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A Review on Importance of Animal Health Economics in Decision Making

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Abstract
Animal health economics is a relatively new discipline emerged during 1990s. This is becoming more and more important as an aid to decision making on animal health interventions at various levels. It concerned with quantification of economic impacts of the diseases, developing methods for optimizing decisions on animal health and determining the profitability of specific disease control and health management programmed. This paper reviews the available literature on the subject. Some authors conceive animal health economics as a discipline that makes use of concepts, procedures and data to support the decision-making process. Most of the economic benefit can be expressed in monetary terms, economic analysis of animal diseases and intervention strategies, including the efficiency and equity of veterinary interventions. Animal health economics can involve spatial time dimensions. Several basic influences on animal health are worthy of study from an economics point of view. These include genetics, the environmental conditions encountered by animals, their nutrition (including the availability to them of water and its quality) and their comfort.
Keywords: Animal health, Decision making, Economics.

1. INTRODUCTION

Preventive as well as treatment programs, based on known risk factors for animal disease, sometimes fail for reasons that immediately understood by the health professionals connected with farmers or policy makers. Why stakeholders in livestock health, even though it would benefit their results, do not implement effective disease management practices is not known. In addition to other factors, decisions are often based on the stakeholders' perception of the economic losses due to animal disease (Ramssay *et al*., 1999).

Animal health economics is relatively a new subject that has been developed to provide quantitative insights into the economic impact of disease and disease control in livestock to support decision-making process in optimising animal health management (Ababneh, 2003). In recent years, there are dramatic changes, which have occurred in the global socio-economic environment. The major epidemic diseases have been brought under control in the majority of the developed countries leaving diseases with less evident economic impact and more complex epidemiology to be tackled by the veterinary profession, with wider market integration, self-sufficiency for livestock products receives lower priority as national policy goal and hence political commitment for national disease control efforts has weakened, the importance of agriculture in the national economy declines as countries develop, resulting in stronger competition for funds by different sectors of the economy, and more responsibilities are being transferred from the public to the private sector, which is more concerned with visible returns on investment. All these lead to the growing importance of animal health economics. Therefore, it has become increasingly important to provide sound economic justification for any proposed action to improve or safeguard animal health to those expected to finance proposed intervention (Otte and Chilonda, 2001).

By economic analysis, quantifying the economic effects of animal diseases, developing methods for optimizing decisions when individual animal, herds or populations are affected, and determining the profitability of specific disease control and health management programs and procedures is possible (Ababneh, 2003).

Two types of modelling techniques are used in economic analysis of animal health: Quantitative analytical models and Qualitative analytical models (Bennett, 1992).Economics comprises both economic theory and methods, which form the framework or tool kit used to analyze economic problems or to plan for the future (Marsh, 1999).

Spatial dimensions can vary from the taking into account the economic consequences of the state of animal health on individuals (for example, owners of livestock), to a consideration of their economic consequences for local communities and regions, for industries, for nations and internationally or globally. The most frequent way of taking into account the time dimension in animal health economics is by the use of discounting of future costs and benefits when undertaking cost-benefit analysis (Rushton, 2009).

However, although considerable progress has been made in applying economics to animal health issues, it remains a relatively neglected field of study for which many of its potential applications have yet to be explored (Tisdell, 2010). Therefore the objective of this seminar paper is to: Organise information and bring

attention to unexplored areas to which animal health economics has application.

2. ANIMAL HEALTH ECONOMICS

Economics is a science which deals how people exercise choice in allocation of scarce resources for production, distribution and consumption of goods. It offers a frame work for analysis of animal health problems, which can be used to assist in setting animal health priorities and in decision-making in animal health program (Picciottor, 1995).

Animal health economics is the area of economics that applies the principles and methods of economic analysis to animal health problems. It is a relatively new discipline emerged during 1990s, which is concerned with the allocation of the available resources to improve animal health in order to satisfy human needs. The subject deals with the animal health system as a whole, it covers the economic impact of animal health on the production, marketing and trade, utilization of animals and consumption of their products and becoming more important as an aid to decision making on animal health interventions at various levels. The level of decision making ranges from individual animal to national herd and finally to international disease control efforts (Otte and Chilonda, 2001).

In the area of economics of disease loss and disease control, many methods and techniques have been used for analysis. The idea of choice is central to any economic analysis. The basic premise in analysis is to compare a single disease control strategy with the consequences of doing nothing. In allocating resources to one activity (say, activity A), rather than to other activities (ranging from B to Z), a cost is incurred. Economists call this the opportunity cost of a decision, i.e. the benefit that one foregoes by not selecting the best alternative course of action among the choices available (B). The benefit obtained from performing and then be compared with the associated economic cost of carrying out B, i.e. the opportunity cost. As long as this benefit exceeds the cost of B, project A is worth undertaking. In animal health one examines the marginal gain of this allocation against the marginal cost (the opportunity cost). Using this methodology, one can rank different activities on the basis of net benefit value, in descending order of preference (Mlangwa and Samui, 1996).

Animal health economics provides solid framework of concepts, procedures and data to support the decision making process in optimizing animal health management have been developed and paved the bases for this new discipline. In this field primarily deals with three interrelated aspects: Quantifying the economic effects of animal diseases, developing methods for optimizing decisions when individual animal, herds or populations are affected, and determining the profitability of specific disease control and health management programs and procedures (Ababneh, 2003). As the economic impact of most diseases that afflict farmed livestock is typically greater at the sub-clinical rather than the clinical level. Animal health management often involves decisions regarding expenditure on preventive measures as well as the treatment of obviously sick animals. Animal health program have been shown to provide a high return on investment. This is because reduction of disease impact increases the efficiency of production, for marketing and trade, utilization of animals and consumption of their products. In institutional development economic classified the effect into direct and indirect (Otte and Chilonda, 2001).

Direct losses may occur at input level by destroying the basic resource of the livestock, by lowering the efficiency of the production process; at output level disease may reduce either the quantity or the quality of the output. Indirect losses due to disease include losses through additional costs incurred to avoid or reduce the prevalence of disease, detriment of human wellbeing directly through zoonosis sub-optimal exploitation of otherwise available resources through forced adoption of production methods, which don't allow the full exploitation of the available resources and reduction in the number of people depending upon livestock have principally focused on providing a framework of concepts, procedure and data to support decision making process (Chilonda and Huylenbroeck, 2001).

2.1. The contribution of economics to animal health

Economics comprises both economic theory and methods, which form the framework or tool kit used to analyze economic problems or to plan for the future. Most of the economic benefit can be expressed in monetary terms (e.g. more animal products available for sale, a higher price per unit of product, lower production costs), but some elements cannot be valued so easily in monetary terms (e.g. reduced risk of human infection with zoonoses, increased work capacity of animals in crop production and transport, increased availability of animals for cultural purposes) (Marsh, 1999).

In animal health economics, the relative merits of different approaches to improving the health of an animal population are evaluated in order to make the best decisions on the allocation of disease control resources. The focus of the evaluation is on the 'marginal' or additional benefit of intensifying disease control by a small degree, until an economically optimal control strategy is identified. This point reached when the increased benefit achieved by a further small increase in disease control effort is exactly balanced by the costs of achieving that improvement up to that point, additional investment has produced a positive net economic benefit (Morris,

1999; and Tisdell, 2009).
Economic analysis is not a form of financial accounting; the main concern in economics is to rank alternative disease control measures in order of the merit of each alternative, hence to make the best decision, and not to calculate the exact monetary value. In economics, the risks of an investment are also investigated, and risk evaluation is an important component of animal health economics (Anteneha, 1991).

2.2. Relationship between animal health economics and veterinary epidemiology
Veterinary epidemiology is the study of disease within livestock population (Leonardd, 1993). These two disciplines, although separate scientific areas, are complementary when the goal is efficient management of animal health and associated delivery systems. In performing economic analyses, an 'economic model' should determine data requirements (epidemiological and socioeconomic), as such analyses require variably epidemiological inputs (Tisdell, 2010).

Epidemiological models are used to identify factors that contribute to the development of disease conditions, the magnitude and directions of the contributions and relationships between diseases and other animal conditions. However, the epidemiological information is not enough to make decision about a disease control unless economic analysis support is included with it (Christy and Thirunavukkarasu, 2006).

Veterinarians, especially epidemiologists, being practical in approach, have not wanted to limit veterinary work purely to technical areas and, as a result, have also entered the field of the socio-economics of animal health. The rigor which epidemiologists apply to their own scientific area should apply when they cross the disciplinary boundaries into financial and economic analysis' (Tisdell, 2010). Economic analysis is a natural progression from epidemiology, since it attempts to put values to estimates of biological productivity effects and to relate the level of disease in a livestock population with its cost to a farmer or society (Leonardd, 1993). Therefore, veterinarians wanting to practise as economists (working in research, animal health policy formulation and evaluation or economic analysis of interventions) should be clear enough in economic theory and methods (Mlangwa and samui, 1996).

2.3. Economic analysis in animal health
Economic analysis in animal health includes consideration of disease and production system; the physical effects of the disease and its subsequent effects on the production system, the incidence and/or prevalence of disease, technologies and options available to control disease and improve health and productivity, the impact of disease and control options on other systems (e.g. on human health) and evaluation the effects of disease and strategies of control (Chilonda and Huylenbroeck, 2001).

Data need to be collected and analyzed to help provision of this information. Prior assessment of economic analyses of disease control decisions have been undertaken after the event. Prior assessment requires the modelling of disease spread, information on the effects of the disease on livestock production and human health and information on the strategy options for controlling or preventing the spread and/or impacts of the disease (Johansson, 1991).

The scope of animal health economics most of the work reported in veterinary journals has been in the area of losses due to diseases and cost benefit analysis of control strategies. Two types of modelling techniques are used in economic analysis of animal health: Quantitative analytical models and Qualitative analytical models (Bennett, 1992).

Quantitative analytical models: Quantitative economic modelling has a particular role to play in providing information on the last of data analyzed. After the causes of a disease have been identified, disaggregated and quantified by epidemiological technique, the next step is to attach monetary value to the quantified impacts. A number of quantitative modelling techniques have been used to provide information to help decision-makers choose appropriate livestock health and decision control strategies (Bennett, 1992).

To develop a quantitative model described three basic interdependent steps: Development of a figurative model to define and better understand the system to be modelled, expression of the figurative model in a mathematical formulation, the choice of an appropriate quantitative technique and the application of the analytical procedure (Marsh, 1999).

Some of the economic quantitative techniques used for; marginal principle, partial budgeting, cost benefit analysis, decision analysis and simulation. In marginal principle, when shifting resources from one activity to another, one should examine what happens at the margin by comparing the extra benefit that will result from this shift and the opportunity cost of the extra resources. Partial analysis, helps in comparing the situation without the project to the situation with the project (the 'with and without project methodology') is preferable to comparing the situation before the project with the situation after the project (the 'before and after methodology'). Decision analysis techniques are helpful when making choices under conditions of uncertainty, especially with complex but poorly structured economic problems. Risk analysis is incorporated in the technique. Simulation attempts to mimic real-life occurrences of variables (states and quantities) over time (Mlangwa and

Samui, 1996).

Qualitative analytical models: A conceptual model demonstrating variables that relate to the specific characteristics of small-scale farmers and farms, economic factors, institutional factors and biophysical factors. Agricultural household models can be used to analyze the demand for veterinary services and the response in function of a number of variables. Agricultural household models are used to estimate the influence of behavioural parameters on demand and supply response. They are usefully applied in empirical analysis to investigate the behaviour of the farmer in animal health management, the factor influencing the willingness of the farmer to pay for animal production and health inputs (Chilonda and Huylenbroeck, 2001).

The factors which influence the demand for private veterinary service by using partial budgeting, decision tree analysis, or cost-benefit analysis techniques which can be used to arrive at the most decisions in animal health economics at the farm level, either alone or in combination. Regardless of the technique chosen, the analysis is only as good as the quality of the data used (Marsh, 1999).

3. DIMENSIONS IN THE ANALYSIS OF ANIMAL HEALTH ECONOMICS

Animal health economics can involve a variety of dimensions. These include spatial dimensions, time dimensions, consideration of different health pathways and elements of these as critical factors in managing animal health, and allowances must be made in economic analysis for risk and uncertainty affecting decision-making about animal health (Rushton, 2009).

3.1. Spatial dimensions

Spatial dimensions can vary from the taking into account the economic consequences of the state of animal health on individuals (for example, owners of livestock), to a consideration of their economic consequences for local communities and regions, for industries, for nations and internationally or globally. Animal health policies that are socially economic for one group may not be the best economic choice for a wider group. For example, while it may not pay an individual country to try to eliminate an infectious animal disease, the net benefit of doing so could be positive from an international perspective (Tisdell, 2009).

3.2. Time dimension

The most frequent way of taking into account the time dimension in animal health economics is by the use of discounting of future costs and benefits when undertaking cost-benefit analysis. The data requirements of social cost-benefit analysis are very high. The final analyses are often very sensitive to small changes in assumptions of discount rates, adoption rates and changes in livestock production parameters (Rushton, 2009).

4. COSTS AND BENEFITS OF ANIMAL HEALTH POLICIES

When assessing the costs and benefits of animal health policies, one must identify additional costs and new benefit streams. This approach can be used as a framework for incorporating more complex methods of examining market impacts and possible price changes. As mentioned above, fixed costs for animal health include investments in coordination, research, information and key infrastructure areas that have traditionally been under governmental control. From a public policy perspective, it is important that animal health investments create synergies with on-going private investments (Mitchell *et al*., 2012).

The state's role usually hinge upon whether a market failure has arisen. Cost estimates should guide policy on allocating public investments, and can be used for financial and social cost-benefit analyses of proposed policy changes. Animal health decisions are based on epidemiological and market models. Market models are dependent on epidemiological models, and each contains levels of uncertainty. Explanations of models used to look at market impacts and the beneficiaries of proposed changes can be found in (Upton 2009, Rich *et al.,* 2005 and Paarlberg, 2013).

4.1. Analysis of costs and benefits of government control policy options

Objectives of either cost minimization or maximization (if benefit streams are available) with in desired constraints. Some of these constraints would be legal requirements; this approach would be useful in examining the change in outcome with the relaxation of legal constraints (Rushton, 2009).

The impact assessment frameworks need to direct national and international data costs, and this is particularly relevant in situations where livestock sectors are becoming integrated with a small number of large companies (Gilbert and Rushton, 2013).

Presenting levels of uncertainty and strategy options should be a critical aspect of decision making. However, this can create difficulties in relaying information back to a policy maker, and many often resort to simple measures of project worth such as benefit-cost ratios or net present values for single strategies (McInerney, 1996).

Cost-benefit analysis include discount rate, it measures the rate at which one is willing to trade present

for future consumption. For public projects, two different measures can be used: Social Opportunity Cost of capital (SOC) and Social Time Preference (STP). SOC indicates the need to measure investments in purely economic terms of the returns of capital across the economy, whereas STP implies the need to look at longer and less quantifiable aspects of investments. The choice of discount rate is dependent on the type of diseases. Diseases with a public health impact, such as the zoonosis, should use a lower discount rate (STP), whereas diseases controlled in ways that are beneficial to commercially run companies while improving economic efficiencies should use a higher rate (SOC) (Lopez, 2008).

An investment is deemed worthwhile if avoidable losses generated from a disease management process are greater than costs of a change in disease status. This is normally measured using the metrics from a cost-benefit analysis, which simply measure economic profitability. These metrics give no indication of financial feasibility and only a limited assessment of social acceptability and political palatability (Tisdell, 2009).

Decision making using cost-benefit and cost-effectiveness analysis would appear to have limitations. The mixing of fixed and variable costs in the analysis may not allow for an examination of where activities are adding value to the overall animal health system. Lessons could be focus on other areas, such as farm management or business. A suggestion for further exploration would be to separate the fixed costs of the system including infrastructure, salaries and maintenance and identify all the activities that are part of the system. Each discrete activity would be associated with the specific resources it uses and its variability with activity levels. These would be akin to the variable costs identified in a gross margin analysis (Gilbert and Rushton, 2013).

The benefit streams could be estimated in terms of the disease reduction achieved where a disease is endemic. If a disease, health or welfare problem has been eradicated, benefit streams could be estimated in terms of the re-entry costs of that problem along with an estimation of the likelihood of re-entry (Paarl-berg, 2013).

5. CHALLENGES OF ANIMAL HEALTH ECONOMICS IN DECISION MAKING

Several basic influences on animal health are worthy of study from an economics point of view. These include genetics, the environmental conditions encountered by animals, their nutrition (including the availability to them of water and its quality) and their comfort. These factors all have consequences for the health of animals and for their susceptibility to diseases. Consider genetics and the choice of a local breed versus an exotic breed of livestock, as an example. Potentially, the profitability of keeping the exotic breed is higher but it is more susceptible to local diseases. This risk can be reduced by adopting safeguards but these safeguards involve a cost. Just how much the risk can be reduced by adopting safeguards will vary from locality to locality and so will their cost. The costs and finance involved in taking health precautions as well as the remaining risks may deter subsistence producers (households) from favouring the exotic breed but commercial producers may adopt the exotic breed. Consequently, dual livestock systems can occur in developing countries like Ethiopia (Tisdell, 2009).

Environmental conditions have been given considerable attention in relation to human health economics (less attention in relation to animal health. Costs and benefits are involved in environmental improvement and therefore, cost-benefit analysis can be applied to such problems. For example, pollution of water from external sources or deficiencies of oxygen in water associated with spill over's in water caused by a high biological oxygen demand (BOD). And result in morbidity and mortality in cultured fish. Economic models can be used to assess the economics of altering the environments involved (Rushton, 2009).

Deficiencies in the nutrition of animals discomfort to them caused by poor housing and inadequate ventilation of housing, heat stress, and so on can increase their proneness to diseases and result in increased morbidity or mortality. Again economic considerations are involved in the management of such factors. Institutional features of animal husbandry also have implications for animal health, especially the spread of diseases and their control. Livestock holders who buy in stock rather than raise their own stock may be at greater risk of introducing diseases to their herds. Therefore, the marketing of livestock has a number of animal health implications from an economics point of view (Tisdell, 2009).

CONCLUSION AND RECOMMENDATIONS

Sometimes, preventive as well as treatment programs fail connected with farmers or policy makers often based on the stakeholders' perception of the economic losses due to animal disease. Economic analysis by choosing modelling technique/s is necessary by taking the roles that animals play in society, the impacts of disease in animals and the prices of resources they compete into account. Economic analysis provides support for decision makers in allocation of scarce resource but does not necessarily identify the ideal solution. Understanding disease epidemiology, the nature of economics and the relationship between economics and epidemiology is essential for realistic economic assessment and for successful institutionalisation of animal health economics to provide support decision making in veterinary delivery systems.

Based on the above conclusions the following recommendations are forwarded:

- The need for, and training of, economists should be given attention by veterinary epidemiology and

economics units in universities, government and the private sector.

- Preventive as well as treatment programs of animal health problems should be designed and communicated with stake holders after doing thorough economic analysis and showing the benefit going to be obtained if allocation is made from the scarce resource
- Veterinary epidemiologists and economists should collaborate effectively to provide basic courses in economic theory and methods to establish provision of decision support system in animal health in Ethiopia.

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