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Assessing the economic impact of an endemic disease: the case of mastitis

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Summary

A large part of the world's resources are used to produce animal products. Efficient use of these resources is important to improve social well-being. Endemic animal diseases decrease production efficiency, because they require a higher level of input to produce the same amount of output or result in a lower output with the same amount of input. The optimal level of production with and without disease differs from farm to farm and depends on varying economic circumstances. Given these difficulties, making an accurate theoretical estimation of the economic impact of endemic diseases is challenging.

Current approaches towards the economic assessment of endemic diseases are, therefore, quite pragmatic. For on-farm decision-making, the total costs consist of failure costs and preventive costs. Failure costs are associated with production losses (i.e. decreases in milk production, mortality and culling), treatment costs (i.e. veterinary treatment, drugs, and discarded milk) and the use of other resources associated with the occurrence of disease (i.e. increased labour costs). Preventive costs are associated with preventive measures in terms of equipment, consumables (e.g. diagnostics and chemicals) and the use of other resources to prevent diseases (i.e. increased labour). There is a substitution relationship between failure costs and preventive costs. That means that, in order to maximise profit at the farm level, the amount of resources invested in prevention should be chosen in such a way that total costs are minimised.

The most studied endemic disease in animal production is mastitis. Most publications on mastitis only assess failure costs, and studies on assessing the total costs and best methods to determine an optimal level of prevention are scarce. Future challenges lie in researching frameworks that can assist decision-makers to establish optimal prevention levels for endemic diseases.

Keywords

Economics – Endemic disease – Mastitis – Production disease.

Introduction

Some endemic diseases are implicitly associated with animal production. These 'production diseases' can have severe adverse economic effects. As a result of the chronic nature of production diseases, economic damage is spread out over the years and a large part of this damage, such as lower production levels, often goes unnoticed by the farmer. Farm accounting reports give all kinds of detail about the costs of production, but generally in terms of feeding costs, machinery costs, and costs for animal improvement. Health costs comprise drug costs and veterinary treatment but these costs are only a small proportion of the total economic damage caused by production diseases.

A good understanding of the economic costs of a disease is important to support farmers' decisions on animal health. Such an understanding goes beyond the averages that are provided by the literature. Calculations of the costs of disease and the cost-effectiveness of preventive and curative measures can be regarded as averages within a certain situation. However, the costs of disease vary from farm to farm. They depend not only on the disease incidence but also on its effects on production, culling, mortality, morbidity, and price levels (1). In order to support farmers' decisions, the advisor (veterinarian) must be able to interpret such published data, translating them for the specific circumstances of an individual farm. For this reason, it is necessary to gain insight into the theories behind economic calculations in the field of animal diseases. In this paper, the authors describe animal health and the damage caused by

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production diseases from an economic perspective. Since mastitis is the most studied production disease (2), a review of the failure and preventive costs of mastitis is given to show the current approach in the application of economic principles to production diseases.

Assessing the impact of endemic diseases

Theoretically, the economic effects of a production disease should be assessed based on the production process of the dairy farm (3). This process consists of the technical relationship between resources that are used (input: capital, labour and land) and products that are produced (output: milk, with meat and calves as by-products), which can be represented by a production function (Fig. 1). This function represents the efficiency with which output is derived from the use of variable resources, within the constraints of the farm structure (for instance, available land, buildings and labour). This process is more efficient (in terms of inputs needed for a certain amount of output) for a farm without animal diseases (the top curve in Fig. 1) than for a farm with animal diseases (the bottom curve in Fig. 1).

Suppose that a farm is producing at point A on the healthy production function. Assuming unchanged use of inputs, the occurrence of disease causes the farm to move from point A on the healthy curve to point B on the diseased curve, so the output will decrease with ($Q_{H1} - Q_{D1}$).

Suppose that the farm is producing not at point A but at point C on the healthy curve. With the occurrence of a disease, the farm will move to point D, an effect of ($Q_{H2} - Q_{D2}$).

It is obvious that, in the first situation, the decrease in output is larger than in the second situation, while the disease situation remains the same.

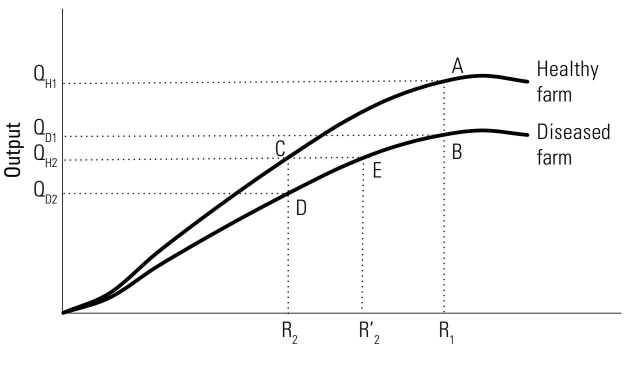


Fig. 1
Effect of disease on the dairy farm production curve

Alternatively, instead of keeping the inputs equal and producing fewer outputs due to the disease, the farmer may decide to increase the level of inputs to maintain the same number of outputs. A farm at point C will then move to point E on the healthy curve, which means that the effect of the disease is measured in the increased amount of inputs needed to produce the same amount of outputs ($R'_2 - R_2$). Depending on the choice, the damage caused by disease to a farm producing at point C on the healthy curve is either $Q_{H2} - Q_{D2}$, multiplied by the price of outputs, or $R'_2 - R_2$, multiplied by the price of inputs.

This example reflects a problem faced by dairy farmers because production diseases are always present. Should I accept a loss in output or should I increase the level of input (more drugs, more time spent by the veterinarian, more hygiene measures, etc.)? In fact, the problem is even more difficult, since the optimal level of production also depends on the prices for inputs and outputs. The economic effect of a disease would then be a movement from the optimal level of production on the healthy production curve to the optimal level of production on the diseased production curve (3). Since production functions differ from farm to farm, and since many farmers do not, in general, optimise their production level according to the rule described above, it is immensely difficult to estimate the on-farm economic effects of production diseases in a theoretically correct way. Approaches that have been used up until now to estimate the economic effects of production diseases are more pragmatic and look at a combination of additional resources to maintain production (e.g. expenditure on drugs to treat disease) or lower production with an equal input of resources (e.g. the market value of milk that has not been produced). This pragmatic approach will be described further in the following paragraphs.

The approach presented by the authors builds upon the framework introduced by McInerney (3), who defined two economic components of animal diseases: losses (L) and expenditures (E). The costs of disease (C) can then be defined as: C = L + E. Losses are the direct effects of disease resulting in reduced production outputs, including animal deaths. Expenditures are the extra resources required when disease occurs, such as treatments, veterinary costs and additional hygiene measures. An increased level of expenditure leads to a decreased level of loss. This relationship takes the form of a concave trade-off curve between losses and expenditures: the loss–expenditure frontier. The loss–expenditure frontier has been the basis of a considerable number of studies over the past 20 years. For example, Tisdell *et al.* (4) applied this framework to study the economics of helminthiasis control, but also suggested a different form of trade-off function for diseases that require an eradication programme, with high start-up costs. Yalcin *et al.* (5) tested the theoretical relationship underlying the loss–expenditure frontier with empirical data. The (normative) economic losses due to a high bulk-milk, somatic-cell count (BMSCC, which more or less reflects the mastitis situation on a farm) were related to the (normative) expenditures of four preventive measures. Rushton and Bruce (6) used the loss–expenditure frontier to study the impact of parasitic diseases on livestock and placed it in a One Health perspective.

Throughout recent years, the McInerney (3) framework has been extended. Rushton *et al.* (7) gave an extensive overview of methods for economic impact assessment. They distinguished between direct and indirect effects. Direct effects were disease losses, which could be visible or invisible. Indirect effects were additional costs (treatment) and revenues foregone (from reduced access to better markets and use of sub-optimal production technology). To develop a series of models to estimate the economic impact of 30 endemic livestock diseases in Great Britain, Bennett (8, 9) expanded the framework with a more detailed description of the components making up the expenditures. The defined components are treatments (T), prevention (P) and non-veterinary resources (R). Treatments are expenditures aimed at reducing disease losses when disease occurs. Prevention comprises expenditure to reduce the incidence or prevalence of a disease and non-veterinary resources consist of elements such as farm labour and additional feed costs associated with disease occurrence. The total costs of a disease were defined as: $C = (L + R) + T + P$. The loss–expenditure framework is also the basis for an overview of the allocation of resources for animal health, described by Howe (10) elsewhere in this issue.

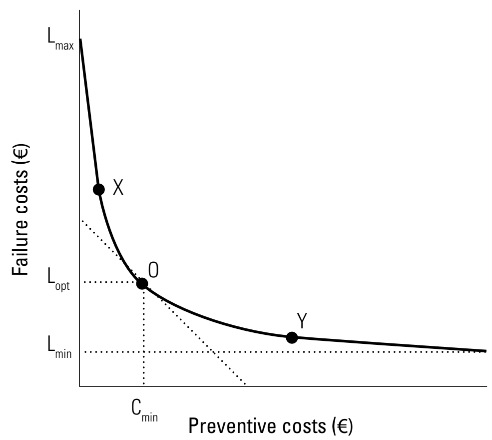
Economic impact assessments can be conducted at various levels (7) and are mostly carried out at the farm/household level or the national/international level. The frameworks of both McInerney (3) and Bennett (8) were aimed at estimating the economic impact of animal diseases at the national level.

However, most publications on production diseases are aimed at supporting the farmer to make decisions on optimal treatment and optimal disease prevention. In past years, published studies on the economic effects of production diseases have tended to estimate the costs of disease as the monetary value of losses combined with the expenditures of treatment, and generally include the human labour associated with treatment.

These costs of disease estimates can be defined as partial costs of disease (C_p) calculations, where $C_p = (L + R) + T$. Such partial costs of disease calculations at the farm level can be used to discuss the appropriate level of prevention with the farmer. Based upon that knowledge, Hogeveen *et al.* (11) introduced a distinction between failure costs (C_f) and preventive costs (C_p) of disease: $C = C_f + C_p$. Failure costs consist of production losses, treatment expenditures and additional resources (R_f) associated with production losses and disease occurrence: $C_f = L + (T + R_f)$. Expenditures associated with treatment (T) are the most obvious factor of failure cost. Treatment costs comprise costs for diagnostics, the veterinarian and drugs, and these are the most visible to the dairy farmer. The most important cost factor is production losses (L). Production diseases in dairy cattle can lead to lower milk yield, loss of growth, lower product quality, an increase in mortality and an increased risk of culling. The additional resources (R_f) required include the use of other on-farm resources, e.g. labour to take care of and treat diseased animals. Within these failure costs, there is a trade-off between expenditures, with additional resources for treatment, and production losses. More treatment expenditures and resources will lead to lower losses and vice versa. This suggests that the application of treatments can be optimised (e.g. 12, 13).

Preventive costs consist of expenditures for prevention (P) and additional resources (R_p) associated with prevention: $C_p = P + R_p$. There are a wide range of possible preventive measures against production diseases and all farmers implement some preventive measures. These can be associated with the design of the barn and milking parlour, as well as the daily management of the herd. Cost factors of preventive measures comprise expenditures on diagnostics, veterinary services (e.g. veterinary herd health and management programmes), investments and consumables (P), as well as the use of other on-farm resources (R_p).

There is also a substitution relationship, represented by a downward sloping convex curve (Fig. 2), between preventive costs and failure costs. The higher the preventive costs, the lower the failure costs of production diseases, and vice



C_{min}: minimum costs of disease
L_{min}: minimal failure costs
L_{opt}: optimal failure costs
L_{max}: maximum failure costs

Fig. 2
Schematic representation of the relationship between failure costs and preventive costs of a production disease
After McInerney (3)

versa. If no preventive measures are taken, the failure costs are maximal (L_{max}). With maximum prevention, the failure costs due to production diseases are minimal (L_{min}), but more than zero. In other words, production diseases cannot be eradicated. Because the relationship between preventive costs and failure costs is not linear, there is an optimal level of control. The optimum level of prevention takes place at that point where an additional amount of money spent on expenditure is equal to the amount of money gained from reduced failure costs. This is the point where the total costs ($C_f + C_p$) are minimal (point O; Fig. 2). In relation to the optimal level of control: at point X, the failure costs are unnecessarily high, and at point Y the preventive costs are not outweighed by reduced failure costs.

Failure costs: the example of mastitis

Mastitis is the most studied production disease and so the authors will use this disease to evaluate the methods applied to assess the economic impact of production diseases. It is possible to assess the economic effects of production diseases from farm accountancy data. In order to do so, data are needed on the incidence/prevalence of the disease of interest in combination with these farm accountancy data.

One of the first attempts to work with farm data was carried out by Vagsholm *et al.* (14). Today, econometric analysis techniques are more widely available and were recently applied in studies on gastro-intestinal nematode infections (15, 16), lameness and digestive disorders (17), reproductive disorders (18), and herd health and management programmes (19).

In terms of mastitis, Irish farm data were used from 2008 to 2011, to determine the relationship between BMSCC, milk yield and gross margin (20). This study found a relationship ($p < 0.10$) between BMSCC and gross margin per cow. A reduction in BMSCC from 400,000 cells/ml to 300,000 cells/ml gave, on average, an annual increase of 19 euros (EUR) per cow per year. Because of the nature of the study, relating gross margin per cow with BMSCC, it was not clear which part of the increased gross margin was related to a higher output (milk production per cow per year) or lower input (lower feed and veterinary costs).The advantage of empirical studies, as described above, is that they are based upon real farm data, including the variation that exists between farms. Therefore, in theory, this type of empirical study should be better able to evaluate the effect of animal diseases on the efficiency and profitability of farms. However, the results of this type of study are often difficult to interpret, as a result of confounders that are hard to correct for. For instance, a farmer with many disease problems might be a much worse herd manager than a farmer without disease problems. This lower management capacity might result not only in more disease problems but also in sub-optimal feeding. It will remain unclear whether a found association between disease and farm income can be fully attributed to the disease. Most studies on the failure costs of mastitis, therefore, use normative modelling, by employing (bio-)economic simulation models.

A wide range of methods are available to calculate the costs of a disease and the economic efficiency of disease control measures (21). A number of reviews are available about the economic effects of mastitis (1, 11, 22). Earlier reviews have summarised the costs of mastitis and estimates vary from EUR 61–97 per average cow in a herd per year (11). Older studies have often ignored important cost factors and provided lower estimates, varying from EUR 22–31 per average cow in a herd per year (1). New information published since the last review in 2011 will be summarised below.

Using a stochastic optimisation model (dynamic programming), Cha *et al.* (23) studied the costs of clinical mastitis. The costs per case of clinical mastitis were estimated under New York State (USA) conditions at 134, 211 and 95 United States dollars (USD) for gram-positive, gram-negative, and other cases of clinical mastitis, respectively. In a follow-up study, the pathogen-specific costs of clinical mastitis were calculated, while optimising treatment, culling and insemination decisions (24). It was optimal to treat the majority (92%) of the clinical mastitis cases. The costs per average case of clinical mastitis were USD 216. Given an average incidence of 35.6 cases per 100 cow-years, the costs per average cow on the farm per year due to clinical mastitis were estimated to be USD 77.

There were large differences between the estimated costs of cases of clinical mastitis caused by different pathogens. The following estimates were made (from highest to lowest costs per case): *Klebsiella* spp.: USD 477; *Escherichia coli*: USD 361; *Staphylococcus aureus*: USD 266; *Streptococcus* spp.: USD 174; and *Staphylococcus* spp.: USD 135.

A similar modelling approach was used by Heikkilä *et al.* (25) for Finnish production conditions. In this study, it was also shown that most cases of clinical mastitis should be treated instead of culled, even up to the fifth lactation. For Holstein cows, the average costs of a case of clinical mastitis were EUR 458, varying from EUR 112–946, depending on the production level of the cow. For Ayrshire cows, the costs of a case of clinical mastitis were EUR 485 (EUR 219–1,006).

Using a stochastic Monte Carlo model, the costs of clinical mastitis caused by different pathogens and treatment options were estimated for Dutch circumstances (13). The average costs of clinical mastitis under the basic treatment regime (three-day intramammary) were USD 226 per case. Other treatment regimens were shown to be more expensive, despite the higher cure rates that could be achieved. A case of *S. aureus* was the most expensive, with an average cost of USD 255, followed by *E. coli* (USD 230) and *Streptococcus* spp. (USD 196). The most expensive lactation stage was the second month of lactation, with an average cost of USD 261 per case of clinical mastitis, while cases of clinical mastitis in the final stages of lactation (≥ month 8) cost USD 154.

Down *et al.* (12) followed up on the study of Steeneveld *et al.* (13) and included the risk of mastitis transmission. They showed that, in the treatment of individual cases of clinical mastitis, the risk of transmission is an important parameter. With a high risk of transmission, a more expensive treatment can become cost efficient.

Rollin *et al.* (26) focused on clinical mastitis in the first 30 days of lactation, using a deterministic model. Most cases of clinical mastitis occur in the first months of lactation and that is also the time when clinical mastitis is most expensive. One case of clinical mastitis was estimated to cost USD 444 (diagnostics: USD 10; therapeutics: USD 36; non-saleable milk: USD 25; veterinary services: USD 4; labour: USD 21; losses from mortality: USD 32; decrease in milk production: USD 125; premature culling: USD 182; and future reproductive losses: USD 9). Apparently, mastitis is most costly of all when it occurs at the very beginning of lactation.

Using a stochastic herd simulation model (SimHerd, Tjele, Denmark), the economic effects of clinical mastitis were assessed for Danish circumstances (27). The estimated costs for a case of clinical mastitis were, on average, EUR 231 and ranged from EUR 149 (*Streptococcus* spp.) to EUR 570 (*S. aureus*). Using the same simulation model, the economic effects of mastitis (clinical as well as subclinical) were assessed for Swedish circumstances (28). The average costs (or improvement of net return) of clinical and subclinical mastitis were estimated at, respectively, EUR 88 and EUR 20 per cow per year, making the total costs of mastitis EUR 108 per cow per year.

A dynamic stochastic Monte Carlo simulation model has been developed to estimate the failure costs of mastitis in Ethiopia (market-oriented dairy farmers) (29). The simulated annual incidence of clinical mastitis varied from 0 to 50% (with an average of 22%), whereas the mean annual incidence of subclinical mastitis was 36%, varying from 0 to 75%. The total failure costs due to mastitis for a (default) farm size of eight cows were 6,709 Ethiopian birr (ETB, approximately USD 293) per farm per year (ETB 838 per cow per year). However, costs varied considerably, with the 5th and 95th percentiles at ETB 109 and ETB 22,009, respectively.

Farmers' estimation of the failure costs of mastitis

The largest proportion of the costs of mastitis consist of production losses or culling, costs that are not directly visible to the farmer. Although dairy farmers know that mastitis is associated with failure costs, in general they do not have a clear idea of exactly what these costs are. When comparing the calculated failure costs with farmers' estimates, it appeared that only 8% of farmers estimated the failure costs of mastitis correctly (30). More than half the farmers underestimated the costs of mastitis by 25% or more. Since correct estimations of the failure costs of production diseases are a basis for economically sound decision-making about preventive measures, it is important that farmers and their advisors do spend time on a proper estimation of the failure costs of production diseases.

Optimal level of prevention: the case of mastitis

The vast majority of publications on the economics of mastitis deal with failure costs. Only a few publications have assessed the economic effects of prevention.

In a Swedish study, farm accountancy data from 361 dairy farms were combined with the results of a questionnaire on preventive mastitis measures (31), using stochastic frontier analysis. The economic performance of the farms was measured by technical efficiency, which is a measure that indicates the farmer's ability to transform input into output. Keeping cows in a loose-housing barn, stimulating udders manually during milking, and having cows stand on clean bedding during milking were found to be positively related to the efficiency of a farm.

The efficiency of 18 preventive measures to reduce the level of mastitis was also assessed, using data envelopment analysis (32). Employing the results of that study, a partial budget was created to assess the net economic effect of these 18 preventive measures (11). The calculations were carried out for a default farm of 65 dairy cows with an average mastitis situation (BMSCC of 200,000 cells/ml and a yearly incidence of clinical mastitis of 30%). In general, the reduction in losses due to these preventive measures was found to be relatively low, varying between EUR 6 and EUR 36 per cow per year. Six out of the 18 preventive measures were expected to be cost effective.

One long-term preventive measure that is often mentioned is the use of sires that have inherited better health. Sorensen *et al.* (27) looked at the use of an improved breeding index for udder health, but concluded that adding pathogen-specific information in the udder health index increased the costs of udder health.

Using the dynamic programming model mentioned earlier (23), the net returns for treatment protocols and vaccination for clinical mastitis were recently generated. Two treatment protocols consisted of treating all clinical mastitis cases either with a broad-spectrum antibiotic or with a pathogen-specific treatment after pathogen identification. The targeted treatment gave the highest average net returns per cow per year. Vaccination also increased the average net returns in all scenarios (33).

The total costs of mastitis were estimated for 108 Dutch dairy farms (34). The failure costs were based on multiple test-day milk records and the incidence data of the disease, and the costs of ten preventive measures were (normatively) estimated based upon a questionnaire. The average total costs of mastitis were estimated at EUR 241 per cow per year. These costs were shared equally over failure and preventive costs. There were large differences among farms (Fig. 3). The total costs of mastitis varied between EUR 120 and 438 per cow per year. The failure costs varied between EUR 34 and 148 per cow per year, while the preventive costs varied from EUR 48 to 180 per cow per year.

Discussion and conclusions

Production diseases are responsible for causing considerable economic damage, leading to an inefficient use of resources to produce animal products. The total costs of production disease consist of failure costs and prevention costs. A first step in making economically sound decisions to assist in preventing production diseases is to gain insight into failure costs. Such failure costs have been well studied, especially in the case of mastitis, and have been found to vary considerably, depending on the production region and research method involved. It is unclear what proportion of this difference is due to different research approaches and what proportion is due to different production systems. Failure costs do vary considerably between farms, depending on the severity of the disease situation and farm-specific price levels. In addition, treatments, mortality rates and the additional need for labour are known, but a large proportion of the failure costs, such as production losses, are not directly visible. Farmers, therefore, tend to underestimate the failure costs of production diseases. Farm-specific estimates of failure costs are essential to support the decisions made by farmers and farm advisors to achieve an optimal level of prevention.

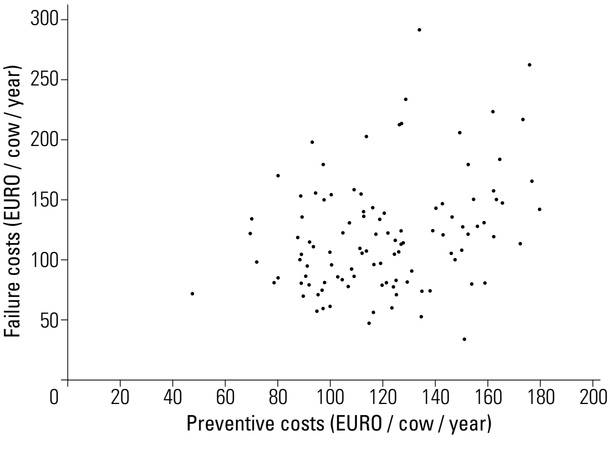


Fig. 3
Relationship between failure costs and preventive costs of mastitis on 108 Dutch dairy farms (34)

Only very limited work has been published on the total costs of mastitis. For Dutch circumstances, the total costs of mastitis were estimated to be EUR 241 per cow per year, varying from EUR 120–438 per cow per year. On average, more than half of the total costs consisted of preventive costs. The large variation in failure costs of production diseases among farms represents the room for investment in preventive measures. As a next step, the net benefits of preventive measures should be calculated. At present, there is very little scientific literature available to provide this type of information. Moreover, given such large differences between the conditions on any given farm, these types of analyses should be specific to each farm.

Not too long ago, endemic diseases, and especially production diseases, were seen as a production problem and thus a farmer's problem. Consequently, there was little involvement of the government or processing industry. However, with Western societies focusing increased attention on animal welfare and the prudent use of antibiotics, governments and the processing industry have regained an interest in production diseases. This is shown by the number of publications concerned with economic assessments of mastitis, a number that has been steadily increasing over recent years. This also means that the value of an improved endemic disease situation goes beyond an increase in production efficiency. Since society as a whole has an interest in production diseases, there is also more interest in farmer behaviour in regard to the prevention of endemic diseases. One could assume that, when farmers strive for profit maximisation, they will work at the optimal level of prevention. However, in general, farmers have more objectives than simply maximising profits (35) and, in addition, their behaviour may not always be strictly rational from the economic standpoint (e.g. 36). These other objectives should be taken into account when using the outcomes of economic calculations for decision-making (37).

In this paper, the authors argue for a novel framework to evaluate the costs of endemic (production) diseases to be used in on-farm economic analyses. In this framework, the total costs of disease consist of failure costs and preventive costs, and there is a trade-off between the two. After evaluating the scientific literature up to the present day, it became apparent that there are a considerable number of assessments of the failure costs of mastitis but only a limited number of studies about preventive costs in relation to failure costs.

Future challenges will lie in assessing preventive costs in relation to failure costs, examining how these differ among farms, and exploring how farmers can be supported and motivated to improve their prevention practices. However, almost all of the current studies are, at least in part, normative. This means that they are based on estimates and not on real farm data. Evaluating the costs of disease from farm accountancy data is very possible, but hardly ever attempted, at least thus far. Scientific research, in the near future, should try to overcome the problems that arise with this type of empirical research.

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Évaluation de l'impact économique d'une maladie endémique : le cas de la mammite

H. Hogeveen & M. van der Voort

Résumé
Une grande partie des ressources mondiales est consacrée à la production de produits d'origine animale. Il est important d'utiliser rationnellement ces ressources si l'on veut améliorer le bien-être des sociétés. Les maladies animales endémiques réduisent la rentabilité des élevages car en cas de maladie il faut plus d'intrants pour maintenir le niveau de production, tandis que celui-ci décroît si la quantité d'intrants demeure inchangée. Le niveau optimal de production avec ou sans maladie varie d'une exploitation à l'autre et dépend du contexte et des fluctuations économiques. Ces facteurs complexes expliquent la difficulté de réaliser une estimation théorique exacte de l'impact économique des maladies endémiques.
En conséquence, les approches actuelles en matière d'évaluation économique des maladies animales privilégient le pragmatisme. Au niveau décisionnel des élevages, les coûts totaux englobent les pertes d'exploitation et les coûts de la prévention. Les pertes d'exploitation sont liées aux pertes de production (baisse de la production de lait, mortalité et animaux sacrifiés), au coût des traitements (prestations vétérinaires, médicaments, perte de lait en raison des traitements) et à l'utilisation d'autres ressources en lien avec l'apparition de la maladie (augmentation des coûts de main-d'œuvre). Les coûts de prévention sont liés aux mesures de prévention et couvrent les équipements, les consommables (les réactifs et matériels de diagnostic et les produits chimiques) et l'utilisation d'autres ressources pour prévenir les maladies (augmentation des coûts de main-d'œuvre). Les pertes d'exploitation et les coûts de prévention sont mutuellement substituables. Ainsi, pour optimiser la rentabilité à l'échelle de la ferme, il conviendra de choisir le montant des ressources investies dans la prévention de manière à minimiser les coûts totaux.
La mammite est la maladie endémique la plus étudiée en production animale. La plupart des publications sur la mammite évaluent uniquement les coûts de perte d'exploitation, peu d'études ayant été consacrées à l'évaluation des coûts totaux

ou aux méthodes permettant de déterminer le niveau optimal de la prévention. Les défis futurs consisteront à élaborer des cadres permettant d'aider les décideurs à déterminer les niveaux optimaux de la prévention des maladies endémiques.

Mots-clés
Économie – Maladie affectant la production animale – Maladie endémique – Mammite.

Evaluación del impacto económico de una enfermedad endémica: el caso de la mastitis

H. Hogeveen & M. van der Voort

Resumen
Buena parte de los recursos del mundo se destinan a la obtención de productos de origen animal. Para alcanzar mayores cotas de bienestar social es importante pues utilizar esos recursos de modo eficiente. Las enfermedades animales endémicas merman la eficiencia productiva porque exigen una mayor cantidad de insumos para obtener el mismo nivel de producción o, alternativamente, reducen la producción obtenida por una misma cantidad de insumos. El nivel óptimo de producción, en presencia y en ausencia de enfermedades, difiere de una explotación a otra y depende de parámetros económicos que son variables. Estas dificultades explican por qué resulta tan arduo hacer una estimación teórica precisa del impacto económico de enfermedades endémicas.
De ahí que los métodos actuales para evaluar en clave económica las enfermedades endémicas revistan un carácter bastante empírico. En lo que concierne a las decisiones adoptadas en el ámbito de la explotación, el costo total está formado por las pérdidas de explotación y los costos de prevención. Las pérdidas de explotación vienen determinadas por las pérdidas productivas (menor producción de leche, mortalidad y animales sacrificados), el costo de los tratamientos (servicios veterinarios, medicamentos y leche desechada a consecuencia del tratamiento) y el uso de otros recursos ligados a la aparición de la enfermedad (mayores costes laborales). Los costos de prevención, que son aquellos vinculados a las medidas profilácticas, corresponden al equipo empleado, los bienes consumibles (como productos químicos o de diagnóstico) y la utilización de otros recursos para prevenir enfermedades (mayores costes laborales). Existe una relación de sustitución entre las pérdidas de explotación y los costos de prevención. Ello significa que, para que una explotación rinda el máximo beneficio, conviene fijar la cantidad de recursos invertidos en prevención de tal manera que ello reduzca al mínimo los costos totales.
La enfermedad endémica más estudiada en producción animal es la mastitis. En la mayoría de las publicaciones que se le han dedicado solo se evalúan las pérdidas de explotación, y en cambio escasean los estudios encaminados a evaluar los costos totales o a definir el mejor método para determinar el nivel óptimo de prevención. De cara al futuro, se trata de buscar modelos que puedan ayudar a las instancias decisorias a fijar los niveles óptimos de prevención de enfermedades endémicas.

Palabras clave
Economía – Enfermedad endémica – Enfermedad propia de instalaciones industriales – Mastitis.

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