure of the consequence of the disease. This consequence might be a cost in currency, or a cost in time, or both (Nogueira and Machado, 2014) [18]. In risk quantification and assessment, data from monitoring and surveillance systems are used throughout the risk assessment process in identification of the disease risk, estimation of potential impacts and the selection of appropriate management strategies (Stark and Salman, 2001) [25].

Animal Health Information Systems such as disease monitoring and surveillance are the potential source of input data for risk quantification and assessments process. The risk assessment process comprises hazard identification, release assessment, exposure assessment and consequence assessment (Stärk *et al.*, 2006) [11]. The process needs for good quality data input and are promoting monitoring and surveillance systems as crucial in providing early warning of animal disease outbreaks and enabling national authorities to inform farmers and other populations at risk of measures for the prevention and control of threats, and to prepare and develop mitigation strategies that minimize the risk of the introduction and spread of animal health threats. In many developing countries, the capacities of veterinary service and personnel to conduct risk assessments in a timely and systematic manner are limited or lacking (FAO, 2021) [7].

#### 3.2 Office International des Epizooties (OIE) Standards

Office International des Epizooties (OIE) and World Trade Organization (WTO) have sets and promoted risk

quantification and assessment as a scientific framework in the international trade and the food safety. Each country planning to export live animal or any animal products have to provide information on its animal health surveillance and information system (International Animal Health Code) (OIE, 2018) [20].

The OIE's international standards improve the health and welfare of animals throughout the world by identifying and evaluating risks. Animal health surveillance and information systems are the basis for an overall risk estimation, or likelihood, for importation of the hazard through animal commodities from the exporting country (OIE, 2021) [21]. Quantifying the risk of disease introduction and its consequence are the timely and resource intensive process, important to identify a critical regulatory concern that enables a risk management. Risk quantification and assessment help the early detection/reaction of health and disease risk, breaking disease transmission cycles, and allow regional/international cooperation (Hitchcock *et al.*, 2007; FAO, 2004) [9, 6]. Adequate recording and exchange of disease/animal health information among national and regional organization provide proper quantification of risks, thereby mitigating the risk (Beckham and Holmstrom, 2015) [3].

### 4. Ethiopian animal health information system

Ethiopia is endemic to a number of livestock diseases which continue to deter livestock productivity and agricultural development. The impact of animal diseases stems from direct losses due to mortality and its indirect effects through slow growth, low fertility and decreased work output that result from morbidity (Tadesse and Sultan, 2014) [27]. The high burden of livestock disease combined with limited infrastructure, poses significant challenges for animal productivity in the country. Animal diseases also have an important impact on human health, with 60% of human diseases being of animal origin. Ethiopia is endemic to a wide range of such zoonotic diseases (Bayissa *et al.*, 2011) [2].

#### 4.1 Existing Surveillance System and its Status

Ethiopian animal disease surveillance and reporting system is poor, irregular and based on manual system; with only about 30–35% of districts submitting disease outbreak reports each month. It is very low that covers below 5% for pastoral and agropastoral areas. Moreover, the sensitivity, specificity and timeliness of the reports are very low (LDMSP, 2007) [13]. Protecting animal and human health requires adequate disease recording and reporting system to allow appropriate action to be taken to mitigate potential risks quickly and effectively. Surveillance systems and animal disease monitoring more generally are a major component of diseases control and risk mitigation systems. Timely and accurate surveillance data at regional and national levels are therefore critical to support continuous improvements in animal health and in detecting outbreaks of diseases, including emerging and zoonotic diseases (Jibat *et al.*, 2018) [12].

The weaknesses in veterinary surveillance systems in Ethiopia have resulted in different outbreaks of infectious diseases such as Foot and Mouth Diseases (FMD), Contagious Bovine Pleuropneumonia (CBPP), Newcastle Disease (ND and Peste des Petits Ruminants (PPR). Conventional passive surveillance has proven largely ineffective due to poor capacity and compliance, and is not able to sustain active surveillance activities. As the result, public veterinary

services and the commercial livestock sector are unable to detect and respond in a timely fashion to outbreaks of new disease threats, nor to manage successfully the control of trans-boundary diseases, which remain endemic in the country (Metaferiya *et al.*, 2021) <sup>[14]</sup>.

Ethiopian livestock and livestock products export are very minimal as compared to the national potential as a result of stringent animal health requirements and repeated bans. Even though, there is a substantial demand for Ethiopian meat and livestock from potential importing countries, exporting animals and animal products to those markets often face impediments due to insufficient animal health information system (MOA, 2010) <sup>[15]</sup>. The presence and prevalence of a number of trade-limiting trans-boundary livestock diseases has denied the country access to international market and makes it vulnerable to trade bans. As many countries rid themselves of infectious animal diseases, and as international trade and travel intensify, these health threats are of increasing concern to Ethiopian trading partners (Jibat *et al.*, 2018) <sup>[12]</sup>.

#### **4.2 New initiative of Ethiopian National Surveillance System (NADDS)**

Currently, Ethiopian Animal Health Information System shows improvements that it builds a web based system of reporting and attempt to employ modern data collection applications. The new Ethiopian National Surveillance System (NADDS) has two components, which include Disease Outbreak and Vaccination Activities Report (DOVAR) and Animal Disease Notification and Investigation System (ADNIS) (MoA, 2015) <sup>[17]</sup>.

##### **4.2.1 Disease Outbreak and Vaccination Activities Report (DOVAR)**

DOVAR is a web-based surveillance system which has five main components (modules) namely data entry and retrieval module, administration module, report management module, laboratory investigation module, and municipal abattoir module. These are electronic version forms designed for collecting monthly disease outbreak and investigation data, laboratory investigation and findings and municipal abattoir data entry. The application saves data collected to database. It operates on a browser with an internet-enabled computer for all operating system. The purpose of this Surveillance System is to collate monthly-based animal disease outbreak data from a wide range of government institution's monitoring programs to provide an overview of animal health in Ethiopia (MoA, 2015) <sup>[17]</sup>.

Upon detection of disease outbreak at district level, information is sent by animal health personnel to relevant regional laboratories by means of convenient medium to get laboratory support. This information could also be shared to national veterinary laboratory for the same purpose. At this point a reference number is given to the outbreak which helps its identification and subsequent follow up until the result is issued. Then, at the end of the month a paper-based disease outbreak reports is filled in three copies by district animal health personnel which is sent to regional laboratory. Once the reports reached at regional laboratories the information is entered into the system after a meticulous assessment for correctness and validity. The system is also collects disease outbreak information from the municipal abattoir (MoA, 2015) <sup>[17]</sup>.

##### **4.2.2 Animal Disease Notification and Investigation System (ADNIS)**

ADNIS is second component of NADDS, with a smart phone-based mobile data collection system used by field staff to immediately notify decision makers of the suspected occurrence of one of the target diseases. The purpose of this rapid notification is to promote a quick response in the form of investigation and implementation of appropriate control and preventive measures. It is a real-time capture of field observations of animal disease symptoms (syndromes) from animal health personnel and secondary information received from farmers, community animal health workers (CAHWs), pastoralists and other community members. It is very important to provide timely information on animal disease to all relevant national bodies thereby triggering action as to contain the progress of the disease before it causes considerable negative impact along the livestock value chain (MoA, 2014) <sup>[16]</sup>.

#### **4.3 Surveillance Actors**

The main actors of Surveillance at the federal level are the Epidemiology Directorate of the Ministry of Agriculture (MoA). The main components include National Animal Health Diagnostic and Investigation Centre (NAHDIC) currently Animal Health institute (AHI), Regional laboratories, National Veterinary Institute (NVI), and National Tsetse and Trypanosomiasis Investigation and Control Institute (NTTICI). The Epidemiology Directorate is charged with overall guidance of surveillance activities and central animal health data collection, collation, analysis and dissemination of information (MoA, 2014) <sup>[16]</sup>. The NVI is mainly involved with production of vaccines required for domestic consumption and for export, but also supports diagnostic and surveillance programs for emergency preparedness, disease prevention, control and eradication. The NTTICI is responsible for the surveillance of tsetse-borne and non-tsetseborne trypanosomiasis and related problems and with devising appropriate tsetse and trypanosomiasis control and eradication strategies (AHY, 2012).

The NAHDIC provides referral diagnostic services, conducts and coordinates animal health surveillance activities, Animal health research, Technical capacity building and support of regional state veterinary laboratories, and delivers referral diagnostic services (MoA, 2015) <sup>[17]</sup>.

#### **5. Conclusion and Recommendations**

The establishment of an efficient animal health information system creates an effective platform for the identification and management of animal diseases. The current increasing movement of human population, livestock, and livestock products within and across countries resulted in a higher risk of transmission of diseases having significant economic and public health significance across continents and countries. As international trade in livestock and animal products is the potential means of distributing diseases, particularly transboundary diseases, among different countries; the development and efficiency of disease surveillance and monitoring systems must be evaluated before importing from those markets. The application of organized disease surveillance and information systems provides relevant data for risk quantification and assessment that will ultimately support risk management and implementation of risk reduction measures. Ethiopian animal health information



system is inefficient even if currently, the Animal Health Information System shows improvements in that it builds a web-based system of reporting and attempts to employ modern data collection applications, which are insufficient for detecting risks and controlling diseases. This in turn resulted in the banning of the country from exporting livestock, meat, and animal products to international markets. Organized efforts and advanced inputs are required to establish an efficient surveillance and disease reporting system.

Based on the aforementioned conclusion, the following points are recommended:

- Efficient animal health information systems should be established to ensure integrated diseases reporting, early detection and rapid containment.
- International markets of animal and animal products must consider the diseases surveillance and monitoring systems of the exporting country.
- Risk quantification and assessment should be conducted based on appropriate data before importing live animals and animal products.
- Ethiopia must establish organized animal disease surveillance and monitoring system for improving the capacity of diseases detection, control and eradication; to avoid international trade sanction in livestock and their products.
- Further researches are required in advance of the current status of Ethiopian animal health information system.

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