

## Animal Health Economics: A review

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### ملخص البحث

يعتبر علم إقتصاد صحة الحيوان نهجاً حديثاً نسبياً من المعارف اذ يرجع ظهوره إلى حقبة التسعينات من القرن الماضي. كان يتم تناول إقتصاد صحة الحيوان ضمن علوم الوبائيات، الصحة العامة، الإقتصاد الزراعي وغيرها. بالرغم من أن علم إقتصاد صحة الحيوان لا ينتمي إلى صلب العلوم البيطرية، إلا أنه اكتسب أهمية خاصة كعلم مساعد في إتخاذ القرارات المتعلقة بصحة الحيوان علي مختلف المستويات، حيث يهتم بتقدير الأثار الاقتصادية لأمراض الحيوان، تطوير طرق وسائل إتخاذ القرارات عند إصابة الحيوانات وتحديد مدى جدوى مكافحة الأمراض.

استعرضت هذه المراجعة بعض ما دون في هذا المجال فقد ركز بعضهم في وضع إطار للمفاهيم، الطرق والبيانات التي تساعد في إتخاذ القرارات الخاصة بصحة الحيوان. تناول البعض أثر أمراض الحيوان كمدخل سلبي في العملية الإنتاجية حيث تم تقسيمها الي آثار مباشرة و غير مباشرة. يرى البعض أن الأطباء البيطريين في أفريقيا جنوب الصحراء يقومون بدور مزدوج فبالإضافة إلى صحة الحيوان والصحة العامة عليهم تولى مهمة الإرشاد والتخطيط، الأمر الذي يقتضى الإلمام بالنواحي الإقتصادية والإجتماعية.

فيما يتعلق بأساليب التحليل فقد قسمت الي نوعين من النماذج: نماذج التحليل الكمي ونماذج التحليل النوعي حيث يعتمد إختيار نموذج التحليل علي المشكلة المعنية، مدى تعقيد النظام، مقدرات مصمم النموذج لإستخدام المزمع ادائه بالنموذج والموارد المتوفرة. خلصت المراجعة الي أن الوضع في ظل العولمة والنمو المتزايد للسكان خاصة، في الدول النامية، يقتضى التوظيف الأمثل للموارد. ذلك لأن سوء توظيف الموارد في قطاع صحة الحيوان ينتج عنه تردى في صحة الحيوان، ضعف في القدرة التنافسية للمنتجات الحيوانية، أثار سلبية علي قطاع الصحة العامة وبالتالي عدم تحقيق الغايات المنشودة لرفاهية الإنسان.

يوصى هذا الاستعراض بمراجعة مناهج التعليم البيطري في السودان لمواكبة تحديات العولمة لرفاهية البشر كما أن الإلمام بقواعد الإقتصاد الكلي والجزئي والدراسات الإجتماعية ضروري للعاملين في مجال صحة الحيوان.

### Summary

**Animal health economics is a relatively new discipline that has emerged during 1990s. Before that time the issue had been tackled in different disciplines e.g. agricultural economics, epidemiology, public health..etc. Animal health economics is a discipline, which does not belong to the core of veterinary science but is becoming more important aid to decision making on animal health interventions at various levels. It is 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 programme. 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. Others discussed the negative impacts of animal diseases and classified the effects of diseases into direct and indirect. Some argued that veterinarians, in sub-Saharan Africa, play multiple roles. Therefore, they are influenced by economic and social factors which imply additional knowledge.**

**Two types of modelling techniques are used in economic analysis of animal health: quantitative and qualitative analytical models. The choice of the appropriate technique depends on the problem to be modelled, the complexity of the systems involved, the capabilities of the model builder, the uses to which the model will be put and finally the available resources.**

**The review concluded that globalization as well as the high human population growth rate, particularly in developing countries, implies better allocations of resources.**

**Mal-allocation of resources in animal health sector will result in poor animal health, less competitive products, unattainable goals of food security and impairment of human welfare. Revision of the veterinary education in the Sudan to include socio-economic studies is recommended.**

### **Introduction**

Animal health economics is relatively a new discipline that has emerged during 1990s. Before that time the issue had been tackled in different disciplines, e.g. agricultural economics, epidemiology, public health..etc. This review was undertaken to highlight the importance of this discipline by reviewing the literature available on the subject. Authors have been quoted for better understanding of their ideas.

### **Definitions:**

Animal health economics is a discipline, which does not belong the core of veterinary science but is becoming more and more important as an aid to decision making on animal health interventions at various levels. The level of decision making ranges from the individual animal to the national herd and finally to international disease control efforts (Otte and Chilonda, 2000).

Economics deals with how societies act to utilize the available resources in order to satisfy human needs. Animal health is a state of body condition in which all systems perform their function normally. Animal health economics 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.

### **Conceptual framework:**

A progressive 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. According to Ababneh (2003) research in this field primarily deals with the following three interrelated aspects:

1. Quantifying the economic effects of animal diseases.
2. Developing methods for optimizing decisions when individual animal, herds or populations are affected, and
3. Determining the profitability of specific disease control and health management programme and procedures.

Ramassay *et al* (1999) mentioned that economics as a discipline offers a framework for analysis of animal health problems, which can be used to assist in setting animal health priorities and in decision making in animal health programmes. Economic analysis provides a broad framework, which enables the implications and impacts of decision to be considered. Externalities, or flow-on effects to other members of the community is incorporated, in addition to the direct effects of a policy action or event.

Animal health economics as a discipline makes use of concepts, procedures and data to support the decision making process with the objective of optimizing animal health management (Marsh, 1999). 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 treatment of obviously sick animals. Animal health programmes have been shown to provide a high return on investment. This is because reduction of disease impact increases the efficiency of production, often without the need for

additional inputs such as feed or labour. Kaasschieter *et al* (1992) argued that livestock and animal health development projects have not always led to substantial increases in animal productivity or in farmers' welfare. Some have even resulted in unsustainable systems, when they were not based on an understanding of (livestock) production systems. The multipurpose functions of livestock and complex relationships between the biological, technical and social components require a systems approach, whereby nutrition, animal health, breeding, biotechnology know-how, inputs and technologies are used to optimize resource use. Different systems need different approaches. Pastoral systems must focus on effective management of grazing pressure of the rangelands. Communal rangelands management involves not only the development and application of technologies (eg feedlots, vaccination campaigns), but also land tenure policies, institutional development, economic return and a reduction in the number of people depending upon livestock. Smallholder mixed farms must aim at intensification of the total production system, in which external inputs are indispensable, but with the emphasis on optimum input-output relationships by reducing resource losses due to poor management. Resource-poor farming systems must aim at the improved management of the various livestock species in backyards and small farms, and proper packages for cattle, buffaloes, sheep, goats, rabbits and poultry should be developed. Specialized commercial livestock farming systems (poultry, pigs, dairy or meat industries) can only be sustainable with adequate marketing, supply of quality feed, veterinary services, labour, management and control of pollution. Animal health programmes play a key role in the proposed system approach.

McDermott *et al* (1999) considered that unique conditions and features characterize smallholder systems, which need to be appreciated when assessing the strategies that have evolved for managing animal health in smallholder systems, and evaluating opportunities for improving disease control strategies. To provide a framework for discussing animal health issues and analytical methodologies, a typology of smallholder livestock and crop/livestock systems is developed. The typology considers livestock systems both in terms of the degree of intensification, as measured by market orientation, and intensity of factor use in terms of importance within the household economy, as measured by contribution to household income. A number of characteristics are identified. These distinguish smallholder systems from the commercialized systems of the developed countries. The characteristics include the multiple functions livestock serve, the integrated nature of livestock activities, multiple objectives of producers, lower capacity to bear risk at the household level and poor infrastructure, markets and access to information at the community level.

Otte and Chilonda (2001) classified the effect of disease into direct and indirect. Direct losses may occur at the 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 include losses through additional costs incurred to avoid or reduce the prevalence of disease, detriment to human well-being directly through zoonosis and sub-optimal exploitation of otherwise available resources through forced adoption of production methods, which don't allow the full exploitation of the available resources.

Chilonda and Huylenbrock (2001) have principally focused on providing a framework of concepts, procedure and data to support decision-making process. Research has primarily covered three interrelated aspects: quantification of the financial

effects of animal diseases, development of methods for optimizing decisions when individual animals, herds or populations are affected and determination of the costs-benefits of disease control measures.

### **Some applications:**

Romero *et al* (1999) discussed the relative importance of the livestock sector in South America, in developing countries and in countries worldwide. The development of animal health services was highlighted and the new challenges which these services must meet with respect to the restructuring of international trade. The economic impact of animal diseases and of disease control is evaluated by taking a regional approach and by analyzing production systems. Emphasis was placed on national control programmes of diseases that affect reproduction, parasitic diseases and mastitis, with particular reference to the livestock sector of Colombia. The authors suggested an integrated livestock development programmes that include management of animal health and production information. A change of attitude is also recommended with greater participation of those involved. The need to coordinate sustained research initiatives is stressed.

Perry *et al* (2001) discussed the general role of veterinary epizootiology and economics in national animal-disease control throughout the world. They considered this role for the four main groupings of animal diseases: zoonotic, food-borne, endemic and epidemic diseases. They pointed out how veterinary epizootiology does this and economics had contributed to priority setting, decision-making, and disease control implementation. Within each of these categories, progress made and future opportunities are discussed. In addition, a review is made of how veterinary epizootiology and economics have been institutionalized. They concluded that veterinary epizootiology and economics hold a unique role in the development of national policies and strategies for improvement of animal health worldwide.

Mlangwa and Kisauzi (1993) argued that veterinarians in Sub-Saharan Africa work in resource-deficient environments. Decisions taken by veterinarians in this Sub-Region, on animal health, animal husbandry and public health issues, are therefore influenced by economic factors including macro-economic considerations related to the current structural adjustment programme being implemented in the Sub-Region. In turn, decisions or advices given by veterinarians have socio-economic consequences on clients, on the effectiveness of the delivery systems for veterinary services and on the growth of national economies. For these reasons, economics and planning should be essential components of all modern veterinary undergraduate syllabi in Sub-Saharan Africa, in order to give veterinarians a basis for making decisions and giving advice, which are both technically and economically sound. They suggest that principles of livestock economics, livestock enterprise management, livestock investment analysis and economics of animal health care are necessary elements in economics and planning courses.

McDermott *et al* (1999) described three representatives of smallholder livestock systems from Africa and highlighted the relevant characteristics and the implications for analyzing disease control strategies. Smallholder dairy cattle system in Kenya demonstrates the role of individual producer decision-making for animal health management in intensive, market-oriented systems. In extensive pastoralist system, where epidemic diseases are still important and infrastructure is poor, disease control primarily involves managing communal natural resources, requiring a different

analytical approach. Finally, in crop farming system using draught cattle, the livestock activity is an integrated component of crop production and this must be reflected in the approach used to evaluate draught animal health management. Continued development analytical approaches and decision-support tools for disease control strategies adapted to the special characteristics of these systems will be needed as smallholder systems continue to intensify in areas with good market access, and those in marginal areas face increasing pressures to optimally manage the natural resource base.

### **Economic analysis in Animal Health:**

Bennett (1992) summarized the information needed for livestock health and disease control as decisions on (i) the disease and production system, (ii) the physical effects of the disease and its subsequent effects on the production system, (iii) the incidence and/or prevalence of disease, (iv) technologies and options available to control disease and improve health and productivity (v) the impact of disease and control options on other systems, e.g. on human health and (vi) evaluation of the disease effects and control strategies. Data need to be collected and analyzed to help provision of this information. Quantitative economic modelling has a particular role to play in providing information on the latest of these aspects.

Bennett (2004) focused on prior assessment of economic analyses as many economic analyses of disease control decisions have been undertaken after the event. For him, prior assessment requires the modelling of disease spread, information on the disease effects on livestock production and human health and information on the strategy options for controlling or preventing the spread and/or impacts of the disease. Such information is necessary to undertake cost-benefit analysis of policy options. Cost-benefit analysis involves identification of the main economic impacts and their magnitudes, appropriate valuation of these impacts and costs estimation of the control strategies.

Two types of modelling techniques are used in economic analysis of animal health; Quantitative and Qualitative analytical models

### **Quantitative analytical models:**

A number of quantitative modeling techniques have been used to provide information to help decision-makers to choose the appropriate livestock health and decision control strategies. These models use mathematical expression to represent aspects of the real world. Mathematical programming, network analysis, decision analysis, simulation and cost-benefit analysis all have been applied to livestock disease control decisions. Due to the dynamic and risky nature of disease and its effect, techniques such as simulation, which take account of these aspects, are particularly useful. Mathematical programming approaches are most suited to a relatively structured-decision problem, whereas approaches such as decision analysis are particularly useful for poorly structured-decision problems. Cost-benefit analysis comprises a range of useful techniques for evaluating alternative courses of action (Bennett, 1992). To develop a quantitative model, three basic interdependent steps are required:

- 1/ Development of a figurative model to define and better understand the system to be modeled.
- 2/ Expression of the figurative model in a mathematical formulation.
- 3/ The choice of an appropriate quantitative technique and the application of the analytical procedure.

The choice of the appropriate technique depends on the problem to be modeled, the complexity of the systems involved, the available information, the capabilities of the model builder, the uses to which the model will be put and finally the available resources (finance and time).

Ngategize and Kaneene (1985) followed by Dijkhuizen (1988) considered quantitative modeling under two main headings: (1) Statistical and/or epidemiological models such as regression analysis and discriminative analysis, analysis of variance, and (2) Economic models such as equi-marginal principle, partial budgeting and cost-benefit analysis.

#### **Qualitative analytical models:**

Chilonda and Huylenbroeck (2001) developed a conceptual model demonstrating variables that relate to the specific characteristics of small-scale farmers and farms, economic factors, institutional factors and bio-physical 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 following:

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.

Marsh (1999) analyzed 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.

#### **Conclusion:**

Globalization as well as human population growth, particularly in developing countries, implies better allocations of resources. Mal-allocation of resources in animal health sector results in poor animal health, less competitive products, unattainable goals of food security and impairment of human welfare. Veterinary education syllabus in the Sudan should be revised to cope with the new challenges. Better understanding of macroeconomics as well as microeconomics is crucial to those involved in animal health and research activities. Their role at the micro level regarding individual animal health is not only focusing on animal welfare, because human health food security, and owner income are involved. Economically feasible decision on keeping and treating animals is important. The feasible diagnostic tests and types of medicament have their role for better allocation of resources. At meso-level, animal health is a determinant factor for all animal industry. Economic diseases have negative impact on these industries. Total quality assurance of animal products need to be considered at all stages to increase their competitiveness with the resulting impacts on macro-economy. Improvement of economics together with social infrastructure related to animal health generates positive results. At macro-level, national animal health policies based on concrete economic analysis and international relation related to animal health should be exploited. Generally, decision-making process at all levels is a key factor in animal health sector development.

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