Cost Benefit Analysis for Regional Pest Management User Guide

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Introduction

The cost benefit analysis tool is a web applet that enables a cost-benefit analysis to be conducted for a proposed Pest Management Programme within a Regional Pest Management Plan as required by the New Zealand Biosecurity Act 1993. It is suitable for the species-led "Exclusion", "Eradication", "Progressive Containment" and "Sustained Control" programme types defined in the National Policy Direction but not the site-led "Protecting Values in Places" programme. The model assumes that the pest would spread logistically in the absence of the programme and that the management would prevent this spread with a probability of success set by the user. The Benefits in the CBA are the lost earnings that would be prevented by the management and the Costs are the sum of the programme's implementation costs and lost earnings in the infested area.

The results of the analysis are presented firstly as a graph of the spread of the pest over time under a no-management scenario, secondly as a graph of pest spread under the selected managed scenario and thirdly as a graph of the discounted values of the Benefits and Costs of the programme. The Net Present Value of the programme is the sum of the discounted Costs and Benefits and this is presented along with the Internal Rate of Return (the discount rate giving NPV=0.0).

When interpreting the results consider whether the scenario report is reasonable and defendable. For a programme to be considered economically worthwhile it should have a NPV greater than zero. An important step in interpreting the results is to see how sensitive the NPV and IRR values are to changes in your parameter values. This sensitivity testing can be conducted by moving the sliders or typing in alternative values.
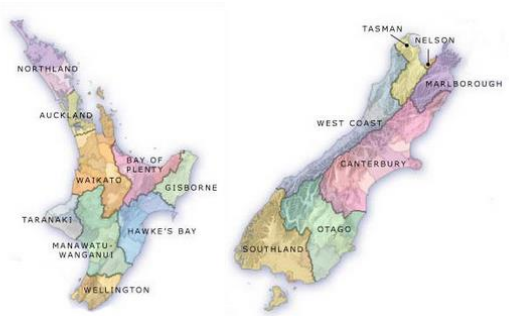
A "Do Nothing" scenario is also provided for where the monetary value of the losses that would be incurred over time in the absence of the proposed pest management programme are calculated.

For guidance on cost-benefit analysis visit

https://www.treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/plan-investment-choices/cost-benefit-analysis-including-public-sector-discount-rates

Start-up screen

The start-up screen allows you to specify the name of a pest species, region, type of management programme and the duration of the CBA.

1) **Pest species** is a free-form entry and is only used in the scenario report. Type the name of the pest species that is the subject of this CBA analysis. You may enter whatever you desire here (Latin name, synonym(s), common name(s), Latin and common name(s).
2) **Region** can be selected from the dropdown list or by clicking on the map.
3) **Management Programme** The selection you make here affects the CBA that you will conduct on the following screen. There are only four options as defined in the "National Policy Direction for Pest Management 2015". Their descriptions are available as popup tooltips in the CBA if you hover your mouse directly over a management programme option.
4) **Number of years over which the CBA is to be conducted** specifies the number of years over which you wish to run your CBA analysis, and therefore how many years will be available for entry of programme implementation costs.

Click the "Begin" button to enter the main screen once these initial values are set.

Main Screen

The layout and options available on this screen vary depending on the type of management programme selected on the start-up screen. The upper portion of this screen has three graphs showing;

1) The pest invasion trajectory without management
2) The pest invasion trajectory under the selected management programme
3) The costs and benefits of the selected management programme

Below the three graphs is an area to enter yearly costs and a brief summary report of the outcomes.

Invasion Trajectory Without Management

Initial area infested (ha):
80

Max area that could become infested (ha):
772080

Time for infestation to reach 90% of max:
201
years

Year 51 = 1430

Invasion Trajectory With Sustained Control Management

Costs and Benefits

Earnings ($ per ha):
99

Reduction in earnings caused by the pest (%):
25

Discount rate (%):
8

Probability of success (%):
100

Value of loss prevented ($)
Programme cost ($) (Implementation + production loss)

NPV: $-173,651

IRR: 4.35%

Yearly Costs

Enter yearly implementation costs of the proposed pest management programme (total cost ($) of the programme for the region) below. Use the ⬇ icon to propagate values downwards.

It is assumed that the implementation cost expenditure is 100% effective in achieving the goal of the proposed management programme (Exclusion, Eradication, Progressive Containment, Sustained Control).

Year	Cost ✏	
1	$ 45000	⬇
2	$ 35000	⬇
3	$ 15000	⬇
4	$ 15000	⬇
5	$ 15000	⬇
6	$ 15000	⬇
7	$ 15000	⬇

Scenario Report ▦

Region: Canterbury (area:4,534,600ha)
Pest species: Chilean Needle Grass
Area infested: 80ha
Maximum area that could become infested: 772,080ha
Time for infestation to reach 90% of maximum: 201 years ($r = 0.05658$, the spread rate)
Earnings: $99/ha
Reduction in earnings caused by pest: 25%
Discount rate: 8%
Number of years for this simulation: 100
Total yearly costs: $1550000
Net Present Value (NPV): $-173,651
Internal Rate of Return (IRR): 4.35% (the discount rate giving NPV=0.0)

Invasion Trajectory without Management
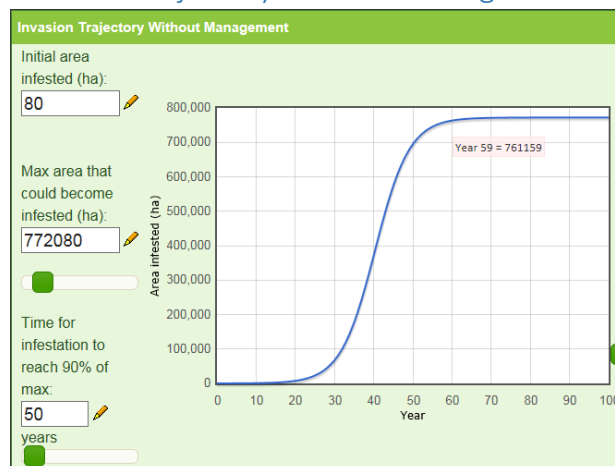
This graph shows the invasion trajectory of the pest species if no management programme was applied. It is used in the Costs and Benefits section to determine the benefits (value of losses prevented) of the proposed programme. The settings in this section are the same under all management programme types.

Values may be entered into the text boxes or set with the slider where available. If you wish to make a note about a value you use, such as how it was estimated or a reference to where the value was sourced from you can click the ✎ icon. Any notes that you add here will be displayed in the "Scenario Report" section.

"Max area that could become infested" must be larger than the initial area infested. This is enforced by the interface.

"Time for infestation to reach 90% of max" is limited to 500 years.
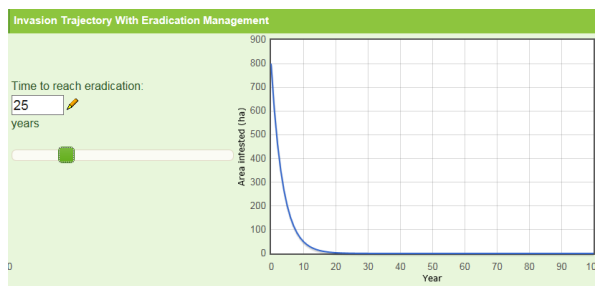
Invasion Trajectory with Exclusion Management

Under an exclusion management programme the area infested will always remain at 0 because the management programme is always assumed to be successful. However, the setting that you make here for "Estimated time of arrival" into the region (i.e. number of years from now when you'd expect the pest to first establish in the region in the absence of your proposed exclusion programme) will affect the "Invasion Trajectory without Management" graph by governing the year in which it starts.
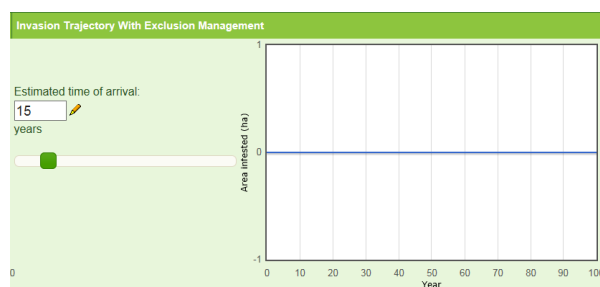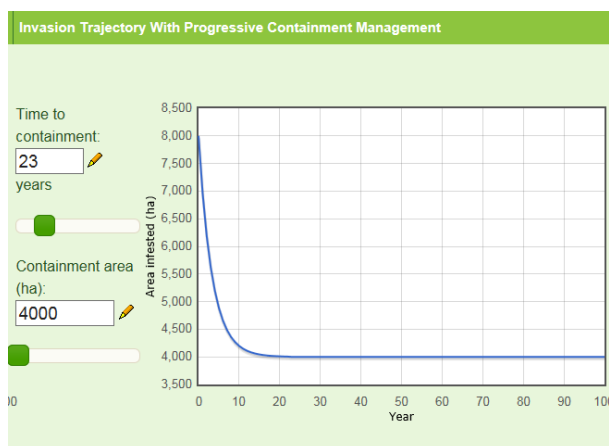
Invasion Trajectory with Eradication Management

Under an eradication management programme the area infested will drop to 0 after the specified "Time to reach eradication".


Invasion Trajectory with Progressive Containment Management

Under a progressive containment management programme the area infested will increase or decrease to the specified "Containment area" after the number of years set by "Time to containment".


Invasion Trajectory with Sustained Control Management

Under a sustained control management programme the invasion trajectory will remain constant at the same level as "Initial area infested". There are no additional values that may be specified for this management programme type.
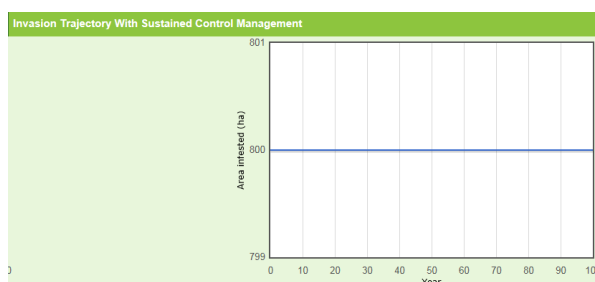
Costs and Benefits

Having defined the invasion trajectory for your pest in both the absence of your programme and in its presence, it is now time to define the benefits and costs of the programme. In the costs and benefits graph the year by year costs (negative values) and benefits (positive values) are plotted and their sum over time (calculated by the app) is the Net Present Value (NPV) of your programme. First you must quantify the value ($/ha) of the system that your pest will impact upon in "Earnings ($ per ha)". Next enter a value that defines the % reduction in the system's value (Earnings) that the pest is expected to cause. Enter an appropriate value for the discount rate and probability of success of the proposed programme. Once you have entered your programme's year by year implementation costs under "Yearly Costs" below, your costs and benefits graph will illustrate how the benefits and costs of your programme, in present value terms, flow over the years. The NPV and Internal Rate of Return (IRR) of your programme, given your current parameter settings, are presented to the right hand side of the graph. The sensitivity of your programme's NPV and IRR to the input parameter values can now be tested either by adjusting the sliders or by typing in alternative values.
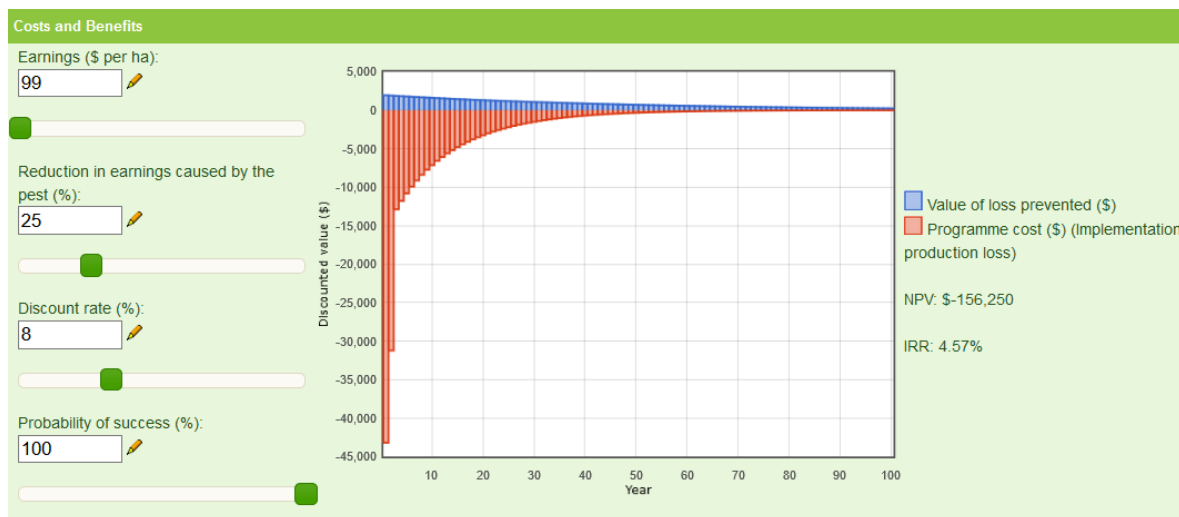
If no costs are entered into the "Yearly Costs" section the model runs in "Do Nothing" mode (see Yearly Costs for more information). Under a Do Nothing scenario, the "Costs and Benefits" section shown above is modified as below:
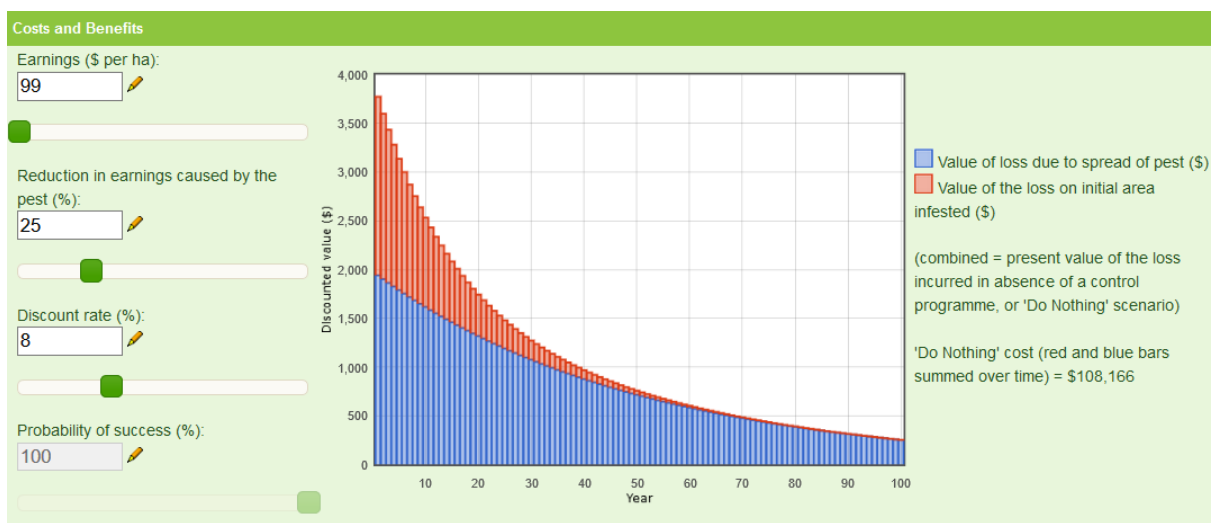
Yearly Costs

The yearly costs section allows you to enter the implementation costs (total cost ($) for the region) for each year of the programme that you have selected. The number of years here is determined by the "Number of years over which the CBA is to be conducted" setting on the start-up screen. The process of entering multiple yearly costs is made easier by using the ⬇ icon to copy values downwards from the row you click the icon on. These year by year implementation costs are added (by the app) to any costs associated with lost production value on the infested area (from the pest's expected invasion trajectory in the presence of your programme) and plotted as negative values (in red) in the above costs and benefits graph.

If no costs are entered into this section the model runs in "Do Nothing" mode. Do Nothing mode causes several changes to the user interface, and alters the way some of the results are displayed. In this mode there are no costs of management and no management. The model then assumes that the pest will spread at the rate set by "Time for infestation to reach 90% of max". The cost of the Do Nothing scenario is calculated as the sum, over the simulation period, of the annual $ values of the loss due to spread of the pest and the annual $ values of the loss on the initial infested area. These two components of the cost of "doing nothing", and their sum, are presented in the "Costs and Benefits" graph.

Yearly Costs

Enter yearly implementation costs of the proposed pest management programme (total cost ($) of the programme for the region) below. Use the ⬇ icon to propagate values downwards.

It is assumed that the implementation cost expenditure is 100% effective in achieving the goal of the proposed management programme (Exclusion, Eradication, Progressive Containment, Sustained Control).

Year	Cost 🖉	
1	$ 45000	⬇
2	$ 35000	⬇
3	$ 15000	⬇
4	$ 15000	⬇
5	$ 15000	⬇
6	$ 15000	⬇
7	$ 15000	⬇

Scenario Report

The scenario report gives a brief report on the results of the scenario you have set up.

If you added any notes they will be displayed at the bottom of the scenario report.

Scenario Report 🔲

Region: Canterbury (area:4,534,600ha)
Pest species: Chilean Needle Grass
Area infested: 80ha
Maximum area that could become infested: 772,080ha
Time for infestation to reach 90% of maximum: 201 years ($r = 0.05658$, the spread rate)
Earnings: $99/ha
Reduction in earnings caused by pest: 25%
Discount rate: 8%
Number of years for this simulation: 100
Total yearly costs: $1550000
Net Present Value (NPV): $-156,250
Internal Rate of Return (IRR): 4.57% (the discount rate giving NPV=0.0)

NOTES
Max area that could become infested: Estimated using Climex (Sagget et al 2012)

The 🔲 icon next to the scenario report opens a data view window that gives you access to the raw results. The values can be copied and pasted into a spreadsheet for further processing and/or graphing.

Region	Canterbury
Area (ha)	4534600
Pest Species	Chilean Needle Grass
Area infested (ha)	80
Maximum area that could become infested (ha)	772080
Rate of spread (r)	0.05658
Time for infestation to reach 90% of maximum (years)	201
Earnings (/ha)	99
Reduction in earnings caused by pest (%)	25
Discount rate (%)	8
Number of years for this simulation	100
Net Present Value (NPV) ($)	-156250
Internal Rate of Return (IRR) (%)	4.567
Notes	
Max area that could become infested	Estimated using Climex (Sagget et al 2012)

Year	Yearly Programme Implementation Costs ($)	Area Infested Without Management (ha)	Area Infested With Management (ha)	Value of Loss Prevented ($)	Programme Cost ($)
1	45000	84.66	67.75	1940.04	-43219.29
2	35000	89.58	57.4	1900.88	-31224.86
3	15000	94.8	48.66	1862.51	-12863.44
4	15000	100.31	41.27	1824.92	-11776.17
5	15000	106.15	35.02	1788.08	-10798.69