

The economic benefits of implementing biosecurity measures in a NSW North Coast cattle herd.

APRIL 2008

A report prepared for Animal Health Australia

by

Dr Ian Patrick
ARECS P/L

and

Dr Tristan Jubb
Livestock Health Systems Australia

Published April 2008

© Animal Health Australia 2008

Disclaimer

This publication is published by Animal Health Australia for information purposes only. Information contained in it is drawn from a variety of sources external to Animal Health Australia. Although reasonable care was taken in its preparation, Animal Health Australia does not guarantee or warrant the accuracy, reliability, completeness, or currency of the information or its usefulness in achieving any purpose.

To the fullest extent permitted by law, Animal Health Australia will not be liable for any loss, damage, cost or expense incurred in or arising by reason of any person relying on the information in this publication. Persons should accordingly make and rely on their own assessments and enquiries to verify the accuracy of the information provided.

Copyright and Trademarks

Use of materials and information

This publication is protected by copyright. Information or material from this publication may be reproduced in unaltered form for personal, non-commercial use. All other rights are reserved. Information or material from this publication may be used for the purposes of private study, research, criticism or review permitted under the *Copyright Act 1968*, which is available online (at <http://www.scaleplus.law.gov.au>).

Any reproduction permitted in accordance with the *Copyright Act 1968* must acknowledge Animal Health Australia as the source of any selected passage, extract, diagram or other information. Any reproduction must also include a copy of the original copyright and disclaimer notice as set out here.

Commercial and other use

No part of this publication may be reproduced, stored in a retrieval system, distributed or commercialised in any form without prior written approval from Animal Health Australia. The contents of this publication may not be used to sell a product or service for commercial reasons such as advertising.

Trademarks

Any trademarks or logos contained in this publication may not be used without the prior written permission of Animal Health Australia.

ISBN 978-1-876714-895

CONTENTS

INTRODUCTION	5
Aims of the study	5
What is farm biosecurity?	5
Why improve farm biosecurity?	5
METHODOLOGY	7
DATA USED IN THIS ANALYSIS	8
NSW NORTH COAST CATTLE BREEDING	9
SELECTED POTENTIAL ANIMAL HEALTH ISSUES	10
ECONOMIC LOSS CAUSED BY THE SELECTED DISEASES	12
EVALUATING BIOSECURITY INTERVENTIONS	13
Costing biosecurity measures	13
Economic evaluation of on-farm biosecurity	13
CONCLUSION	15
APPENDIX 1: GROSS MARGIN ASSUMPTIONS	17
APPENDIX 2: ECONOMIC CONSEQUENCES OF SOME PATHOGENS IF THEY ESTABLISHED IN A COMMERCIAL BEEF HERD IN SOUTHERN AUSTRALIA	18
APPENDIX 3: BIOSECURITY RISK CONTROLS	19
APPENDIX 4: CASH-FLOW FOR THE ‘HIGH BENEFIT BIOSECURITY ADOPTED’ SCENARIO	25

INTRODUCTION

Aims of the study

This study was intended to be a brief economic analysis to determine cost-benefits of biosecurity for a livestock enterprise after developing an appropriate methodology.

The approach taken was to:

1. select appropriate cattle health issues to be evaluated,
2. define and measure on-farm economic loss,
3. define and cost appropriate biosecurity interventions,
4. undertake BCA (10 yr cashflow) for a single enterprise cattle production system,
5. identify and discuss off-farm or other benefits and costs of biosecurity.

What is farm biosecurity?

“Biosecurity is a general description for a set of measures designed to protect our country, state and individual farming properties from the entry and spread of unwanted animals, pests, diseases and weeds.” (R. Delane et al 2002)

“Biosecurity is simply the implementation of a series of basic management practices to prevent the introduction of contagious diseases and noxious weeds.” (K. Rutter et al, 2002)

At the farm level, biosecurity is concerned with the monitoring and control of animate and inanimate farm inputs (ie. animals, people, machinery, feedstuffs etc) acting as potential sources of pathogens, such that animals on the farm are minimally exposed to the pathogens. With increasing globalisation comes increasing concerns by Australia's livestock industries and animal health authorities about entry of exotic diseases to Australia especially after the equine influenza (EI) outbreak and with highly pathogenic avian influenza (HPAI) at Australia's doorstep to the north. Demonstrating cost-effectiveness of biosecurity is one way to encourage farmers to protect their own livestock and therefore protect Australia's livestock industries. The methodology developed here to determine cost-effectiveness of biosecurity can potentially be used by individual farmers and their animal health advisors, to assist them in their decisions on adoption of and level of implementation of biosecurity measures.

Why improve farm biosecurity?

Improving biosecurity is another method for farmers to improve long-term profitability and sustainability. There would be many activities that farmers already implement without consciously realising that they may be regarded as biosecurity interventions e.g. vaccination programs, quality fencing, pest control. These activities increase profitability and minimise the risk of disease outbreaks. While it may be easy to measure the increase in cattle weight through control of internal parasites, it is more difficult to quantify the on-farm benefits of washing down trucks or wearing clean clothes around the farm. Farmers will only adopt activities which they believe will increase income or income security. Investment in biosecurity is more of an investment in income protection rather than short-term profitability,

it is an insurance cost rather than a production input cost. Benefits depend on farmers' attitudes to risk rather than a desire to adopt a new production technology. In saying that, there are significant and increasingly important economic reasons for individual farmers to implement biosecurity interventions. Not adopting appropriate biosecurity measure may cause significant economic loss through:

- Reduced productivity (because of negative affects on productivity i.e. reproductive, growth and mortality rates)
- Reduced market access (access to certain markets or premium prices denied),
- Increased management costs (includes management and husbandry procedures that may have to be adopted including increased use of vaccination, antibiotics and disinfectants, labour, facilities, equipment etc)

There may also be social impacts such as loss of reputation and social stigma that provide incentives for farmers to adopt 'cleaner' production system.

The level and type of benefit to farmers depends on the nature of the pathogen or risk. For example control of internal and external parasites will have direct on-farm **production** benefits. Eradication and continued monitoring for diseases such as FMD and, to a large extent, brucellosis have industry-wide **market** or **price** benefits. With increasing globalisation and concern about issues such as HPAI and EI, there is, and will continue to be, an increasing emphasis on the need to improve and maintain on-farm biosecurity. Without on-farm biosecurity not only can the *"farming enterprise be damaged financially, but the community and wider livestock industries may also be affected, and the Australian economy devastated for many years."* (K. Rutter et al, 2002).

METHODOLOGY

This analysis uses a 10-year discounted cash-flow to compare the ‘before’ biosecurity intervention with the ‘after’. The analysis evaluates the on-farm benefits to cattle producers of adopting specified biosecurity interventions and hence minimizing the possibility of disease spread within the 100 head breeding herd. A cattle breeding enterprise was selected as it is a common and simple production system with clearly defined biosecurity alternatives. It is a useful generic production system that can be used as a template for further analysis of biosecurity interventions in a range of other livestock industries.

Although there are a range of pathogens that could be included, this introductory analysis selected five of the more important ones that affect on-farm productivity (growth rates, reproduction and mortality) on the NSW North Coast.

In terms of the biosecurity interventions implemented on the cattle property, the study subjectively costs a large range of these and then includes all, and then a selection, in the economic analysis. The selection includes those interventions that are perceived to be the cheapest to implement and yet have the greatest payoff, in terms of costs saved or risk minimised. While simplifying the analysis it is likely that this approach underestimates the potential benefits of adoption as benefits such as minimizing the risk of exotic disease outbreak and public good benefits are not included¹. This methodology provides some simple measures of benefits and costs of the adoption of biosecurity interventions to a cattle breeding system in Northern NSW. The analysis therefore:

1. constructs gross margin for weaner production on the NSW North Coast,
2. estimates potential economic loss caused by disease,
3. costs a range of biosecurity interventions that will minimise the risk of disease impact,
4. and uses a 10-year cash flow to estimate the financial benefits (or costs) of implementing biosecurity in NSW North Coast breeding herds.

¹ Other economic benefits not included in this present introductory study include; increased market value of the farm and land, reduced risk of catastrophic losses and failure of the business, reduced risk of zoonotic disease in workers and consumers, eligibility for compensation during a disease outbreak by having demonstrated biosecurity, increased access to certain markets, increased access to finance, improved animal welfare, preferred supplier status for buyers and consumers, preferred contractee status for contractors.

DATA USED IN THIS ANALYSIS

This analysis is a brief (5 day) desk top study which subjectively determined all the parameters and assumptions used. It concentrates on one production system (using NSW DPI gross margin estimates) and includes only five pathogens. The study does highlight the types of data required to undertake an analysis such as this and the type of results that are possible. The study would benefit through a more rigorous collection of data and a broader discussion of the effects and costs of implementing biosecurity interventions. To collect more useful data would require collection from a number of sources, these include;

- a panel of experts to determine appropriate lists of biosecurity measures for all livestock activities and management systems,
- farmer interviews to determine present biosecurity measures adopted and costs of adoption, and farmer's perception of risk and effectiveness of adoption,
- economic assessment of impact of real disease events on farms where a breach in biosecurity has occurred

NSW NORTH COAST CATTLE BREEDING

For this study a self-replacing 100 cow herd producing store weaners (NSW North Coast) has been selected. Cattle are grazed on native pasture, with steer and heifer (not required to be kept for replacements) weaners being sold at approximately 9 months of age. To run this sized herd will require 171 hectares of improved. Table 1 provides a standard gross margin (GM)² for this enterprise and is the basis of the economic analysis.

Table 1: Gross margin for NSW North Coast production - 100 breeding cows

INCOME:

Animal Sales

44.2	steers @	\$567	\$25,047
22.7	heifers @	\$513	\$11,634
0.6	CFA Bull @	\$807	\$484
8.6	CFA cows @	\$528	\$4,523
A. Total Income:			\$41,689

VARIABLE COSTS:

Replacements	0.6	Bull @	\$4,000	\$2,400.00
	0.00	Cows @	\$0	\$0.00
Commission @	4.0%			\$1,667.54
Husbandry	Vet Costs:			\$612.50
		Yard dues	\$3.28 /hd sale stock	\$249.42
		NLIS Tags	\$2.90 /hd sale stock	\$220.52
Transport and Marketing			\$5.50 /hd sale stock	\$418.23
MLA Levy			\$5.00 /hd	\$380.21
Pasture maintenance (171ha improved pasture)			\$30 /ha	\$5,130.00
B. Total Variable Costs:				\$11,078.42
GROSS MARGIN (A-B)				\$30,610.18
GROSS MARGIN/COW				\$306.10

Source: NSW DPI Farm Enterprise Budget Series: December 2007

It is a generic gross margin that assumes the manager has not introduced any biosecurity interventions (including vaccination program) and has no animal health issues, these will be included as the study progresses. This production system provides a return to the owner or manager of \$306 per breeding cow or a total of \$30,600 per year. The assumptions used to estimate the GM are provided in Appendix 1. The important starting production assumptions are:

- Calving rate - 95%
- Mortality rates; calves - 7%, adults - 2%
- Sale weights; steer calves - 270kg, heifer calves - 250kg, cull cows - 220kg (dressed), cull bulls - 350kg (dressed)
- Sale prices; steer calves - 210c/kg, heifer calves - 205c/kg, cull cows - 240c/kg (dressed), cull bulls - 230c/kg (dressed)

² Gross margin assumptions are provided in Appendix 1.

SELECTED POTENTIAL ANIMAL HEALTH ISSUES

There are a number of important pathogens that can have economic impacts on Australian cattle herds (see Appendix 2). This report has subjectively selected five diseases that have a range of impacts on production (growth, reproduction and mortality), have a range of treatments and a range of transmission methods. The diseases selected are: pestivirus, salmonella, bovine genital campylobacteriosis, neospora, and internal and external parasites with parasiticide resistance. Table 2 provides an overview of the effects of these diseases on production and is used to calculate the potential economic loss caused by each individual disease and the combined effect of all the selected diseases on production.

Table 2: Impact of disease on cattle growth, reproduction and mortality rates (%)

	Growth [#]						Reproduction [#]						Mortality [^]					
	Year 1			Year 10			Year 1			Year 10			Year 1			Year 10		
	Minor	Moderate	Severe	Minor	Moderate	Severe	Minor	Moderate	Severe	Minor	Moderate	Severe	Minor	Moderate	Severe	Minor	Moderate	Severe
pestivirus	5	10	15	1	3	5	5	10	15	1	3	5	1	2	3	1	1	1
salmonella	5	10	15	3	5	10	5	10	15	3	5	10	3	5	8	1	3	5
campylobacteriosis	1	1	1	1	1	1	5	10	15	1	3	5	1	1	1	1	1	1
internal parasites	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
neospora	1	2	3	1	1	1	10	20	30	1	5	10	1	2	3	1	1	1
cumulative effect	6	12	18	3	6	10	13	26	39	3	9	16	3	6	9	2	4	5

percentage decrease in growth and reproduction rate

^ percentage point increase in mortality rate

- *Pestivirus* is a viral disease that causes ill-thrift and mortalities in young cattle (3 mo-3 yo) and reproductive failure in breeding herds. The most effective eradication is through a testing program to cull persistently viraemic cattle but many herds choose to live with the problem. A vaccine is available (Pestiguard) but is not commonly used. The disease is spread mainly through direct contact of susceptible herd mates with carriers and recently infected cattle that might be incubating the disease, however, biting insects, fomites, semen, biologic products, and possibly wild ruminants also can spread pestivirus. Quarantines, screening testing and vaccination of cattle and cleaning and disinfection of fomites are some of the biosecurity measures used to keep pestivirus out.
- *Salmonella* are bacteria that can cause septicaemia in calves and acute and chronic enteritis and abortion in older age groups. The disease may become endemic on a farm with explosive outbreaks occurring when the herd is stressed such as by malnutrition. Spread is mainly by faecal contamination of feed and water supplies by carrier animals, or in introduced feedstuffs that have been compromised at source or in transport. There are many ways that farmers might try to prevent introduction and minimize spread within the herd including to test and quarantine introductions, minimizing stress in the herd, protecting feed and water supplies and strategically using vaccines and antibiotics.

- *Bovine genital campylobacteriosis (vibriosis)* is a venereal disease that causes reproductive failure in female cattle and is usually spread by introduced non-virgin bulls (and sometimes female cattle) from diseased herds. It can also be spread by contaminated instruments, bedding, or by artificial insemination using contaminated semen. The disease is controlled by vaccination and purchase of breeding stock from disease-free herds.
- *Internal (worms) and external parasites (lice, ticks) resistant to parasiticides* may be inadvertently introduced in purchased cattle. Greater use of management such as alternating pasture with cropping and other techniques to provide safe pastures would be required for control of some of them, whereas more frequent treatments at higher dosages may be attempted in other situations such as for lice. Careful sourcing, adjustment and transport of cattle, and isolation and special treatment of introduced animals may be required to prevent entry.
- *Neospora* is a protozoan parasite that has emerged as a major cause of abortion in dairy cattle but can affect beef herds. Infection can be vertically transmitted in cattle but usually enters a herd when feed and water are contaminated by dog faeces; dogs being the definitive host. To prevent entry, dogs must be prevented from defecating in cattle feed or pastures used for grazing or catching run-off water.

The cumulative impact is a subjective combination of the effects of all the diseases on enterprise profitability. It is calculated as an addition of the individual impacts divided by two to take into account the joint impacts and the understanding that all cows would not be affected by every disease. It also assumes that the herd is 100 per cent guaranteed to contract all of these diseases in year 1. The impacts for many pathogens are likely to be highest in year 1 and then attenuate in ensuing years as herd immunity increases. The exceptions might be resistant parasites both internal and external, and salmonella which will impact most severely on young animals from year to year. All of these diseases are potentially eradicable by depopulation, but then the risks of disease entry into a newly founded herd start again. Depopulation is not evaluated in this study.

ECONOMIC LOSS CAUSED BY THE SELECTED DISEASES

Based on the data provided in Table 2 and the base gross margin (Table 1) the potential for economic loss from each disease is provided in Table 3. Based on the level of impact these diseases have the potential to cause significant loss to cattle producers. The gross margin provided is for the enterprise in the first year of disease impact. For example if pestivirus (at a moderate level) enters the farm, the returns per head will decrease to \$209/cow a decline of \$97/cow (30 per cent). Taking into account that herds often get comfortable with the disease and the impacts are reduced in later years, Table 3 also presents the NPV of returns over a 10 year period. Using a discount rate of 10 per cent the NPVs also decline over time. Each cash-flow analysis assumes that the disease hits in Year 1 and then remains for the entire 10 year period.

In terms of the cumulative effect a GM of \$200 assumes that the herd contracts half of the individual minor impacts of all the diseases in year 1, a 33 per cent reduction in enterprise profitability. The severe impact was not calculated for this cumulative effect as viability required a change in enterprise management from a self-replacing herd to a purchased replacement herd. The number of heifers being bred in the self-replacing activity were insufficient to provide breeding cow replacements. This analysis uses the moderate cumulative impact estimates (e.g. gross margin of \$109) as the basis for estimating enterprise economic loss.

Table 3: Gross margins and NPV of cattle breeding enterprise under disease scenarios

	<i>Minor impact</i>		<i>Moderate impact</i>		<i>Severe impact</i>	
	<i>GM \$/cow</i>	<i>NPV</i>	<i>GM \$/cow</i>	<i>NPV</i>	<i>GM \$/cow</i>	<i>NPV</i>
pestivirus	256	165,098	209	143,935	165	124,039
salmonella	236	154,067	182	125,352	124	90,559
campylobacteriosis	270	170,447	248	160,463	227	150,480
internal parasites	287	176,650	269	165,436	251	154,441
neosporea	248	162,692	193	138,216	139	113,244
cumulative	200	138,630	109	91,404	na	na

EVALUATING BIOSECURITY INTERVENTIONS

Costing biosecurity measures

After estimating the potential economic loss the next step is to define the biosecurity interventions that will most effectively and efficiently minimise the risk of disease entry. The biosecurity interventions required will depend on the disease in question, the topography and management systems already in place, the effectiveness of the biosecurity measures and the farmer's perception of the risk. The decision as to which strategy (combination of biosecurity interventions) to use will vary with each farm; there will be no 'one size fits all'.

A complete list of potential interventions is provided in Appendix 3. These have all been evaluated with regard to their effectiveness and implementation costs. It is a subjective selection by the authors and could well be improved through broader discussion and input of experts. It does provide a starting point for discussion and analysis. The costs of implementing biosecurity interventions are divided into 3 categories; *labour*, *inputs* and *capital*.

- *Labour* is a variable cost and may include either additional employed labour or extra owner/manager labour. Even though owner labour is regarded as a fixed cost, this analysis assumes that if the owner is required to spend more time managing the cattle enterprise there is an opportunity cost involved. The owner either has to employ labour in other areas or lose leisure time. It can also be treated as variable costs as there is only one activity on the farm and therefore all costs can be attributed to the cattle activity. ***All labour is valued at \$25/hour.***
- *Inputs* are other additional variable (annual or direct) costs that are incurred through the adoption of biosecurity activities. They include animal health costs (antibiotics, anthelmintics etc), repairs and maintenance of infrastructure, cleaning agents etc.
- *Capital costs* are those particular one-off purchase or construction costs incurred to improve biosecurity. These costs are purchased in year 1, depreciated and valued in year 10 within the cash-flow. These costs include construction of office, truck cleaning facilities, changing fence lines and cattle movement systems, construction of new yards near farm exit, purchase of signs etc. ***Standard cost of internal fencing used is \$2,000/km and external fencing \$4,500/km.***

Economic evaluation of on-farm biosecurity

Table 4 provides an indication of the potential costs required to be outlaid to ensure security of production under the threat of moderate impacts from the five specified diseases. If there are no biosecurity measures adopted and no disease the cattle breeding activity will have a GM of \$360/cow (Table 1) and a NPV over 10 years of \$188,086. If there were moderate disease impacts, however, this GM would be reduced to \$109/cow (Table 3) with a NPV of \$91,404. The economic analysis considers whether or not it is economically viable for the farm to implement biosecurity measures that would ensure that there are no disease impacts (i.e. GM of \$306/cow).

Table 4: Economic benefits of on-farm biosecurity implementation

	<i>Extra hrs /yr</i>	<i>Extra variable costs /yr</i>	<i>Extra variable cost \$/hd</i>	<i>Extra capital costs</i>	<i>NPV</i>	<i>BCR</i>	<i>IRR</i>
No biosecurity - no disease	0	0	0	0	188,086	-	-
No biosecurity - disease	0	0	0	0	91,404	-	-
All biosecurity measures adopted	438	9,180	201	70,600	11,729	1:0.6	Never viable
‘High’ benefit biosecurity adopted	228	3,840	95	52,600	90,644	1:1.0	8%
All management, no infrastructure adopted	438	9,180	201	0	65,787	1:0.8	Never viable
‘High’ benefit mgt, no infrastructure adopted	228	3,840	95	0	130,919	1:1.6	Always viable

Full implementation of all biosecurity activities is estimated to require an extra 438 hours of labour per year, an extra \$9,180 to be spent on input costs and an initial capital requirement of \$70,600. This was a combined annual cost of an additional \$201 per breeding cow per year. Under the assumptions used in the analysis this scenario is not viable, the costs are too high. The NPV³ of \$11,729 is significantly lower than the ‘do nothing’ disease scenario. If these costs needed to be outlaid to control disease it would be more efficient for the farmer to suffer the consequences of disease. Under this scenario for every dollar the farmer invested only 6 cents would be returned (BCR 1:0.6). However, if only the biosecurity measures that are defined as ‘high’ benefit in Appendix 3 are included in the analysis the investment in biosecurity breaks even. This provides a BCR of 1:1 and an Internal Rate of Return (IRR) of 8%. If no infrastructure is required, only labour and other variable costs then there a significant benefit for the farmer (i.e. BCR of 1:1.6 and an always positive IRR).

³ The NPV, BCR and IRR are calculated in 10 year cash-flows. The cash-flow for the ‘high benefit biosecurity adopted’ scenario is provided in Appendix 4.

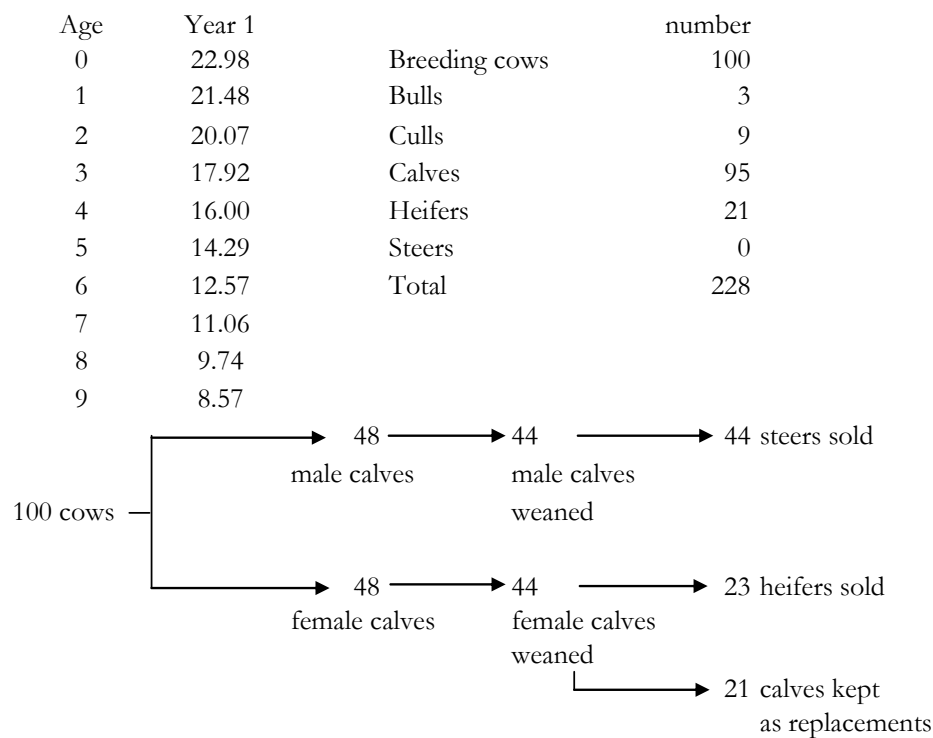
CONCLUSION

The short desk-top study provides evidence that there are methodologies to analyse the on-farm benefits of adopting biosecurity measures. The analysis, using a discounted cash-flow budget shows that NSW North Coast cattle breeders concerned with the possibility of contracting moderate animal health problems (the five specified diseases) could spend \$95/breeding cow in extra labour and inputs to efficiently minimise their risk. The results can be sensitized to take into account a range of production and risk preference and expectation variables.

These results give a taste of the type of analysis that can be undertaken to measure the on-farm benefits of adopting biosecurity interventions. It does not however, include the benefits of minimizing the risk of other diseases, nor does it take into account the reduced risk of potential exotic disease spread (e.g. reduced cattle prices). The analysis also does not effectively include the levels of risk that can be minimised by the different biosecurity measures.

APPENDIX 1: GROSS MARGIN ASSUMPTIONS

Assumptions		Weaner production (breeding replacements)			
Enterprise Unit		100 cows			
Calving Rate		95%			
Mortality Rate: Adults		2%			
Mortality Rate: Calves		7%			
Culling Rate		10%			
Bull Percentage		3% heifer			
Weight		weight	c/kg		
steer		270	210.00	/liveweight	
		250	205.00	/liveweight	
cull cow		220	240.00	/dressed	
cull bull		351	230.00	/dressed	
Commission		4.0%			
Vet Costs:		4.10	\$/cow	(preg text only)	
		67.50	\$/ bull	(fertility test only)	
		0.00	\$/replacement heifer		
		0.00	\$/calf		
Yard dues		3.28	\$/hd sale stock		
NLIS Tags		2.90	\$/hd sale stock		
Transport and marketing		5.50	\$/hd sale stock		
MLA Levy		5.00	\$/hd		
Cull bull rate		20%			
Replacement cow		600.00	\$/hd		
Replacement bull		4000.00	\$/hd		
Herd Structure					



APPENDIX 2: ECONOMIC CONSEQUENCES OF SOME PATHOGENS IF THEY ESTABLISHED IN A COMMERCIAL BEEF HERD IN SOUTHERN AUSTRALIA

Economic consequence scores: 1 = minor impact of <3%, 2 = moderate impact of <15%, 3 = severe impact of <30%

<i>Pathogen category</i>	<i>Pathogen</i>	<i>Growth</i>	<i>Reproduction</i>	<i>Mortality</i>	<i>Market access</i>	<i>Management costs</i>
Exotic diseases	foot and mouth disease	1	1	1	3	1
	bovine spongiform encephalopathy	1	1	1	3	1
Viruses	pestivirus	2	2	1	1	1
	infectious bovine rhinotracheitis	1	1	1	2	1
	warts	1	1	1	1	1
	enzootic bovine leucosis	1	1	1	2	1
Bacteria	Johne's disease	1	1	1	2	2
	salmonella	2	2	2	1	1
	anthrax	1	1	3	3	1
	Moraxella bovis (pinkeye)	1	1	1	1	1
	leptospirosis	1	1	1	1	1
	campylobacteriosis (aka vibriosis)	1	2	1	1	1
Parasites	lice	1	1	1	1	1
	internal parasites	1	1	1	1	1
	ticks	1	1	1	1	1
Protozoa	neospora	1	2	1	1	1
	coccidiosis	1	1	1	1	1
	cryptosporidiosis	1	1	1	1	1
	trichomoniasis	1	2	1	1	1
Other	genetic defects	1	1	1	1	1
	cancer eye	1	1	1	1	1
	chemical residues	1	1	1	3	2
	anthelmintic resistance	2	1	1	1	2
	antibiotic resistance	1	1	1	1	1
	acaricide resistance	1	1	1	1	2

APPENDIX 3: BIOSECURITY RISK CONTROLS

Control category	Risk control	Cost			Benefit
		Labour hr/month	Input \$/month	Capital	
Limit visitor access to the farm	Minimise the number of entrances to the property			Close off 2 gates \$2,000	High
	Post signs at the farm entrance; identify the farm as a biosecure area to inform visitors of procedures to follow and requirement to follow the farm's biosecurity rules			Purchase 3 signs; \$600	High
	Establish a visitor's parking area away from areas where animals might graze or be held			4 car area \$5,000	High
	Place animal delivery and load-out facilities on the perimeter of the farm			1 set cattle yards \$15,000	High
	Lock gates	1hr			High
	Severely restrict farm access for visitors who have traveled to certain international areas where they may have had contact with potentially infectious animals				High
	Restricted farm access for higher risk personnel who may have had contact with animals such as neighbors, stock and station agents, feed salesman, AI technicians, and veterinarians, pipeline, electricity line or telecommunications contractors.	Extra phone calls 1hr			High
Ensure vehicles are cleaned and disinfected	Establish wash-down points for vehicles and equipment			Water supply, concrete slab, runoff \$10,000	High
	Install wheel baths with disinfectant		\$5	With above \$5,000	Low
	Ensure stock transport vehicles are cleaned before loading animals coming to the farm. Trucks and other vehicles entering the property should not have visible manure and mud	Extra phone calls, checking each vehicle 1hr			High
	Insist that feed delivery trucks have not previously carried meat and bone meal	Extra phone calls 1 hr			High
Minimise vehicle traffic	Keep a separate vehicle just for use on the farm		Running costs \$200	Old vehicle \$10,000	High
	Prevent off-farm vehicles from driving in areas where animals travel	Managing appropriate cars 1 hour			High
Establish	Locate the farm/herd in an isolated area			Expensive (new farm)	Moderate

Control category	Risk control	Cost			Benefit
		Labour hr/month	Input \$/month	Capital	
farm in low risk location	Locate the farm/herd on an elevated area where afforded some protection by gravity			Expensive (new farm)	Moderate
	Locate the farm/herd upstream of other farms			Expensive (new farm)	Moderate
	Plant windbreaks around the farm perimeter to break up wind-flow			Plant trees \$10,000	Moderate
Fence off high risk areas	Minimize fence line contact with neighboring animals by erection of suitable barriers or establishing suitable buffer areas	Discuss cattle management with neighbour 1hr		Fences	High
	Regularly inspect and maintain fences to keep the farm's animals in and others out	Fence maintenance 3hr	Increased maintenance \$70		High
	Fence off creek and river waters potentially contaminated by faeces from neighbouring or upstream herds and stray or wild animals	Extra maintenance ½hr	Increased maintenance \$20	Fences 2km \$9,000	High
Use quarantine and isolation	Maintain a closed herd		Inability to import improved genetic stock \$50		High
	Quarantine all new animals or animals that have been taken off the farm, such as bulls and show animals	½hr			High
Source introductions from low risk herds	Prevent direct and indirect contact of cattle with other cattle at shows				High
	Buy cattle from quality assured farms and herds with a biosecurity plan. Require disease testing, vaccination records, and health certification i.e. know the health history of incoming animals. Examine the production records of the source herd for signs indicative of disease. Don't buy at sale yards	1hr			High
Segregate livestock by age	Graze susceptible younger stock on the higher ground or near the centre of the property or both	Extra management 1hr			Moderate
	Do not place cattle of different ages in the same paddock or stockyard pen	1hr			Moderate
	Work from younger or healthier animals to older higher risk animals	1hr			Moderate
Manage sick and dead animals	Isolate all sick animals, preferably for two weeks after symptoms of illness have stopped. designate a hospital pen or paddock	1 hr	Reduced stocking rate \$50	Fence 1 km \$2,000	Moderate
	Promptly euthanize animals that are not going to recover	Extra monitoring 1hr			Moderate
	Promptly remove and dispose of dead animals	Extra monitoring 1hr	Dig pit, burn etc \$20		Moderate

Control category	Risk control	Cost			Benefit
		Labour hr/month	Input \$/month	Capital	
Control visitors	Provide clean boots and clothes or coveralls to visitors	Washing ½hr	Purchase clothes boots etc, wash as required \$10		High
	Install footbaths		Antiseptic etc \$5	\$1,000	Low
	Do not let visitors step into feed troughs or wash in water troughs	Advise visitors ½hr			High
	Limit contact by visitors with the herd				High
Suppress other animals	Prevent pets straying into cattle grazing areas	Communication with neighbours ½hr	Fence maintenance \$50		High
	Do not allow visitors to unnecessarily bring farm dogs or other animals onto the property				High
	Do not let dogs, birds, or other animals have access to dead livestock				High
	Control flies, mosquitoes, rodents, foxes, scavenging birds and other vermin		\$5 week		High
Clean and disinfect extra-farm fomites	Minimise exposure of farm staff to other cattle outside the herd	Advise staff ½hr			High
	Wear clean clothing and boots when working around animals	Washing ½hr	Washing \$5		High
	Ensure veterinarian's and stock and station agent's equipment is disinfected before it is used on the farm	Washing ½hr	Disinfectant \$5		High
	Clean and disinfect farm equipment shared with other livestock owners	Washing ½hr	Disinfectant \$5		High
	Buy equipment to avoid borrowing from other farmers			\$1,000	High
Clean and disinfect intra-farm fomites	Clean equipment, boots and change clothing between animal groups with different health status	Washing ½hr	Disinfectant \$5		Moderate
	Clean and disinfect all shared equipment between different groups of animals	Washing ½hr	Disinfectant \$5		Moderate
	Disinfect animal husbandry equipment between animals – includes dehorner, castration knives	Washing ½hr	Disinfectant \$5		Moderate
	Do not use the same loader for feed and manure hauling, or properly clean and disinfect between uses	Washing ½hr	Disinfectant \$5		Moderate
	Use a new needle for each animal in vaccination and blood sampling programs		\$5		Moderate
Monitor the health of the	Educate owners, managers and employees to recognize and report diseases	½ hr			High

Control category herd	Risk control	Cost			Benefit
		Labour hr/month	Input \$/month	Capital	
	Keep records of all disease occurrences and treatments	1 hr			High
	Maintain a written biosecurity plan and update it regularly				High
	Individually identify every animal and keep movement records				High
	Monitor and inspect animals daily for signs of illness	1 hr			High
	Have a veterinarian necropsy animals that die from unknown causes	Attending, ½ hr	\$50		High
	Routinely sample the herd and the environment for pathogens	1hr	\$50		High
Monitor and protect feed and water supplies	Monitor water quality and ensure upstream contamination by other animals is not occurring	1 hr	\$10		Moderate
	Protect stored feed; lock feed storage sheds	½ hr			High
Source only quality assured feedstuffs and biological products	Source only quality assured feed from reputable vendors	½ hr			High
	Source only quality assured feed supplements and additives for reputable vendors	½ hr			High
Increase the resistance of the herd to disease	Vaccinate the herd against endemic diseases	5 hr	\$100		Moderate
	Use low stress management practices during movement and processing	Extra time to move cattle ½ hr			Moderate
	Prevent overcrowding		Decreased stocking rate \$50		Moderate
	Prevent inbreeding				Moderate
	Ensure proper nutrition	Feed management 2hr	Supplementary feed \$40		Moderate
	Total	36.5 hr	\$765	\$70,600	

Notes to Table:

- Farms with low biosecurity can substantially increase biosecurity for little cost, whereas, farms with high biosecurity can usually only increase biosecurity further at high cost.

- Efficacy of controls may be low when acting alone, but may be very high when acting in combination with other controls of low efficacy
- Biosecurity risk-controls for one pathogen often control other pathogens.
- Biosecurity controls are often multipurpose, providing other value to the farm i.e. washdown facilities, fences
- The costs of facilities and equipment used to control biosecurity risks can usually be defrayed (depreciated) over a number of years.
- Many risk controls cost very little ie compliance with procedures such as traffic flow. Note that all risk controls cost something; none are completely free of cost.

Extra costs that should not be overlooked

- Biosecurity strategies should incorporate a system for early detection of pathogens should they enter the farm. This system may include monitoring farm production records, investigating disease events and routine sampling of animals and the environment - these are extra costs to a biosecurity program.
- The extra costs of administrating and auditing biosecurity will need to be considered if participating in quality assurance programs.

APPENDIX 4: CASH-FLOW FOR TH E 'HIGH BENEFIT BIOSECURITY ADOPTED' SCENARIO

	year 1	year 2	year 3	year 4	year 5	year 6	year 7	year 8	year 9	year 10
Cost \$/head	95	95	95	95	95	95	95	95	95	95
Calving Percentage	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Calf Mortality Percentage	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%
Adult Mortality Percentage	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Income										
Animal Sales										
Culls	5,008	5,008	5,008	5,008	5,008	5,008	5,008	5,008	5,008	5,008
Calves	36,681	36,681	36,681	36,681	36,681	36,681	36,681	36,681	36,681	36,681
Slaughter Cows	0	0	0	0	0	0	0	0	0	0
Capital										20,378
Total Income	41,689	41,689	41,689	41,689	41,689	41,689	41,689	41,689	41,689	62,067
Cumulative Total Income	41,689	83,377	125,066	166,754	208,443	250,132	291,820	333,509	375,197	437,264
					158,033					264,015
Costs										
Control Programme	9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500	9,500
Commission	1,668	1,668	1,668	1,668	1,668	1,668	1,668	1,668	1,668	2,483
Vet costs	613	613	613	613	613	613	613	613	613	613
Husbandry	864	864	864	864	864	864	864	864	864	864
Replacements										
Bulls	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
Cows	0	0	0	0	0	0	0	0	0	0
Extra cows	0	0	0	0	0	0	0	0	0	0
MLA Levy	208	208	208	208	208	208	208	208	208	208
Pasture maintenance	5,130	5,130	5,130	5,130	5,130	5,130	5,130	5,130	5,130	5,130
Capital	52,600									
Total Costs	72,982	20,382	20,382	20,382	20,382	20,382	20,382	20,382	20,382	21,197
Cumulative Total Costs	72,982	93,364	113,746	134,128	154,510	174,892	195,274	215,657	236,039	257,236
Total Gross Margin	-31,293	21,307	21,307	21,307	21,307	21,307	21,307	21,307	21,307	40,870
Total GM per breeding cow	-313	213	213	213	213	213	213	213	213	409
Cumulative Gross Margin	-83,893	-62,587	-41,280	-19,974	1,333	22,639	43,946	65,252	86,559	147,807
Cumulative Gross Margin NPV	-28,449	-10,840	5,168	19,721	32,950	44,977	55,911	65,851	74,887	90,644