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Analyzing Economic Impacts of Animal Diseases: Methods and Approaches

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Abstract

Animal diseases pose a major impediment for a flourishing livestock sector in meeting the increasing global demand for livestock products. An economic analysis of the impacts of animal diseases, if accurately formulated and estimated, will provide an invaluable basis for policy directions and budgetary allocations, research direction and extension of effective animal disease prevention and control technologies and practices. The analysis of economic impacts due to animal diseases is assessed through its major sources of impacts *viz*., direct effects of the disease, costs incurred on control and preventive measures and other externalities like market disruption and effects beyond the livestock sector. The level of impact is also affected by the context such as production system, social system, food system and economy. The impact is felt at every level starting from the smallholders, large commercial producers, pastoralists, retailers, processors and consumers. A carefully crafted animal disease programme or policy will provide tremendous benefits in terms of food security, poverty alleviation and general economic welfare.

Keywords: Animal diseases, Economic analysis, Economic impacts, Livestock

Introduction

Livestock production make up over 40% of the total value of agricultural production worldwide. With increasing average income, urbanization and population growth, the demand for livestock products, such as meat and milk, is estimated to increase by 63 and 53% in 2050 (Kappes *et al.*, 2023). The increase is reportedly more pronounced in developing countries which are increasingly accounting for more proportion of the global livestock production during the last decade. However, livestock disease poses threat to the livelihood of commercialized animal farms as well as smallholder farms. Worldwide, 1.3 billion people depend on animals for their living and 300 billion US dollars is lost to animal diseases in livestock (Anonymous, 2025). Losses in production due to death and culling of animals cause price distortions due to the shortage of supply. After the African Swine Fever (ASF) outbreak of China in 2018, roughly 150-200 million pigs were slaughtered, which caused a price hike by 30-40% and the total economic loss was estimated to be 111.2 US dollars (You *et al.*, 2021). The Avian Influenza, which is a highly contagious viral disease, has become animal pandemic, having been reported in over 108 countries over the five continents with huge economic and health consequences. The zoonotic potential of many animal diseases is also one of the greatest concerns which effectively drives preventive and control measures. Government has to allocate scarce resources for the control and preventive measures of animal diseases with extensive economic impact. Farmer producers, consumers and other market players also have to bear the brunt of market disruptions caused by animal disease outbreaks.

An economic analysis of the impact of animal diseases is essential for planners and policy-makers, researchers and extension functionaries for various reasons. Planners and policy-makers particularly have use for economic analysis of animal diseases to know the animal diseases having greatest impact on the economy. This can help in directing the public policy regarding the particular disease or in

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allocating the scarce public resources/ budget. It also helps in assessing the economic viability of a proposed policy of the government to control an animal disease or to compare alternative approaches. Researchers and funding agencies use economic analysis of animal diseases in planning animal health research for designing technologies and methods to control animal diseases. Extension functionaries need it to determine the suitability of disease management practices and technologies for livestock farmers in a particular region or food system. They provide advisories and training to farmers regarding new technology or approach for managing animal diseases.

General Framework of Economic Impact Analysis vis-à-vis Animal Diseases

The economic impacts of animal diseases are most appropriately measured by collecting primary data through surveys especially designed for the purpose. However, due to its costly and time consuming nature, secondary data from published sources such as reports are also often used to draw information which are used to arrive at estimates using statistical and economic models. Many frameworks and approaches using various economic modelling and tools are being applied for economic analysis of animal diseases. The impact of an animal disease can be assessed from different perspectives of the stakeholders.

- For livestock farmers, traders, processors and retailers of animal products, animal disease may represent a threat to livelihood.
- Providers of animal health services and the suppliers of products such as vaccines and drugs may see an animal disease as a source of revenue and sales.
- To consumers, animal disease acts as a threat to their health, increase in food prices and disrupted food supply.
- Travel restrictions due to the presence of animal diseases adversely affect tourism and trade.

Identifying the sources of impact, such as loss in production and productivity and costs of disease control measures prove to be simple and comprehensive approach while assessing the economic impact of animal diseases. The following sources of impact, as affirmed by FAO (2016), are used for the discussion:

- *Disease Effects*: The loss in production due to mortality or decrease in productivity of the diseased animals.
- *Market Disruption*: Consumer fears, shortage of supply and restrictions on trade in livestock and livestock products causes market disruption.
- *Control Measures*: The impact of measures undertaken by farmers, government and other stakeholders for control and prevention of disease outbreak in terms of the costs and benefits.
- *Effects beyond the Livestock Sector*: The carry over effect of animal diseases are felt in other sectors like the public health system, tourism sector and wildlife.

The extent or nature of economic impacts of animal diseases is also affected by the context in which it occurs, such as:

- *Production System*: The nature of impact depends on the scale and intensity of production, the timing of outbreaks, the type of owners (poor women, small scale or large scale commercial farmers, breeder, *etc*.).
- *Food Production and Marketing System*: Different systems of the management and regulation are prevalent in different regions. Some may have more stringent regulations while other may have quite unorganized system which respond differently to animal disease occurrences. The effectiveness of prevention and control measures are usually more in a more organized food system.
- *The State of Economy*: Rich economies have different concerns about animal diseases as they are more focused on export trade and profiteering from those that are poor who are mainly concerned about livelihood and food availability.
- *Social and Cultural System*: Some traditions and culture may restrict the ownership of livestock by certain groups, which often limits them in diversifying their farm animals to protect against some potential diseases.

Some Methods for Evaluation of Economic Impacts from Animal Diseases

According to literature, economic evaluation of impacts of animal diseases is mostly conducted at global level, national/ sectoral level and at stakeholders' level.

1. Global Perspectives

At global level, estimates are generally made by aggregating the existing national estimates. However, this can rarely be accomplished due to paucity of sufficient number of accurate and comparable estimates. The alternative is to use animal diseases outbreaks and incidences and other relevant secondary data of selected countries and then combine for global estimate. An economic simulation model estimated the global economic impacts of 12 numbers of cattle diseases in 185 countries to be 65 billion US dollars (Rasmussen *et al.*, 2024).

2. National Perspectives

At national or sectoral level, two major approaches are adopted for impact evaluation, *viz*., macroeconomic modelling and simulation modelling. Some examples of macroeconomic modelling to estimate animal diseases impacts on national economies are Social Accounting Matrix (SAM), Computable General Equilibrium (CGE) model, partial equilibrium model, input-output model and epidemiological model, *etc*. These methods mostly use macroeconomic indicators like Gross Value Added or Gross Domestic Product of the economy or the sector, consumption level in two scenarios *viz*., with and without the disease. Simulation modelling consists of developing a mathematical model that simulate a diseased population and a healthy population, and make comparisons of the output values under the two scenarios.

3. Stakeholders Perspectives

At stakeholders' level, Simulation modelling and Sustainable Livelihood Framework Assessments are most conveniently used. Simulation models have been used to analyse the impacts of CSF outbreaks on pig farmers and on traders

in Vietnam (FAO, 2016). When the stakeholders are smallholders and most vulnerable groups, the sustainable livelihoods framework described by DFID can provide a comprehensive and systematic approach to assessing the impact on livelihood of the vulnerable groups. This approach is particularly adopted for the vulnerable groups as the animal diseases have the potential to increase their vulnerability to other shocks, in addition to their direct and significant economic impacts.

4. Designing an Economic Analysis

An economic analysis should be planned, designed, incorporated and budgeted at the start of any animal health programme, rather than commissioning it as an afterthought. To obtain an informative and useful economic analysis, the key is to frame specific questions that must be answered.

a) Specify the Objective: The objectives should express the questions that are expected to be answered, the scope of the study, the level of accuracy or precision required and the time frame on how soon they are expected to be completed.

b) Specify the Work: According to the nature of questions to be answered and the quality and quantities of data available, the scope of the study will vary. Generally, according to the scope of the study, the type of work required to be planned may be reviewing the existing literature; exercise on developing models and test available data and information; interviews with key informants; field surveys to collect additional data.

c) Plan for Feedback: It is important to include a feedback mechanism where the stakeholders are contacted to view any discrepancies in the variables taken or assumptions made while arriving at the estimates of the economic analysis. The results should represent what people experienced in real life.

d) Data Requirements: An economic analysis of possible impact of animal diseases is quite situation specific and the necessary data will not be readily available for analysis. A combination of data collection including survey, interviewing experts and mining published government data will be required to complete the task. Some of the basic data required for economic impact analysis of animal diseases are:

✓ *Livestock population size*: Information on the size of the livestock population that falls under risk for particular disease under investigation will be required along with the value of the animals.

✓ *Data on disease incidence and production parameters*: Data on disease incidence is captured through disease surveillance and monitoring systems. In India, a web-based disease reporting system, National Animal Disease Reporting System, perform the surveillance system in all states and union territories. The analysis will not be complete without the information on basic production parameters, such as age and weight at the time of sale, reproduction and mortality rates, *etc*.

✓ *Economic data on livestock production and trade*: Data on profitability of the activities in the livestock value chain is required to estimate the profits and losses loss due to animal diseases.

✓ *Consumption pattern of livestock products*: Information on consumption patterns of livestock commodities as well as its responsiveness to price changes is required to estimate the impact on consumers of animal sourced foods who are affected negatively through market shocks as a result of animal disease outbreak.

e) Quantifying the relation between Livestock and Other Sectors: Macroeconomic models such as previously mentioned SAM, CGE and input-output models are used to establish macroeconomic impact of animal diseases.

Conclusion

Animal diseases have far reaching economic impacts which are estimated either as direct or indirect or according to the sources of the impact. Due to its simplicity and comprehensive approach, the latter is more conveniently used. The analysis of economic impacts due to animal diseases is assessed through its major sources of impacts *viz*., disease effects, market disruption, control measures and effects beyond the livestock sector. The level of impact is also affected by the context such as production system, social system, food system and economy. The impact is felt at every level starting from the smallholders, large commercial producers, pastoralists, retailers, processors and consumers. An economic analysis of such impacts will provide a base for justified policy directions towards animal health management and obtain a budgetary allocation towards control and preventive measures. A carefully crafted animal disease programme or policy will provide tremendous benefits in terms of food security, poverty alleviation and general economic welfare.

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