Exploring the financial implications of bovine babesiosis

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The financial implications of endemic stability as a control strategy for Bovine babesiosis in veld grazing beef production systems of the KwaZulu-Natal Midlands

Industry Sector: Cattle and Small Stock

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EXECUTIVE SUMMARY

Introduction

In South Africa, cattle production has increased by 46% in 2014 compared with 2005. Local consumption trends indicate that the country is a net importer of bovine meat products, due to the supply not capable of meeting demand requirements. The country's projected population growth of 1.2% and the expected rise in beef consumption by 24% over the next ten years will require farmers to produce at greater efficiencies to meet local demand and to reverse the trade role it currently finds itself in. However, agricultural production comes with many challenges. Production diseases, such as the myriad of tick-borne diseases, are partly responsible for the challenges agriculturalists face. Amongst these, bovine babesiosis is considered as one the greatest economically important tick-borne diseases in South Africa.

Pathogenic parasites, such as *Babesia bigemina* and *Babesia bovis*, are responsible for the cause of this disease. The distribution of the parasites is directly related to the distribution of their vectors; *B. bigemina* has a greater distribution than that of *B. bovis*. Primary transmissions of *B. bigemina* in cattle older than nine months are less virulent when compared with *B. bovis*. Production losses can occur in the form of mortality, weight loss and abortions by varying degrees for either parasite. These losses coupled with treatment and prevention expenditure can result in significant costs for a farmer. A prevention strategy that has long been discussed is to apply the concept of endemic stability. This means that the cattle are provided the opportunity to take advantage of their non-specific immunity through less aggressive tick eradication methods in order for herd resistance to develop over time.

Bovine babesiosis is considered a globally important disease and is one of South Africa most economically pertinent tick-borne diseases. However, no conclusive literature has been published regarding the economic impact caused by bovine babesiosis in South Africa and is known to be a problem since at least the early 1980's. If bovine babesiosis is regarded with such high economic importance, why has there been little economic or financial research conducted internationally? Furthermore, why has South Africa not conducted exploratory economic or financial research studies in the last 35 years in an attempt to address this concern? The concept of developing a state of endemic stability through less aggressive acaricide applications is an intervention which has been suggested and is slowly implemented by the country's farmers, but no economic and financial insight is provided to those who implement this method of control.

The main research question for this study is; what is the value of adopting a strategic dipping option in an attempt to promote the development of endemic stability compared with an intensive acaricide treatment routine? By doing so, this study asks a question pertaining to the economic impact and financial implications of developing endemic stability by implementing a strategic dipping intervention. The study will be conducted at the herd level within the KwaZulu-Natal Midlands and is compared with an intensive dipping approach.

Objective Statements

The objective is to establish a set of principles enabling further economic and financial research to be pursued by primarily exploring the value of adopting a strategic dipping option in an attempt to promote the development of endemic stability compared with intensive acaricide prevention. This exploratory research should provide estimates identifying the economic consequences and financial implications of bovine babesiosis at the herd-level for either dipping strategy.

Project Aims

1. Develop a model which can provide an estimate of the economic impact and financial implications of bovine babesiosis has at the herd level of a typical farm in the KwaZulu-Natal Midlands with the available data and existing research efforts.

2. Financially compare the established dipping strategies of the KwaZulu-Natal Midlands as a result of the developed model highlighted in Point 1.

3. Establish factors in which data relevant to the research problem is scarce or non-existent encountered through the development of the model as in Points 1 and 2.

4. Establish the need for correct data collection by farmers when confronted with an infected animal in relation to Point 3.

5. Suggest methods of data collection in relation to Points 3 and 4 and further research opportunities in order to develop more accurate estimates of cost-effective management options.

Results

Preceding model development and the definition of various scenarios, simulations were run and results were analysed. For the sake of this executive summary, only the production, financial and economic analyses are presented.

The production effects of *B. bigemina* and *B. bovis* were translated into an economic impact assessment and a financial analysis of each dipping strategy per parasite prevalence. The economic impact and financial analyses of either dipping strategy and respective scenario were compared. The economic impact assessment included the sum of all discounted costs as a result of disease prevalence and severity after a primary infection had occurred in either the breeding cows, weaners and calves in each one of the fifteen simulated years. The financial analysis included all the cash in- and outflows directly related to the production of beef weaners in the face of a bovine babesiosis challenge respective of the parasite prevalence and resulting disease severity. In light of a *B. bigemina* infection, the economic impact in Scenario 2 to 4 was greater for strategic dipping but less than intensive dipping in Scenario 1. The economic consequences for intensive dipping decreased by an average of R21 115.34, with a range from R15 925.43 to R23 954.69, for each decrease in seroprevalence as per the respective scenarios. Adversely, the economic impact of strategic increased with a decrease in seroprevalence. Scenario 1 incurred the lowest impact of R82 082.86 and the greatest consequence of R95 679.96 was achieved in Scenario 4. The greatest component of the economic cost in each strategic dipping scenario was the value of weight lost consisting an average of 76% in each year. Dipping and treatment costs consisted of 10% and 9% in each year. The balance consists of recovery feed and compensatory growth costs. The value of weight lost cost component for an intensive dipping programme was greatest in Scenario 1, 2 and 3 consisting 67%, 63% and 53% of the total economic impact, respectively. This is followed by the dipping expenditure component which made up 21%, 25% and 36% of the total economic cost in each year. Dipping expenditures in Scenario 4 are greatest at 66% of the total economic cost followed by the value of weight lost at 29%. Treatment costs for Scenario 1 to three comprised 9% of the economic costs in each year and 5.0% in Scenario 4. The balance of the economic impact consists of recovery feed and compensatory feed costs. Results of the financial analyses for either dipping strategy and the respective scenarios indicate that the intensive prevention is a better financially viable option regardless of the parasite seroprevalence, and is indicated by the larger NPV and IRR values achieved.

The economic consequences of *B. bovis* are greater than that of the impacts realised due to *B. bigemina*. In all scenarios, the total economic cost of *B. bovis* is greater for strategic dipping when compared with the respective scenarios of intensive dipping. The largest cost component in strategic dipping is the value of weight lost as a result of a greater number of acute deaths and the longer duration of a recoverable infection. The value of weight lost held at an average of 95% of the total economic impact per year for either scenario of strategic dipping followed by treatment costs at 2.0%. The mean value of weight lost for intensive dipping in Scenario 1 to 3 made up 94% of the total economic cost while in Scenario 4 it is 8.0% less. Treatment costs outweighed dipping expenditures in Scenarios 1 and 2 whereas the latter component is greater than the former in Scenario 3 and 4. The economic impact realised in intensive dipping decreased by an average of R320 418.40, with a range from R244 736.00 to R362 558.30, with each decrease in seroprevalence as per the respective scenarios. Adversely, the economic impact increased from R1 255 592.16 to R1 492 277.39 with each respective decrease in seroprevalence. Despite the larger economic impact realised in all scenarios of strategic dipping, the financial analysis indicates that strategic dipping is more financially viable in Scenario 1 where a greater NPV is achieved. The conflict between NPV and IRR is resolved by identifying a cross-over rate of 7.89%. This indicates that strategic dipping is the more profitable prevention programme to choose while the interest rate remains below or equal to the cross-over rate and the seroprevalence of *B. bovis* is at 90%. In

Scenario 2 to 4, intensive dipping is the more financially viable option to choose due to the greater NPV and IRR values realised.

Conclusion

The objectives of this study have been achieved. A dynamic stochastic model was developed to simulate the economic impact of bovine babesiosis a typical beef farm of the KZN Midlands would encounter where one of two dipping strategies are applied. A financial analysis of the cash in- and outflows was performed for either dipping strategy based on the data generated by the simulations. However, the model is limited in its performance due to various assumptions that were specified. Assumptions were made due to data collection difficulties.

Considering the limitations of this model, the overall results indicate that intensive dipping realises greater benefits. These benefits are increased as the seroprevalence decreases towards a 0% situation as demonstrated when NPV results are compared with those of a healthy farm. This suggests achieving a disease-free situation by means of parasite eradication. This study does not attempt to offer economic or financial insight as to the attainment of this state. Eliminating disease through eradication will contribute to an increase in animal welfare since fewer animals will have to undergo clinical infections in order for the farmer to achieve the state of endemic stability. Current results indicate that the concept of creating endemic stability as a control strategy is not a financially viable option. It is imperative to understand that these results are inconclusive due to the lack of available data as well as the limited research efforts concerned with various production effects of the disease. Emphasis is thus placed on the need for more stringent data collection routines and research efforts in order to effectively analyse the impact of various control strategies of bovine babesiosis from an economic perspective. The economic cost component of the model in this study has been developed as a foundation for future economic research in the realm of bovine babesiosis.

Popular Article

Title for Popular Article

The economic impact of redwater and the need for data associated with the production effects of the disease

INTRODUCTION

Bovine babesiosis, more commonly known as redwater in South Africa, is considered as one of the country's most economically important tick-borne diseases. This is certainly not new information since the disease has been tagged with a label of economic importance for at least 35 years. Despite this dangling red tag of economic threat, little is known about the actual costs incurred by various stakeholders in the South African beef industry. The most recent economic impact estimate is reflected in an average annual expenditure of R5.1 million on babesicides. But how does this information help those that are affected the most by the disease; perhaps the producers? Furthermore, why has there been little to no economic research conducted to shed a little more light on this economically important disease?

A masters research study from Stellenbosch University was established to explore the economic consequences of redwater in veld grazing beef production systems of the KwaZulu Natal Midlands. For producers, research concerning the economic impact of disease is important so that a benchmark cost is known in order to compare the feasibility of other

disease mitigation strategies with a current management strategy. Estimating the cost of redwater comes with difficulties due to the scarcity in data concerning the production effects of this disease in various management systems. The lack of data is a regular constraint in other economic impact assessments of disease. To cope with data scarcity, the first objective of our research was to develop a simulation model in which can provide cost estimates of African and Asiatic redwater at the herd- and cow-level based on available data and existing research efforts. The second objective was to establish factors in which data relevant to the research problem is scarce or non-existent encountered through the development of the model, in turn emphasising the need for greater data collection efforts.

A typical farm model was developed for the design of this exploratory research. An intensive dipping management strategy was chosen since it has long been the approach to manage tick populations, and therefore the transmission of the *Babesia* parasites, before the more recent approach of strategic dipping in order to promote the development of endemic stability. Other prevention measures such as blocking and blooding were excluded due to the lack of data. The chosen factors in which redwater affected production were the cost of mortality, weight loss, compensatory growth. The cost of recovery feed, treatment and dipping is also included. Four seroprevalence scenarios for *Babesia bigemina* and *Babesia bovis*, the respective parasites responsible for the cause of African and Asiatic redwater, were simulated. The scenarios included seroprevalence levels of i) 10% as per a situation of minimal disease; ii) 40% as per an endemically unstable situation; iii) 70% as per a situation approaching endemic stability, and iv) 90% as per an endemically stable situation. Using the seroprevalence and the average age of the herd the inoculation rate could be estimated. The inoculation rate is defined as the daily probability that an animal may receive a Babesia infection.

Simulation results, summarised in Figure 1, prove that Asiatic redwater is cause for greater concern. A comparison between the Babesia seroprevalence levels show that the economic cost of Asiatic redwater per breeding cow is on average tenfold that of African redwater. The value of weight loss either as a result of acute deaths or reduced weight gains following an infection is responsible makes up the largest cost component in all scenarios for both diseases, results are summarised in Table 1. Further investigation identified which animal cohort – cow, calf and weaner – yield the greatest economic cost given the inoculation rate for each simulated seroprevalence scenario. As illustrated in Figure 2 the economic impact is greatest in cow cohorts for lower seroprevalence levels. In higher seroprevalence scenarios the economic impact is felt greatest in weaner cohorts. This may be due to the calves being weaned where too few of them have received a primary infection before the age of nine months, resulting in too few attaining a non-specific immunity, but enough such that a risky population of Babesia parasites are harboured in the newly formed weaner cohort. Thus, more weaners receive a primary infection in which a nonspecific immunity can no longer be attained. In our research, we attempted to simulate the economic impact of a strategic dipping strategy for the same herd. However, it was quickly discovered that results would not be reliable since there was not enough data to serve as input for this prevention strategy.

The objectives of this research were achieved in which a model was developed to explore the economic impact of redwater at the herd- and cow-level. Through the process of conducting this study, many constraints were encountered. These were largely in the form of scarce or non-existent data. Data concerning the production effects of redwater on *Bos indicus* cross *Bos taurus* breeds are not enough. Research efforts have investigated effects of the disease on certain variables such as weight loss, compensatory weight gain during recovery and are

more concerned with *Bos taurus* breeds. Therefore, studies as such should be continued but more focus should be placed on the cross breeds. No studies were available concerning the effect that redwater had on milk production - and the subsequent effects it would have on calf growth, fertility, abortion and replacement. This gap in the literature should be addressed by livestock scientists and veterinarians. Greater knowledge pertaining to the effects of these production variables will lead to better cost estimates and the promotion of various cost-effective intervention strategies. *Babesia bovis* should continue to be the primary researched parasite due to its greater impact on production. The collection of data by farmers encountering such production effects should also be documented more strictly. Most farmers acknowledge the presence of the disease but do not document it and the resulting production effects; such data can aid research. This, however, is a challenging task as it requires the farmer to know the current seroprevalence amongst his/her heard and to continuously check its status throughout the year, to maintain strong relationships with the veterinarians in the area in order to correctly diagnose a sick animal and to communicate the data between the actors effectively. This may be costly for a farmer and lead to further economic studies researching the economic value of continuous Babesia seroprevalence monitoring in a herd.

In conclusion, this research has laid down the first stepping stone in the path of exploring the economic impact of redwater. Estimating the economic impact of redwater may only tell us something we already know, but without a cost estimate of redwater research cannot compare the costs of alternative management strategies to a “norm”. Therefore, the need for more data associated with the production effects of redwater is emphasised. With the collective efforts of those in practice and research with an aim to collect data, more light will be shed on redwater for the benefit of the beef industry.

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