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Discounted Cash Flow Analysis of Disease Control Programs

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'The overall goal of this project is to develop and evaluate the .necessary tools to provide decision-makers with reliable animal health information which is placed in context and analysed appropriately in both Thailand and Australia. This goal will be achieved by improving laboratory diagnostic procedures; undertaking research to obtain cost-effective population referenced data; integrating data sets using modern information management technology, namely a Geographical Information System (GIS); and providing a framework for the economic evaluation of the impact of animal diseases and their control.

A number of important diseases will be targeted in the project to test the systems being developed. In Thailand, the focus will be on smallholder livestock systems. In Australia, research will be directed at the northern beef industry as animal health information for this sector of livestock production is presently scarce.'

For more information on *Research Papers and Reports Animal Health Economics* write to Professor Clem Tisdell (c.tisdell@economics.uq.edu.au) or Dr Steve Harrison,(s.harrison@uq.edu.au) Department of Economics, University of Queensland, Brisbane, Australia, 4072.

DISCOUNTED CASH FLOW ANALYSIS OF DISEASE CONTROL PROGRAMS

ABSTRACT

In this paper the benefits of *B. bovis* vaccination are valued, and the decrease in expenditure on the diagnosis and treatment of disease determined and valued. The costs associated with the *B. bovis* vaccination program are then identified, quantified and valued. The effect of changes in disease incidence, level of natural disease resistance in the herd, and choice of discount rate on economic performance criteria are examined in model simulations.

Keywords: Animal disease, Babesia Bovis, livestock vaccination

JEL Classification: Q16.

DISCOUNTED CASH FLOW ANALYSIS OF DISEASE CONTROL PROGRAMS

1. Introduction

As part of the examination of a vaccination program the costs and benefits associated with the program can be determined and valued and the economic performance criteria estimated.

Discounted cash flow analysis is a suitable method to assess the economic performance of a livestock vaccination program. In this chapter the principles of private discounted cash flow analysis are outlined. Then discounted cash flow analysis is used to determine the economic viability of *B. bovis* vaccination from the viewpoint of an individual cattle producer. Production benefits of vaccination in terms of production loss avoided have been estimated in the previous discussion paper and estimates from the model developed are used as inputs into the analysis carried out in this paper. In this paper the benefits of *B. bovis* vaccination are valued, and the decrease in expenditure on the diagnosis and treatment of disease determined and valued. The costs associated with the *B. bovis* vaccination program are then identified, quantified and valued. The effect of changes in disease incidence, level of natural disease resistance in the herd, and choice of discount rate on economic performance criteria are examined in model simulations.

2. Discounted Cash Flow Analysis

The aim of discounted cash flow analysis is to reduce the costs and benefits of a program to a common unit, money at a set point in time, usually the present, by the use of discounting and to compare the costs and benefits. A project generates cash flows where cash flow refers to any movement of money to or away from a project. Cash outflows are payments including capital outlays and annual operating costs while cash inflows are the revenues or cost savings that the project produces. The net cash flow in each year is the difference between total cash inflows and total cash outflows. The cash flows predicted for the control program are compared to those in the absence of the control program. In this case the cash flows are also referred to as incremental cash flows.

Expenditures are included in the cash flows at the time at which they occur. Cash flows do not include interest payments. This is because discounting simulates interest payments and if interest payments are included in the cash flow they are counted twice.

Taxation is not included in the discounted cash flow analysis in this chapter. This is because each producer will have a range of investments and it is not possible to calculate taxation for each individual.

2.1 Discounting in cash flow analysis

Discounting is used to estimate the present value of a future value. Discounting is used because project costs and benefits occur at different times in the project life. For example, in a vaccination program the cost of vaccination is incurred before the benefits of vaccination are received in the form of increased productivity. The value of the costs or benefits in today's dollars is called the present value. The process of discounting is the reverse of compounding interest and principal calculations (Gittinger, 1982, p. 308; Department of Finance, 1991, p. 42). Discounting is carried out separately for each year of the program.

The discount rate can be estimated as the cost of capital, that is a weighted average of borrowing rate and opportunity cost of own funds. However, if the farmer owes money, the rate of interest he is paying is generally higher than that he would receive from the bank if he had money to invest. Therefore, the appropriate discount rate may vary with the circumstances of the farmer.

2.2 Dealing with inflation in discounted cash flow analysis

Future costs and benefits can be valued using either real, also referred to as constant, prices or current prices. If constant prices are used, all variables are expressed in terms of the price level at a fixed point in time. This approach assumes that inflation will affect all costs and benefits equally. If it is probable that particular costs or benefits will not follow general price movements, then changes in relative prices can be allowed for in the analysis. The less commonly used current price approach uses the estimated prices at the time the cost is incurred or the benefit received. This is a more complex approach because inflation rates must be estimated for the duration of the project (Department of Finance, 1991, p. 52). While the current price approach provides the advantage of allowing for the impact of inflation on the cash flow projections, cash flows are usually calculated in terms of real prices.

2.3 *Economic performance criteria in discounted cash flow analysis*

Several criteria can be used to compare the performance of a project. Some of the commonly used criteria are benefit to cost ratios, the net present value and the internal rate of return. Each of these criteria is examined in this section.

A benefit to cost ratio (B/C ratio) is the ratio of the present value of benefits to the present value of costs for a program. This ratio can be calculated as either a gross or net B/C ratio, defined respectively as:

$$gross\ B/C\ ratio = \frac{PVB}{PVC}$$

$$net\ B/C\ ratio = \frac{PVB - PVCO}{PVCC}$$

where *PVB* is the present value of benefits

PVC is the present value of operating costs plus capital costs

PVCO is the present value of operating costs, and

PVCC is the present value of capital costs

For a program to be acceptable, the ratio must be at least one. Where the costs and benefits occur at different times of the program the B/C ratio can be highly susceptible to the discount rate that is used to calculate present values. The B/C ratio can be used to rank disease control strategies with priority being given to those diseases for which the control program yields the highest B/C ratio. However, it is not necessarily logical to determine the optimal scale of a program nor to choose between alternative programs by maximising the B/C ratio (Mcinerney, 1991; Tisdell, 1995).

The net present value of a program is the sum, for all years of the project, of the total benefits received in the year minus the total costs in the year (that is the annual net cash flow) discounted by the appropriate discount factor to convert each annual total to present value terms. The formula to calculate the NPV is as follows:

$$NPV = \sum_{t=0}^{t} \frac{(B_t - C_t)}{(1 + r)^t}$$

where B_t is the dollar benefits received in any year t

C_t is the costs incurred in any year t

r is the discount rate

A project is economically viable if the net present value is positive. In comparing projects it has been suggested that the project that maximises the net present value is preferable (Department of Finance, 1991, p. 48). However, this is not necessarily so as NPV does not provide an indication of the rate of return on invested funds. For example, a project may have a high NPV but use a large amount of capital and provide a low return on invested funds. The net present value was used as the criterion in the cost-benefit analysis carried out on foot and mouth disease by Power and Harris (1973).

The internal rate of return (IRR) is the discount rate that would give a net present value of zero. The IRR suffers from a number of limitations, in particular the IRR may not exist or may not be unique. For example, where the net cash flow of a project is positive for each year of the project the NPV will never be zero regardless of the discount rate. In this situation it is not possible to calculate an NPV. Where the net cash flow varies from negative to positive several times during the life of the project the IRR can have a number of values. In this case it is not possible to determine a single IRR. In addition, when used to compare two projects the IRR can be misleading when the projects differ in scale (Department of Finance, 1991, p 114). The internal rate of return can be determined by trial and error (Gittinger, 1982 p. 332) or by using Newton's approximation to solving a polynomial equation (Harrison, 1996).

The B/C ratio and the IRR indicate a rate of economic payoff while they and the NPV indicate whether or not a project is economically viable. A project is economically viable if B/C is greater than one, IRR is greater than the cost of capital and the NPV is greater than zero. None of the criteria alone is sufficient to make a decision on whether to carry out a disease control program or not. However, providing their limitations are understood they provide valuable guidance.

3. Costs of a *Babesia bovis* Vaccination Program

In this section the costs associated with a *B. bovis* vaccination program are identified. Project costs are made up of capital expenditures and variable costs. Capital costs in a *B. bovis* vaccination program are examined first followed by variable costs.

In general no capital costs are incurred in the implementation of a vaccination program on a cattle property in Central Queensland. This is because the necessary infrastructure such as fencing and cattle handling facilities are already in place and are used for other management activities.

The major costs in a vaccination program are variable costs, namely:

- cost of vaccine
- cost to administer the vaccine
- cost of mustering and handling the cattle

3.1 Valuation of variable costs of a Babesia bovis vaccination program

In this section the values of the variable costs of a *B. bovis* vaccination program, namely vaccine cost, administration of vaccine cost and mustering cost are determined.

Vaccine against *B. bovis* is usually sold in combination with vaccine against *A. marginale*. The vaccine is also available in combination with *B. bigemina*. While available vaccine against *B. bovis* alone is not often used. A price of $1.59 per dose was estimated for the *B. bovis* vaccine and is used in this chapter. This price was determined in association with Dr Bert de Vos of the Tick Fever Research Centre, Wacol, Queensland that produces the vaccine. The cost to administer the vaccine is estimated as 50 cents per head.

Vaccination of cattle is often carried out when cattle are mustered for another purpose, such as weaning, and is therefore not an additional cost that is incurred by the vaccination program. Mustering costs are therefore considered to be zero in this analysis.

4. Benefits from a *Babesia bovis* Vaccination Program

The benefits from a *B. bovis* vaccination program are outlined and valued in this section. The benefits of a disease control program are made up of two components. These are firstly the production loss avoided due to the disease being controlled and secondly the reduction in expenditure in treating cases of the disease due to the reduced number of cases.

It is more difficult to value benefits than costs. Where possible in determining the value of a benefit the market value of that benefit should be used. For most agricultural commodities the price at the first point of sale is appropriate provided this is a competitive market (Gittenger, 1982). The price that the farmer sells his product for is known as the 'farm gate price'. The increased value added as the goods are processed and delivered to a market is a payment for market services and therefore is not a result of the investment to produce the commodity (Gittinger, 1981, p. 70). However, the use of the farm gate price may actually undervalue the animal for the producer. For example, if the farmer had to buy another to replace one he would not only have to pay the transaction costs but would also have to transport the animal from the market to his farm.

The production loss avoided by vaccination in liveweight terms is estimated in the previous paper. The value of the loss avoided is determined using prices estimated from market prices published in the Queensland Country Life (Anon., 1996) these are presented in Table 1. The prices used are indicative of prices being paid in Central Queensland at the time of writing. Additional calves born are valued at $50 per calf.

Table 1: Prices of cattle derived from sales data for Central Queensland

	Price	
Age (years)	Price for males (cents per kilogram liveweight)	Price for females (cents per kilogram liveweight)
1	82	77
2	93	77
3	93	60
4	82	60
5	77	60
6	77	60
7	77	50
8	77	50

The expenditure no longer incurred as a result of the *B. bovis* vaccination program consists of the costs for the diagnosis and treatment of animals avoided due to disease avoided. A proportion of animals that exhibit clinical disease following infection with *B. bovis* would have a diagnosis made and treatment instituted. Empirical data are not available to determine the proportion of cases for which this is done. Estimates are therefore made about the proportion of cases in which a diagnosis is made and treatment instituted. These estimates were made in association with Dr Peter Black of QDPI. The estimates are:

- one third of all cases of disease have a diagnosis made and the diagnosis costs $10 per case, and
- one third of all cases of disease have treatment instituted and treatment costs $20 per case treated.

5. Linking the Discounted Cash Flow to the Disease Prediction I Vaccination and Production Loss Avoided Models

The discounted cash flow was entered into a computer spreadsheet using the package Microsoft Excel. The spreadsheet has automatically updated links to the models developed in earlier chapters. This enables model simulations to be carried out using outputs from the disease prediction/vaccination model developed in Discussion Paper 34 and the production loss avoided model developed in Discussion Paper 35 as inputs into the discounted cash flow analysis. The effect of vaccination programs on economic performance criteria can therefore be rapidly assessed for various levels of age specific seroprevalence and susceptibility of cattle in the herd to disease.

6. Results of Model Simulations to Determine Economic Performance Criteria for *Babesia bovis* Vaccination Programs

The results of model simulations carried out to determine the economic performance criteria for *B. bovis* vaccination programs are presented and examined in the next three sections. The input data, on the production loss avoided by *B. bovis* vaccination programs, are derived from simulations carried out using the spreadsheet models developed in Discussion Papers 33, 34 and 35. The transition matrix of the disease prediction/vaccination model is held constant in these experiments. The initial state vector is the steady state vector without a vaccination program. The planning horizon is eight years and is the same as that used in the disease prediction/vaccination model.

The effect of variation of two factors on the economic performance criteria are examined in the simulations. The factors varied are:

- level of disease resistance in the herd
- incidence risk of infection

Three herds with different levels of host susceptibility to disease following infection are examined. The three levels of disease susceptibility are resistant, intermediate and susceptible are discussed in Section 6.1, Section 6.2 and Section 6.3 respectively. The herd size and structure is the same as that developed in Paper 33 and is held constant.

Seroprevalence in yearling animals is used as the indicator of incidence risk of infection in the model simulations. Seroprevalence data are the data collected in SAHS in Queensland and provide the input into the disease prediction model used to estimate the incidence risk of infection. In model simulations the effect of variation in seroprevalence in yearling cattle on economic performance criteria is examined at nine levels, namely 10, 20, 30, 40, 50, 60, 70, 80 and 90%, for each level of host susceptibility to disease.

Two vaccination programs are examined, Vaccination program 1 and Vaccination program 2 which are defined in Discussion Paper 34.

Three performance criteria NPV, a B/C ratio and IRR are estimated. Sensitivity analysis using three discount rates (4%, 8% and 12%) is performed for NPV and B/C ratio.

6.1 Economic performance criteria for Babesia bovis vaccination programs in disease resistant cattle

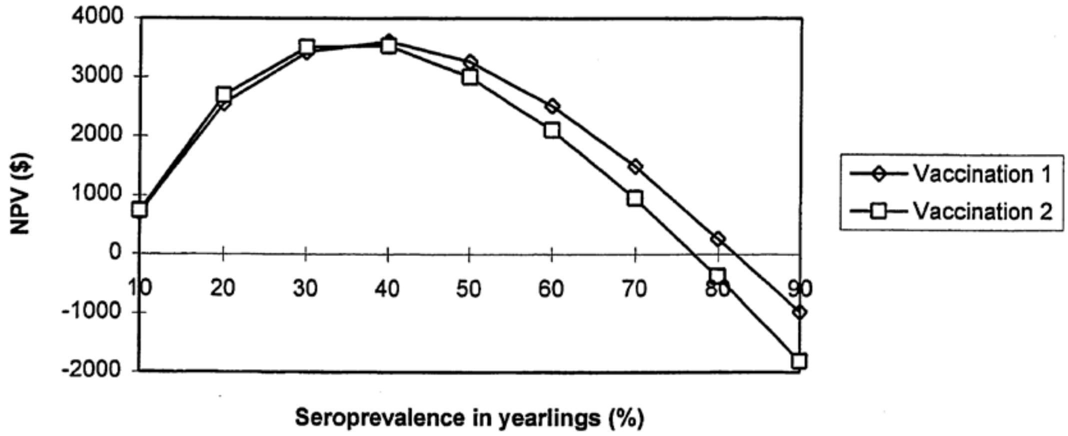
In this section the results of model simulations to determine the economic performance criteria for a herd of disease resistant cattle are presented and examined. Figure 1 illustrates model estimates of the NPV while Figure 2 illustrates model estimates of the B/C ratio. In these two figures estimates for both vaccination programs examined at each seroprevelance are displayed for each of three discount rates. The IRR for the two vaccination programs at each seroprevalence are presented in Figure 3.

As illustrated in Figure 1 the NPV is positive for both Vaccination program 1 where the seroprevalence in yearling animals is 80% or less and for Vaccination program 2 where the seroprevalence in yearling animals is 70% or less. NPV decreases with increases in the discount rate for both vaccination programs, but the predicted reductions are small. Changing the discount rate in sensitivity analyses does not modify the ranking of the programs using the NPV. The NPV for Vaccination program 2 exceeds that for Vaccination program 1 when the seroprevalence is between 20% and 40%.

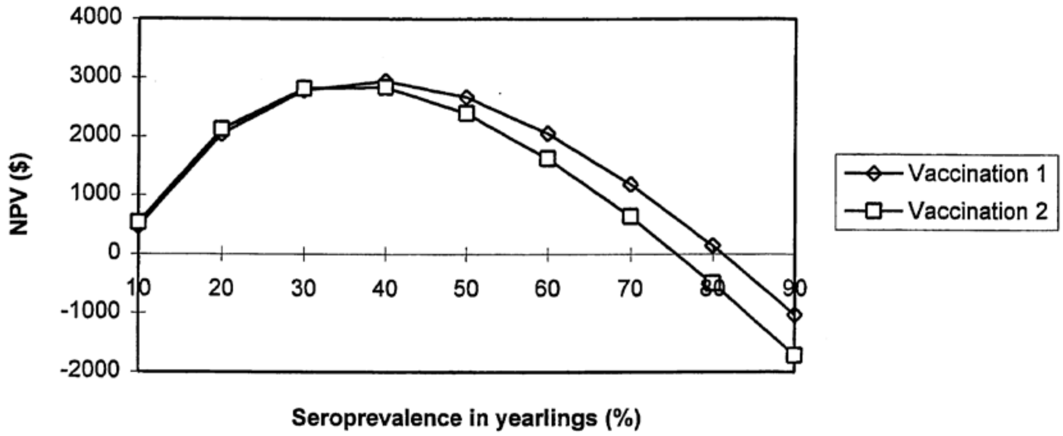
The B/C ratio is greater than one for Vaccination program 1 at all seroprevalences below 90%. In the case of Vaccination program 2 the B/C ratio is greater than one at all seroprevalences below 80%. The B/C ratio of Vaccination program 1 exceeds that for Vaccination program 2 at all seroprevalences (Figure 2). Small decreases are seen in the B/C ratio with increasing discount rate in sensitivity analysis.

Figure 1: NPV for *B. bovis* vaccination programs in a herd of disease resistant cattle

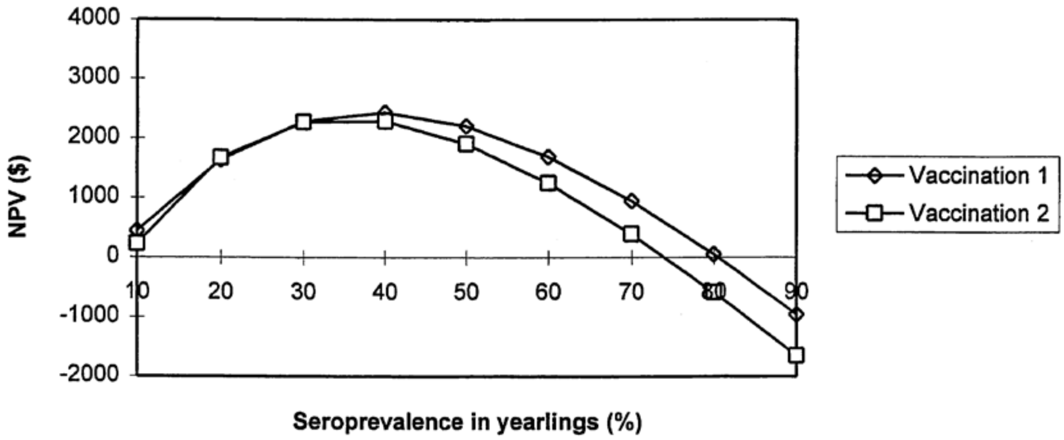
1a: Discount rate 4%



1b: Discount rate 8%



1c: Discount rate 12%



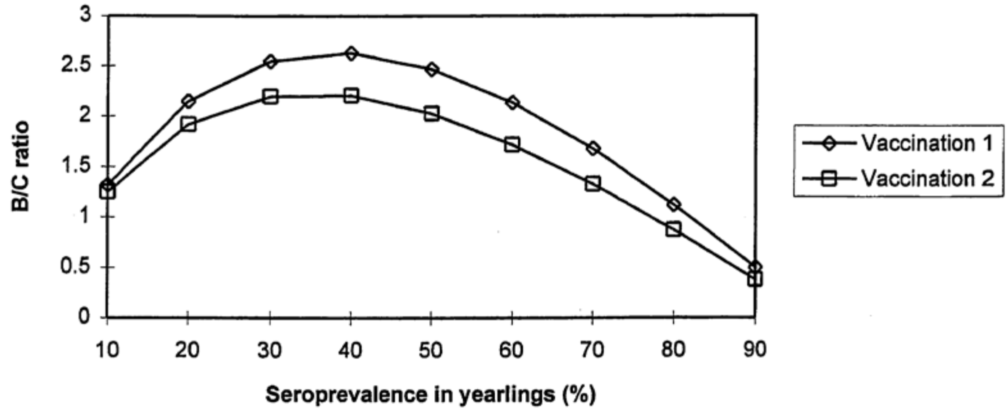
In the case of Vaccination program 1 where the seroprevalence in yearlings is 80% the IRR is positive and at 15% would exceed the cost of borrowing money in most cases. Where the seroprevalence in yearlings is less than 80% the IRR is larger than that at 80%. For Vaccination program 2 where the seroprevalence is 70% the IRR at 21% would exceed the cost of borrowing in most cases. For Vaccination program 2 where the seroprevalence is less than 70% the IRR is greater than that at 70% and where the seroprevalence is greater than 70% the IRR is less than that at 70%. The IRR for Vaccination 1 exceeds that for Vaccination 2 at all seroprevalences at which the IRR could be calculated (Figure 3). The IRR cannot be calculated where the seroprevalence in yearlings is 90% because the cash flows are negative in each and every year for both vaccination programs. The highest internal rates of return are obtained where the seroprevalence is 40%, with an IRR of 114% for Vaccination program 1 and an IRR of 62% for Vaccination program 2.

Vaccination program 1 meets the criteria for economic viability (defined in Section 2.3) where the seroprevalence in yearling animals is less than or equal to 80%. Vaccination program 2 meets the criteria where seroprevalence is less than or equal to 70%. From this it is seen that *B. bovis* vaccination is economically viable in disease resistant cattle herds except where the incidence risk of infection is high.

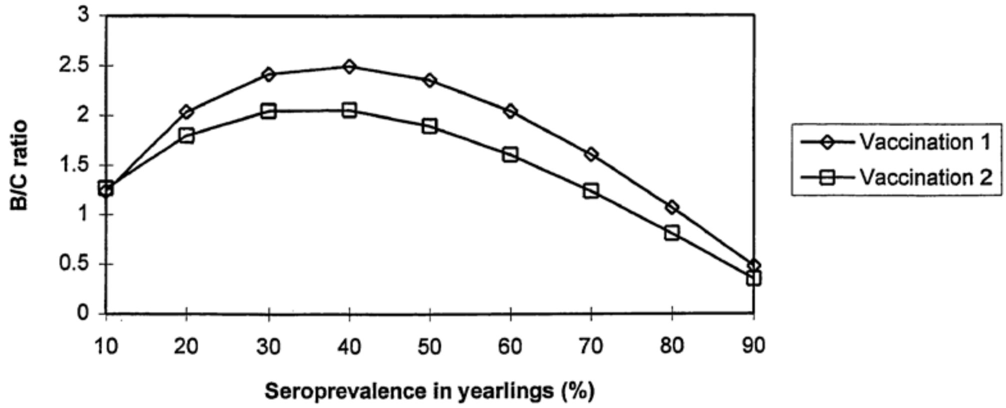
Small changes in NPV and B/C ratio occur with sensitivity analysis and probably occurs because there are not any capital costs associated with the project and both costs and benefits occur in each and every year of the program.

Figure 2: BIC ratios for *B. bovis* vaccination programs in a herd of disease resistant cattle

2a: Discount rate 4%



2b: Discount rate 8%



2c: Discount rate 12%

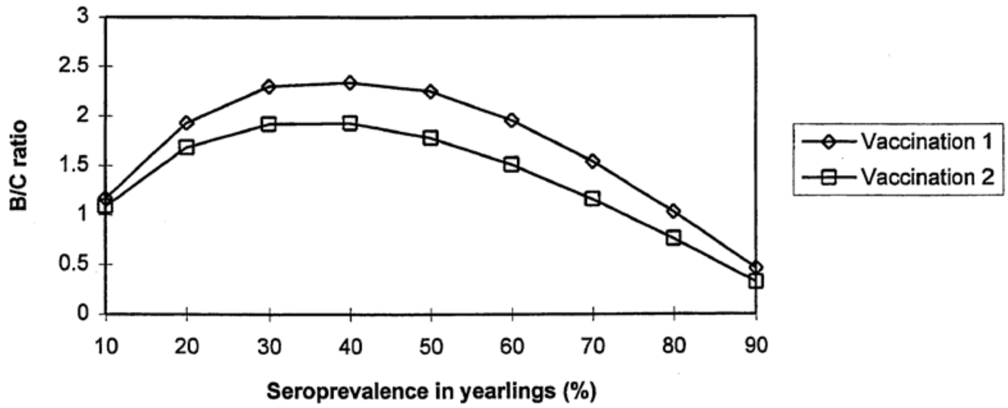
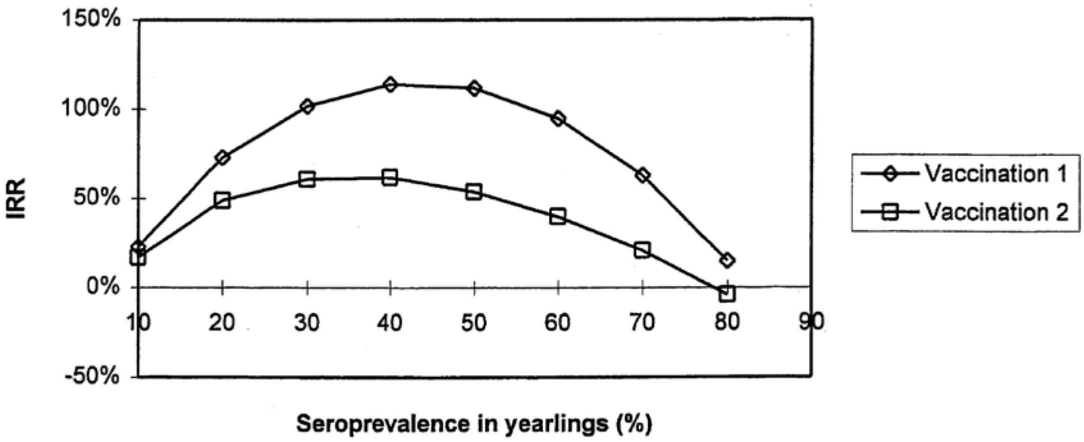


Figure 3: IRR for *B. bovis* vaccination programs in a herd of disease resistant cattle



6.2 Economic performance criteria for Babesia bovis vaccination programs for cattle of intermediate disease resistance

In this section the results of model simulations to determine the economic performance criteria for a herd of cattle of intermediate disease resistance are presented and examined. Figure 4 illustrates model estimates of the NPV while Figure 5 illustrates model estimates of the B/C ratio. In these two figures estimates for both vaccination programs examined at each seroprevelance are displayed for each of three discount rates. The IRR for the two vaccination programs at each seroprevalence are presented in Figure 6.

The performance criteria of both vaccination programs examined in the herd of cattle of intermediate disease resistance follow similar patterns to those for the disease resistant herd. In all cases the performance criteria are superior to those predicted for the disease resistant herd.

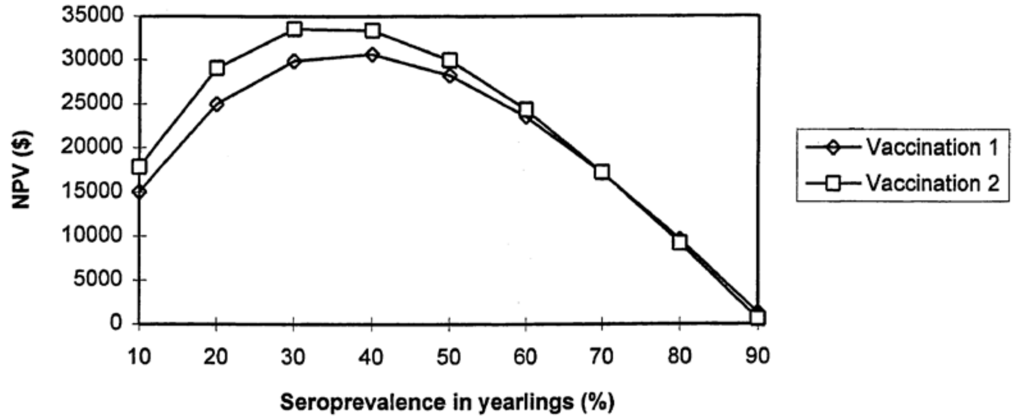
As illustrated in Figure 4, the NPV is positive for both Vaccination program 1 and Vaccination program 2 at all levels of seroprevalence in yearling animals. However, the NPV is low where the seroprevalence is 90%, being $1030 for Vaccination program 1 and $344 for Vaccination program 2 at a discount rate of 8%. Vaccination program 2 has the higher NPV's when the seroprevalence is below 60%. The NPV of the two programs are similar at seroprevalences higher than 60%.

Vaccination program 1 has a higher B/C ratio than Vaccination program 2 at all levels of seroprevalence. The B/C ratio is low where the seroprevalence in yearling animals is 90%, being 1.52 for Vaccination program 1 and 1.13 for Vaccination program 2 at a discount rate of 8%. At all other levels of seroprevalence in yearlings the B/C ratio is larger. The B/C ratio is highest at 14.82 at a seroprevalence of 40% for Vaccination program 1 and at 12.49 at a seroprevalence of 30% for Vaccination program 2.. Sensitivity analysis for the discount rate has a small effect on the B/C ratio.

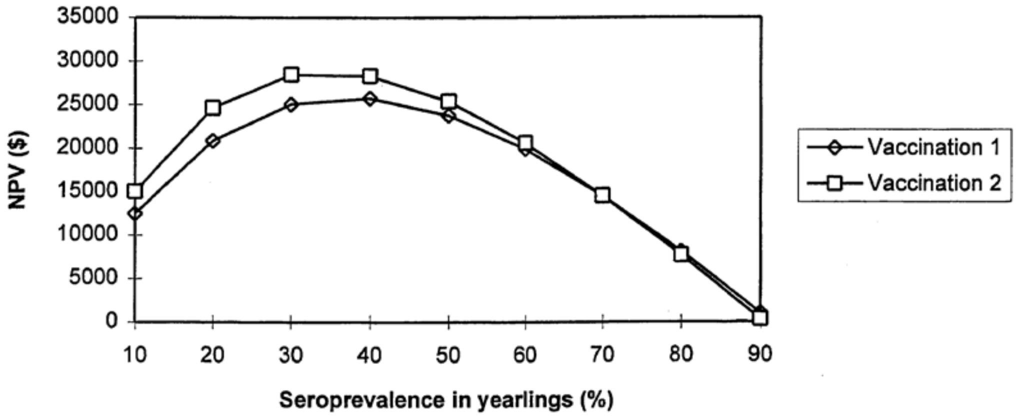
The IRR is above 100% at most levels of seroprevalence for both vaccination programs. The IRR decreases where the seroprevalence in yearlings is 90%, and is 63% for Vaccination program 1 and 15% for vaccination program 2 at that level of seroprevalence. The results are presented in Figure 6.

Figure 4: NPV for vaccination programs in a herd of cattle of intermediate disease resistance

4a: Discount rate of 4%



4b: Discount rate of 8%



4c: Discount rate of 12%

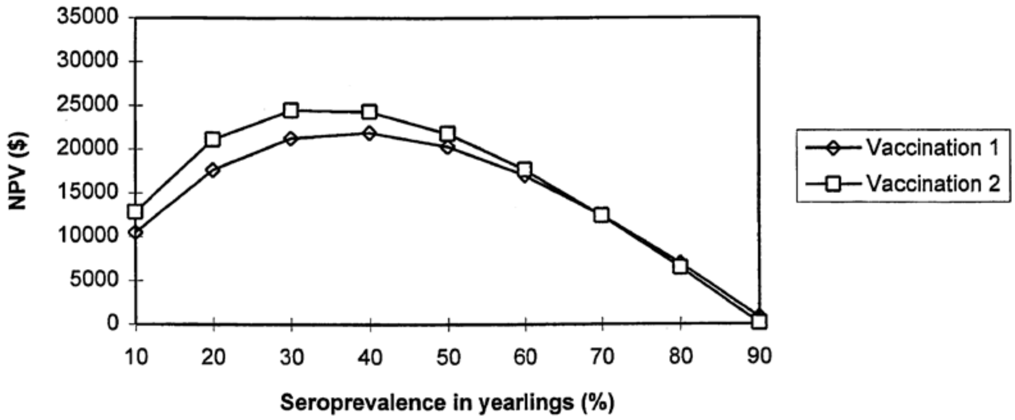
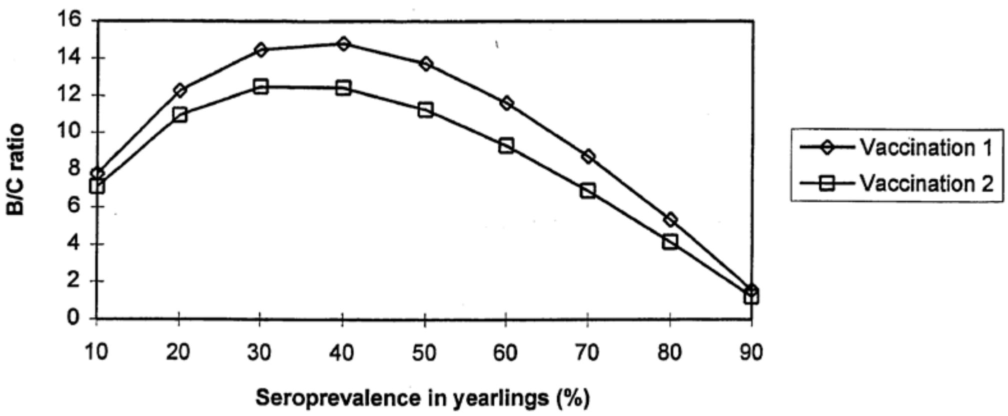
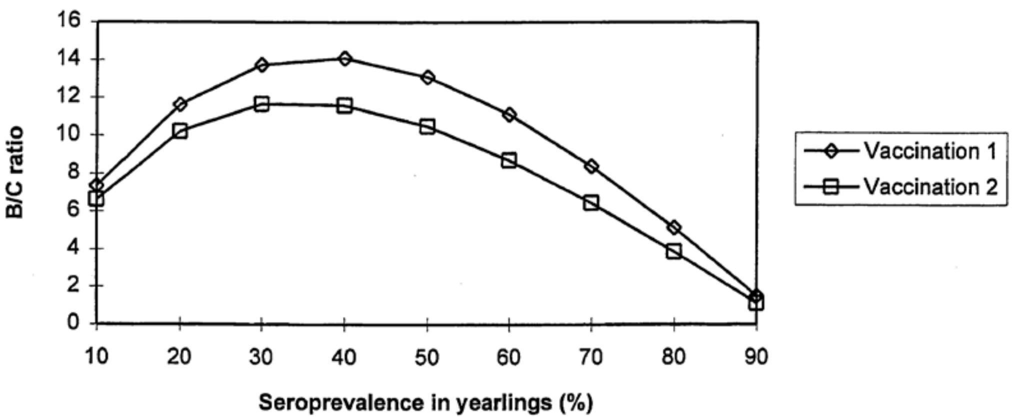


Figure 5: B/C ratios for vaccination programs in a herd of cattle of intermediate disease susceptibility

5a: Discount rate of 4%



5b: Discount rate of 8%



5c: Discount rate of 12%

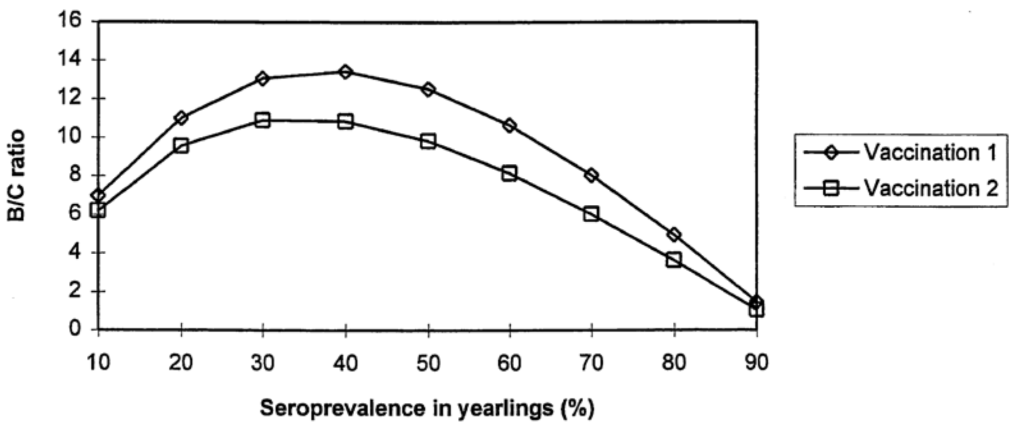
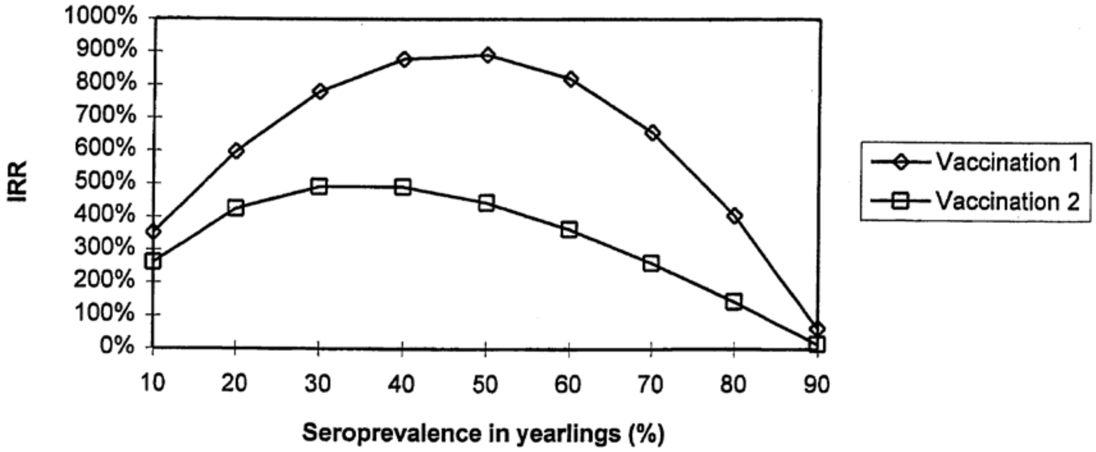


Figure 6: IRR for vaccination programs in a herd of cattle of intermediate susceptibility



6.3 Economic performance criteria for Babesia bovis vaccination programs in herds of disease susceptible cattle

In this section the results of model simulations to determine the economic performance criteria for a herd of disease susceptible cattle are presented and examined. Figure 7 illustrates model estimates of the NPV while Figure 8 illustrates model estimates of the B/C ratio. In these two figures estimates for both vaccination programs examined at each seroprevelance are displayed for each of three discount rates. The IRR for the two vaccination programs at each seroprevalence are presented in Figure 9.

The performance criteria estimated for Vaccination program 1 and Vaccination program 2 in the herd of disease susceptible cattle follow a similar pattern to those for the disease resistant and intermediate herds examined in the previous sections. The performance criteria are higher than for both the resistant and intermediate herds.

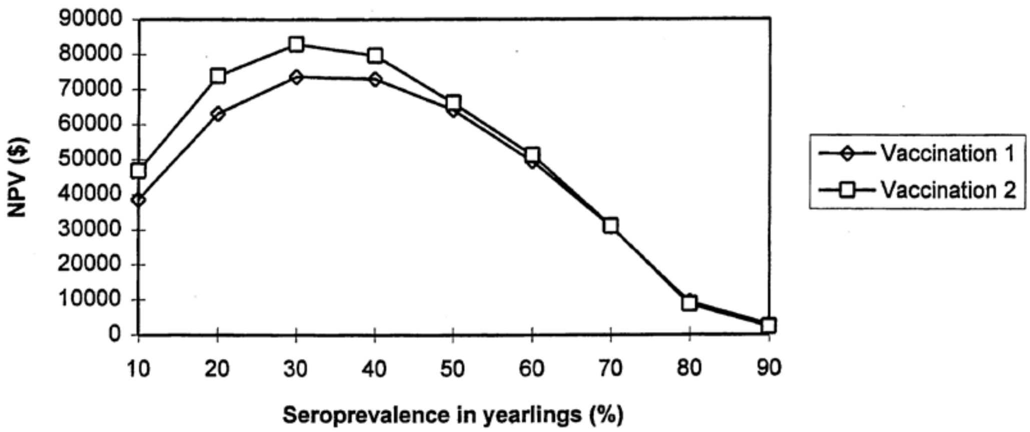
For herds of susceptible cattle, as illustrated in Figure 7 the NPV, is positive for both vaccination programs for all levels of seroprevalence. The NPV is lowest where seroprevalence is 90%. Where seroprevalence is 90% in yearling animals the NPV is $2319 for Vaccination program 1 and $1694 for Vaccination program 2 at a discount rate of 8%. Vaccination program 2 gives rise to a higher NPV than Vaccination program 1 when the seroprevalence is below 60%. Variation of the discount rate in sensitivity analysis has little effect on the NPV for either vaccination program and does change the ranking of the programs at any of the seroprevalences examined.

Vaccination program 1 has a higher B/C ratio than Vaccination program 2 at all levels of seoprevalence in yearling animals (Figure 8). Sensitivity analysis on the discount rate does not affect the ranking on the programs by the B/C ratio and the effect on the value of the ratio is small.

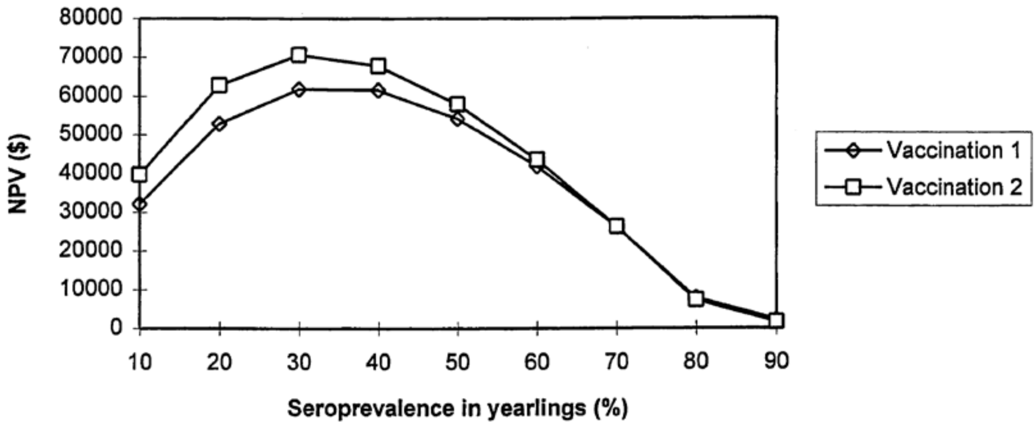
IRR reaches its highest level of 2177% for Vaccination program 1 where the seroprevalence in yearlings is 40% and 1196% for Vaccination program 2 where the seroprevalence in yearlings is 30%. The lowest IRR values of 66% for Vaccination program 1 and 32% for Vaccination program 2 are predicted to occur where the seroprevalence in yearling animals is 90%.

Figure 7: NPV for *B. bovis* vaccination in a herd of susceptible cattle

7a: Discount rate 4%



7b: Discount rate 8%



7c: Discount rate12%

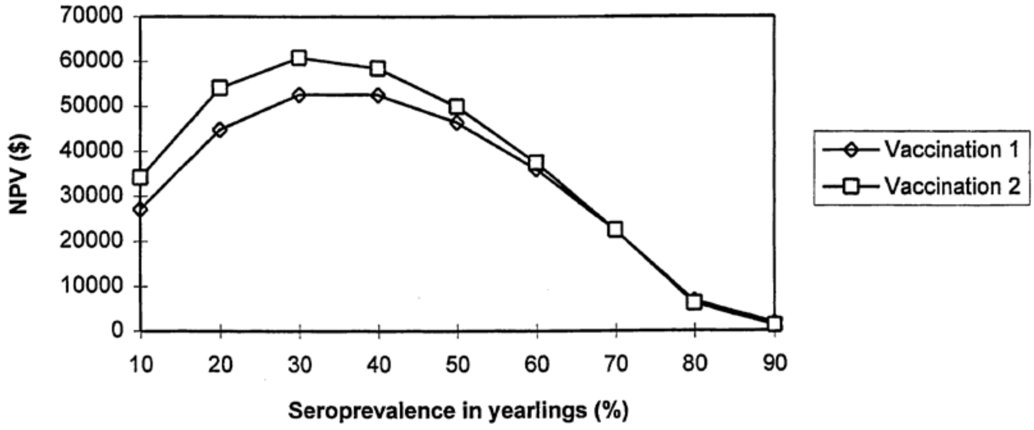
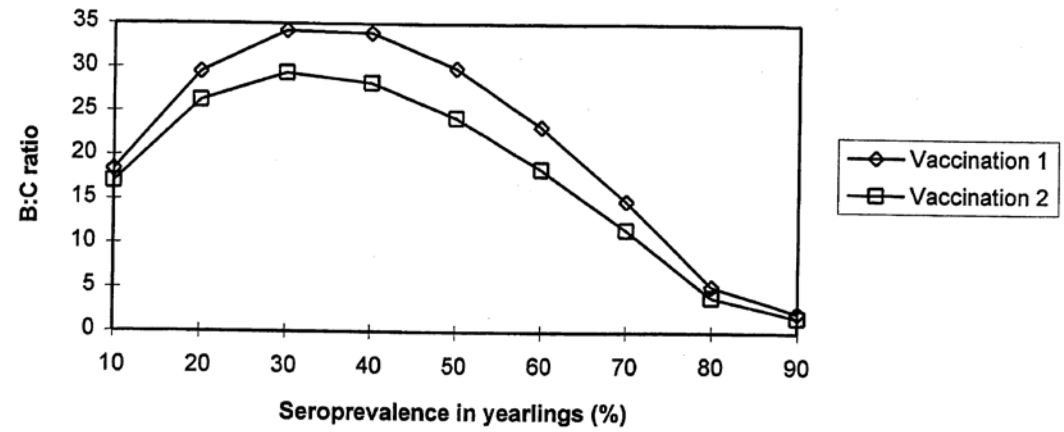
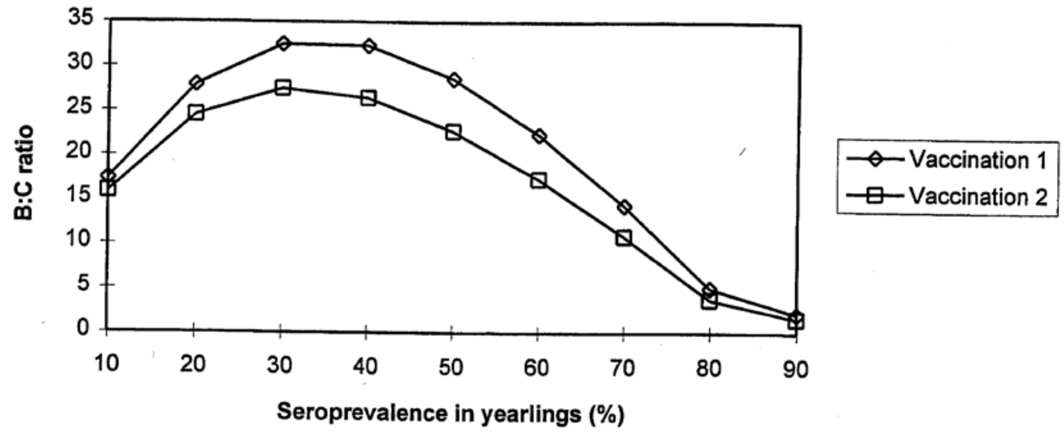


Figure 8: B/C ratio for *B. bovis* vaccination in a herd of susceptible cattle

8a: Discount rate 4%



8b: Discount rate 8%



8c: Discount rate 12%

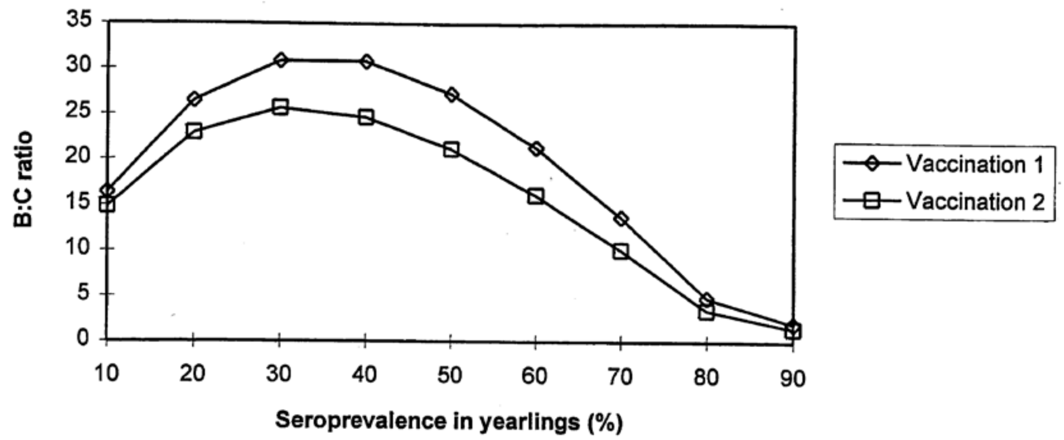
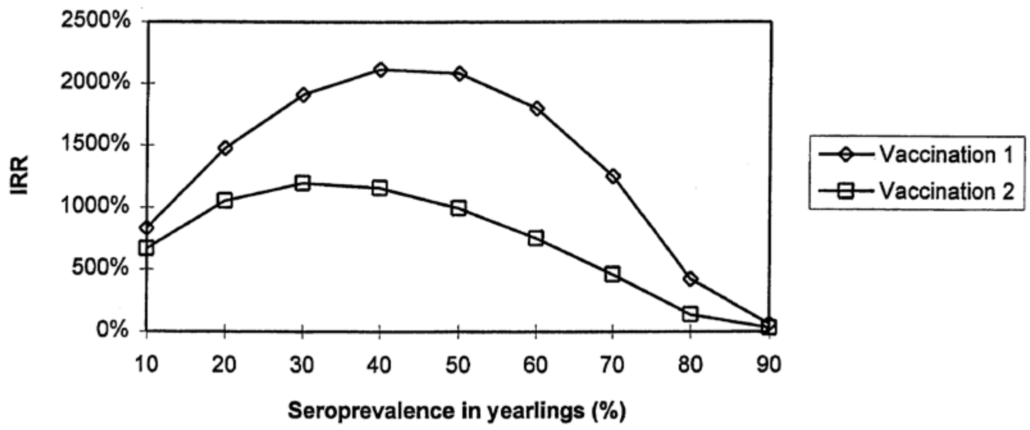


Figure 9: IRR for *B. bovis* vaccination programs in a herd of susceptible cattle



7. Discussion

The simulations carried out in this paper reveal that vaccination is an economically viable method for the control of disease caused by *B. bovis* in most situations.

Vaccination program 2 in which all cattle are vaccinated in the first year of the program produces a larger NPV than Vaccination program 1 at low incidence risk of infection. This occurs because where the incidence risk of infection is low many cattle in the older age groups have not been exposed to infection and are therefore susceptible to disease. The vaccination of older animals where the incidence risk of infection is low to medium has greater impact on herd immunity and the number of cases of disease prevented than where the incidence risk of infection is high. As the incidence risk of infection increases the proportion of older cattle that have been exposed to infection increases and the effect of vaccination on herd immunity also decreases.

The size of the NPV, B/C ratio and IRR vary with the incidence of infection and the susceptibility of the herd to disease. All are predicted to be highest in the susceptible herd and lowest in the disease resistant herd. Within each herd the performance criteria are predicted to be highest where the seroprevalence in yearlings is around 40%. The pattern in the economic performance criteria illustrated in this chapter in relation to the incidence risk of infection (using the seroprevalence in yearling animals) can be explained by examination of the production loss avoided by vaccination at different levels of incidence risk of infection. As presented in Discussion Paper 35 most production loss is avoided due to vaccination where the incidence risk of infection is medium and is lowest where the incidence risk is high. The economic performance criteria follow a similar pattern.

High values are produced for all economic performance criteria especially in susceptible cattle. This is because vaccination does not require a capital outlay, variable costs are low and benefits from the program are received in every year.

The effect of taxation on the economic performance criteria has not been considered in this analysis. This is because the taxation situation varies for each cattle producer and the effect of taxation needs to be assessed on an individual basis.

8. Summary

In this paper, discounted cash flow analysis is defined and applied to determine the economic consequences of vaccination programs for cattle producers in Central Queensland.

The results of simulations show that vaccination against *B. bovis* is a viable economic option resulting in high economic performance criteria especially where the herd is made up of disease susceptible cattle and cattle of intermediate disease susceptibility. Lower economic performance criteria are predicted for herds of disease resistant cattle.

Vaccination against *B. bovis* is economically viable where the incidence of infection, as calculated from the age specific seroprevalence in yearlings is medium. Where the incidence of infection is low the financial viability of vaccination is reduced and where the incidence of infection is high the financial viability is further reduced but vaccination is still predicted to be an economically viable option.

The findings in this paper provide useful guidelines for the evaluation of vaccination against *B. bovis*, in addition to providing a basis for the evaluation of additional animal health information in decision making pursued in the next discussion paper.

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