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Weeds R&D investment analysis

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Executive summary

This study reviews previous investments in weed RD&E and uses the resulting data to complete a series of ex ante benefit cost analyses of proposed LPI Weed Pillar investments. LPI Weed Pillar investments cover the period from 2014 and are grouped under four themes – Table E1.

Page and Lacey (2006) demonstrated that for every dollar invested in weed biocontrol a benefit to agriculture of $17.40 is generated. This comprehensive analysis became the 'yardstick' by which proposed LPI investments in weed RD&E were judged i.e. each theme must achieve at least a Benefit Cost Ratio (BCR) of 17.4:1, or have a sound reason based in strategy, for achieving a lower level of performance.

Table E1 Weeds Pillar ROI - MLA investment of $1.5 million pa (7% discount rate, 30 year analysis period)

Theme	PV Costs ($'million)	PV Benefits ($'million)	NPV ($'million)	Benefit Cost Ratio (BCR)
Weed Management in Production Systems	1.51	33.30	31.79	22.11
Biocontrol of Impacting Weeds	1.15	20.00	18.84	17.40
New Approaches to Management and Monitoring	1.36	32.40	31.04	23.90
Improving Recommended Practices	1.00	29.27	28.27	29.15
Weeds Pillar Total	**5.02**	**114.96**	**109.94**	**22.90**

Table E1 shows that for each of the proposed LPI Weed Pillar themes, BCRs exceed the biocontrol investment 'yardstick'. The highest BCR is achieved by theme 4 the analysis of which assumes a shortening of the period before benefits commence. Analysis results are consistent with ex poste BCAs completed for other weed investments reviewed in this report.

Total MLA investment in the Weeds Pillar has been modelled assuming an annual investment of $1.5 million for five years. Total net present value (NPV) is estimated at $109.94 million and the total BCR is estimated at 22.9:1 i.e. for every dollar invested by MLA a return of $22.90 is forecast for livestock producers. This forecast return on investment is net of spillover benefits to the broader Australian community. Spillover benefits are quantified in the body of the report and include environmental gains (e.g. biodiversity, habitat and ecosystem protection) and social benefits (e.g. decreased health impacts from weeds).

The original terms of reference required a total Weeds Pillar analysis for alternative MLA investments i.e. a total MLA investment of $1 million and $2 million per annum. More detail is needed on the portfolio before these analyses can be completed with any confidence. Additional insight required includes the link between additional MLA investment and the shortening of lapsed time before benefits are realised by livestock producers. This type of information might be generated from consultation with researchers once projects within the Pillar are better understood.

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Abbreviations and Glossary

AWS	Australian Weeds Strategy
BCA	Benefit Cost Analysis
BCR	Benefit Cost Ratio
Biocontrol	Use of a biological agent to control weeds
C4C	Caring for Our Country Program
CRC	Cooperative Research Centre
FIP	Feedbase Investment Plan
GICA	Goat Industry Council of Australia
KPI	Key Performance Indicator
LPI	Livestock Production Innovation
MDC	MLA Donor Company
MLA	Meat and Livestock Australia
MSA	Meat Standards Australia
NABRC	North Australia Beef Research Council
NLWRA	National Land & Water Resources Audit
NRM	Natural Resource Management
RMCiC	Red Meat Co-investment Committee
RD&E	Research, Development & Extension
SISP	Sheepmeat Industry Strategic Plan
WONS	Weeds of National Significance

Acknowledgements

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1 Project objectives

The objectives of the project were to:

Review previous investments in weeds R&D – Australia wide and in red meat in particular. Review to provide data for Benefit Cost Analysis.

Work with MLA to understand strategies and themes being prepared under a proposed Weeds Investment Framework (Allan and Rothwell December 2012).

Complete an analysis of up to 9 themes;

a) Valuing potential returns to red meat producers
b) Valuing broader community benefits using any previous contingent survey analysis results.

Complete a whole of 'Weeds Portfolio' Benefit Cost Analysis for:

- the current MLA investment budget ($1 million pa)
- 30% Increase
- 60% Proposed increase

2 Success in achieving milestone

The project was completed except for the alternate funding scenarios. These required additional information with expenditure and its impact in either changing the size of the benefit or the rate of adoption. otherwise, with all other aspects being equal, a larger cash investment will decrease the BCR.

3 Methods

Page and Lacey (2006) demonstrated that for every dollar invested in weed biocontrol a benefit to agriculture of $17.40 is generated. This was the 'yardstick' by which LPI investments in weed RD&E will were judged i.e. each proposed investment pillar must achieve at least a Benefit Cost Ratio (BCR) of 17:1, or have a sound reason based in strategy, for achieving a lower level of performance. The literature was reviewed to inform this approach.

4 Introduction

The purpose of this study was to review previous investments in weeds RD&E and use the data generated from the review to complete an analysis of proposed LPI investment themes.

The objectives of the project were to:

1. Review previous investments in weeds RD&E – Australia wide and in red meat in particular. The review was to provide context for the LPI Strategy and data for the ex-ante Benefit Cost Analysis.

2. Work with MLA to understand strategies and themes being prepared under a proposed Weeds Investment Framework (Cameron Allan and Jim Rothwell, December 2012) and subsequent updates (Cameron Allan, August 2013).
3. Describe and where possible quantify the likely benefits generated from investing in the four LPI weed themes.
4. Complete a whole of Weeds portfolio benefit cost analysis.

4.1 Proposed MLA investment in weeds portfolio 2014+

LPI strategy 4.1 NRM – Weeds Pillar period 2014+ (August 2013) describes four key themes with supporting initiatives:

1. Weed management in production systems
   - Investigate remote and objective tools to assist intervention decisions
   - Devise thresholds and lead indicators for weeds in production systems
   - Understand and package the financial implications of weed management
   - Determine biophysical and decision based drivers of successful weeds management
   - Improve guidelines by researching system implications in 4 agro-ecological zones
2. Biocontrol of impacting weeds
   - Maximising relevance through improved prioritisation
   - Invest in species with greatest relevance to provide broadest industry benefit
   - Increase delivery of agents utilising a broader array of networks
3. New approaches to management and monitoring
   - Investigate new technologies e.g. thermal, microwave, electrical
   - Explore approaches to better utilise existing on-farm resources in weed management
   - Develop monitoring methods and a compelling case for early action on emerging weeds
4. Improving recommended practices
   - Improve regionalisation of messages and sharing of local experiences in weed management and R&D output by developing communities of interest

4.2 Analysis approach

Page and Lacey (2006) demonstrated that for every dollar invested in weed biocontrol a benefit to agriculture of $17.40 is generated. This is the ‘yardstick’ by which LPI investments in weed RD&E will be judged i.e. each proposed investment pillar must achieve at least a Benefit Cost Ratio (BCR) of 17:1, or have a sound reason based in strategy, for achieving a lower level of performance. The literature was reviewed to inform this approach.

5 Overarching data to drive the analysis

5.1 Previous weed initiatives relevant to livestock industries

Responsibility for weed management rests heavily with private landholders and public land managers. This has long been recognised through state-based legislation. However, where weed problems are extensive collective action is often needed (Woodburn et al 2010).

Collective action brings together stakeholders that include all three levels of government, regional Natural Resource Management (NRM) bodies, primary industries, research organisations and community groups concerned with natural resources and the environment.

The Australian Government provides policy leadership and direction in weed management. It is responsible for international border protection and the management of Commonwealth lands (e.g. Commonwealth national parks and defence lands). Through various legislative instruments it is responsible for World Heritage Areas, Ramsar wetlands and listed threatened species and communities.

Key among Australian Government weed management initiatives relevant to the livestock industries have been Weeds of National Significance; the 'Defeating the Weed Menace' Program; 'Caring for Our Country' Initiative; and National Biosecurity.

Weeds of national significance (WONS)
WONS was a joint States and Commonwealth initiative to prioritise weed species to improve understanding of the species, its distribution and possible containment lines, as well as best practice management information. WONS are weeds that have degraded large parts of Australia's natural and productive landscapes. WONS were classified on the basis of invasiveness, impacts, potential to spread, socio-economic and environmental considerations. The WONS process is overseen by the Australian Weeds Committee.

Defeating the weeds menace
This program ran from 2004 to 2008 and invested $40 million to tackle Australia's most invasive weeds through: research, biological control, community awareness, and on-ground action. The R&D component of this program is described in Section 2.2.

Caring for Our Country (C4C)
The C4C initiative commenced in 2008 and recognises that weed invasion represents a key pressure on biodiversity and natural icons; coastal environments and critical aquatic habitats; sustainable farm practices; and the sustainable management of northern and remote Australia. C4C funding is not intended to support research.

National biosecurity
In recent years the Australian and state/territory governments have been working together to develop stronger partnerships directed at improving responses to exotic plant pests and diseases. The recent Inter Governmental Agreement on Biosecurity (IGAB), which has strong links to the Australian Weeds Strategy, sees a growing focus on science-based decision-making in which R&D will increasingly support necessary emergency responses to weed invasion.

Australian Weeds Strategy (AWS)
The AWS established in 2007 is a national coordinating initiative whose mission is to provide guidance for national leadership so all Australians can work together against the serious impact of weeds. The AWS has limited funding in its own right and its goals address prevention of new weed problems, reducing the impact of existing priority weed problems (i.e. WONS) and enhancing Australia's weed management capacity.

5.2 Previous investments in weed RD&E

As the AWS identifies (Natural Resource Ministerial Council 2007):

> 'Weed management is an essential part of the sustainable management of natural resources for the benefit of the economy, the environment, human health, and amenity.
>
> Good science underpins the effective development, monitoring and review of weed management strategies.'

Cooperative Research Centres (CRC)
The complexity of weeds management was recognised in the establishment of the CRC for Weed Management Systems in 1995. Together with its successor, the CRC for Australian Weed Management, it has hosted and coordinated a diverse program of research addressing areas including:

- Weed biology and ecology
- Weed risk assessment
- Pasture management
- Crop agronomy.

The Weeds CRCs focussed on enhancing the sustainability of farming systems and the conservation status of natural ecosystems across Australia through research that targeted control problems using integrated approaches.

Some examples of achievements of the CRCs include:

- An economic assessment of weed costs to Australian agriculture (Sinden et al 2004)
- An economic evaluation of biological controls that showed that over the past 30 years the benefit cost ratio for biological control programs averaged $17.40 for agriculture, $3.80 for society and $1.90 for government for every $1 invested (Page an Lacey 2006)
- A series of technical reports that evaluated biological control agents
- Significant developments in Weed Risk Assessment for Australia
- Collaborative work on the management of glyphosate resistance
- A series of weed management guides designed to summarise current knowledge and translate it into management advice.

The CRCs attracted funding from the Australian Government, GRDC, Landcare Research NZ and DAFF. Between 2001-02 and 2007-08 more than $26 million was invested.

Defeating the weeds menace R&D program
Defeating the Weeds Menace R&D program was directed at 'national priority weed issues across Australia that are having an impact on extensive land systems and conservation areas'. Projects and themes aligned to the AWS. Program reviewers noted 'omission of a research theme addressing social and institutional factors that influence adoption of improved weed management strategies' (Woodburn et al 2010).

A series of synthesis reports generated from this R&D program include:

- An evaluative commentary on funded biological control projects
- An integrative framework for controlling weeds within natural resource management
- A survey-based analysis of the diversity of end-users of information on weeds and the needs of each of these groups
- A discussion paper on policy, institutional and management considerations for weeds that also have commercial value
- Preliminary work on the likely spread of 'sleeper' and 'alert' weeds under changing climate conditions
- Innovative new uses of robotic aircraft, spectral analysis and machine learning in detecting significant weeds.

National weeds and productivity research program – Stage one (DAFF) and Stage two (RIRDC)
The Australian Government committed approximately $16 million over four years from 2008-09 to establish a new comprehensive National Weeds and Productivity Research program to reduce the impact of invasive plants on farm and forestry productivity and also on biodiversity.

DAFF led the first stage of this program by investing in 39 projects valued at nearly $3.6 million. The projects were short term and covered:

- Surveillance and detection
- Herbicide resistance
- Biological control
- Integrated weed management strategies
- Future risks (climate change)
- Impact of weeds on biodiversity
- Maximising knowledge for adoption of existing research.

Stage two of the National Weeds and Productivity Research Program was administered by RIRDC and resulted in investment in 30 projects valued at $12.4 million across four research objectives:

- Improve knowledge for effective risk management of weeds
- Reduce the impacts of weeds on Australia's productive systems and environment
- Support improved adoption of weed management approaches
- Plan for future funding and institutional arrangements.

Limited projects funded under this now completed program were of relevance to the Australian meat and livestock industry (Weston 2011).

MLA investments
For the grazing industries, the focus of weeds research has been on invasive species that compete with pasture, degrading its nutrient value and limiting access to grazing areas. (Woodburn et al 2010).

Both AWI and MLA have invested in collaborative research directed to the discovery of new biological control (biocontrol) agents for problem weeds and in better understanding the ecology of some of these species to assist in improving their management (Dyer 2008).

Since 2003 MLA has invested approximately $800k pa in weeds management. MLA is presently investing $500k pa in weed management in Northern Australia and has not had a dedicated weeds management program for Southern Australia since 2009 (Allan and Rothwell 2012).

The MLA Feedbase Investment Program (FIP) was approved in July 2011 with an indicative budget for weed research of $1.3 million over 5 years. The FIP weeds pillar has not been developed. This program will replace the FIP weeds pillar request. The weeds pillar will be nested within the MLA NRM Plan (Allan September 2013). Weeds are a priority in the Beef and Sheepmeat National RD&E Plans and with NABRC (Allan and Rothwell 2012).

5.3 Economic, environmental and social cost of weeds

The scale of the weed problem

Sinden et al 2004
The area occupied by weeds indicates the national importance of the weed problem, and the percentage of Australia occupied by each of the WONS is shown in Table 2.1.

Table 2.1 Area of Australia occupied by the top 20 WONS (Year 2000 data)

Weed	Aust Land Mass %	Weed	Aust Land Mass %
Bitou bush	3.0	Alligator weed	0.4
Blackberry	9.0	Athel pine	1.0
Gorse	3.0	Bridal creeper	5.0
Lantana	5.1	Cabomba	0.5
Mimosa	1.0	Chilean needle grass	0.2
Parkinsonia	12.4	Hymenachne	1.0
Parthenium	5.6	Mesquite	5.3
Prickly acacia	2.3	Pond apple	0.4
Rubber vine	7.7	Salvinia	5.0
Serrated tussock	2.2		
Willows	0.8		

Source: Thorp and Lynch 2000 reported in Sinden et al 2004
NB Audit Report 2007 shows mapped location of each weed

The table shows that many individual weeds occupy large areas and several of these species each occupy more than five per cent of Australia's land mass.

The impacts of weeds are more relevant for management decisions than information on the areas that they occupy.

A range of economic, environmental and social impacts

Sinden et al 2004
The total cost of weeds in Australia was estimated at $2 billion pa in 1981-82 (Combellack 1987). Combellack's estimates included the cost of weeds on agricultural land, national parks and in Indigenous owned land.
Sinden et al 2004 estimated producer and consumer surplus loss associated with weeds in 2001-02 at $4 billion or approximately 0.5% of GDP. The cost was estimated as the maximum benefit that could be achieved by reducing the weed population; it represented the size and national significance of the problem in 2001-02.

Agricultural costs were estimated by Sinden as the cost of chemicals, non-chemical controls, fuel and hired labour (no data on owner operator labour was included) plus production loss (5% of gross margin). The total agricultural management cost of weeds was estimated at between $1.4 billion and $1.5 billion in 2001-02. Some 23% of this cost was relevant to the livestock sector. In addition to weed management costs Sinden estimated pasture yield losses (as a % of gross margin loss) totalled $2.2 billion ($1.87 billion in the livestock sector).

The cost to natural environments (including national parks) for weed control was $20 million pa and this estimate excluded ecosystem functions and benefits lost when weeds invade. The value of protecting a threatened plant species in either agriculture or a production forest was estimated at $65,000 per annum. In addition to weed control costs in national parks there were inspection, coordination, survey, education and administration costs of at least $80 million per annum. This estimate does not include the opportunity cost of free labour provided by community groups. Commonwealth authorities invest approximately $8 million per annum in weed R&D.

Smith & Young (2005)
Biological controls offer environmental advantages visa vie alternatives such as chemicals. Little work has been done on the economics of weed control over multi-year investment horizons.

Page and Lacey (2006)
Reviewed all past economic analysis of biocontrol in Australia and where possible analysed all remaining control programs. The aggregate impact of biocontrol was a BCR of 23:1. This was comprised of a BCR of 17.4 for agriculture (control cost savings and increased production); 3.8 to society (health benefits) and 1.9 for government (control cost savings). Based on this historical return and an annual investment in biocontrol of $4.3 million a net annual return of $95.3 million would be delivered in which $71.8 million flowed to agriculture. The annual costs of biocontrol programs have increased and will continue to increase due to expanded regulatory requirements over time. However the overall benefits of biocontrols are so large that even if program costs were to double, the overall BCR would still be 11.6 i.e. a return of $11.60 for each $1 invested.

Page and Lacey 2006 concluded that weed biocontrol programs have been demonstrated to provide a significant return on investment, far better than most alternative investments of public or industry money. A summary of key economic,

environmental and social impacts identified to flow from weed biocontrol programs are contained in the table below.

Table 2.2 Summary of the impacts of the weed biocontrol program

Economic	Environmental	Social
Increased production (yield)	Reduced toxicity from chemicals	Decreased health impacts
Cost reductions	Biodiversity (flora and fauna)	Improved market access
Improved product quality	Reduced fire hazard	Improved food quality
Increased market access	Maintenance of natural habitat / ecosystems	Improved consumer satisfaction
Reduced price penalties		Decreased exposure to chemicals
Reduced risk		Reduced risk of variable income
Assistance in pest animal control		Maintenance of cultural values
Maintenance of tourism value		Improved recreational access to land and water
		Improved scenic amenity

Source: Page and Lacey 2006

Plant Health Australia 2012 – Environmental Cost
PHA 2012 concluded that weeds are one of the major threats to Australia's natural environment. Major weed invasions change the natural diversity and balance of ecological communities. These changes threaten the survival of many plants and animals because the weeds compete with native plants for space, nutrients and sunlight. Almost all of Australia's native vegetation communities have been invaded, or are vulnerable to invasion by exotic species that could result in changes to the structure, species composition, fire frequency and abundance of native communities. Nationally, invasive plants continue to invade the land with exotic species accounting for about 15% of total flora. About one-quarter of all weed species are either serious environmental weeds or have the potential to be serious weeds.

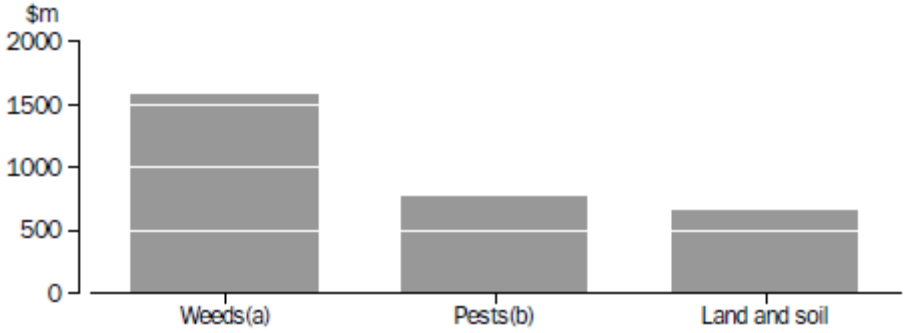
Sinden and Griffith 2005 Valuing the Environmental Gains from Controlling 35 Weed Species
Sinden and Griffith 2005 concluded that when control of a WONS results in protection of either a threatened species or a conservation area it can be reasonably argued that an annual environmental gain valued at approximately $65,000 is realised by the Australian community. This estimate was derived using relevant environmental valuation studies including non-market valuation techniques such as contingent valuation.

Allan and Rothwell December 2012
The annual economic impact of weeds in Australia has been estimated at beef/veal: $882.99 million; and lambs/mutton at $283.30 million, wool $588.20 million. These data were drawn from Sinden et al 2004.

ABS Australian Year Book 2012
ABS data for 2006–07 shows that farmers spent $1.6 billion controlling and preventing weeds, which was more than for other pests ($768m) and land and soil problems ($649m) combined (graph 2.21). Weed management activities also proved

very time consuming, with agricultural businesses undertaking, on average, 31 person days of effort on these activities in 2006–07.

2.21 FARM EXPENDITURE ON NATURAL RESOURCE MANAGEMENT—2006–07



(a) A weed is a plant growing where it is not wanted. Weeds may damage crops or poison livestock when growing in pasture.
(b) A pest is a noxious, destructive or troublesome animal or insect.

Source: Natural Resource Management on Australian Farms, 2006–07 (4620.0).

http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1301.0~2012~Main%20Features~Land%20and%20biodiversity~278

Plant Health Australia 2012 – Social Cost

Some weeds can have adverse effects on people's health, recreation, safety and aesthetics. One of the WONS, Parthenium, produces pollen that contains potent allergens that can cause reactions such as dermatitis and hay fever. Weeds like ryegrass produce pollen than can cause hay fever and other allergies in sensitive people. Many weeds have annoying thorns, spines, burrs or sticky seeds that can cause injuries to humans and livestock. Weeds add to the cost of gardening and parks management as well as acting as reservoirs for diseases and pests of vegetables and ornamentals. Weeds spoil natural landscapes and affect recreational use of natural areas for activities such as bushwalking and water sports. Weeds can also increase the risk of bushfire and harbour feral animals. Weed control on road and rail corridors is necessary to maintain line of sight and the safety of transport systems.

Thorp, J 2011 Cost of Weeds, Ranking Weeds of Importance to the Grazing Industry

Literature shows that weed prevention typically has a BCR of between 38 and 100; spread a BCR of 8; and control a BCR of 4. Potential grazing industry costs associated with weeds include – loss of pasture production, animal poisoning, product down grade and barriers to trade. The cost of weeds to graziers is equivalent to the production loss plus cost of control plus loss of sales resulting from weed contamination. In this study estimates were only prepared for control cost.

Thorp 2011 applied an environmental impact score to grazing weeds. The score covered conservation values, biodiversity factors, number of threatened species and conservation areas. It included capacity of the grazing weed species to create environmentally destructive monocultures. The 'top 5' grazing weeds were all temperate species. Thorp 2011 noted that there are large parts of Australia which are generally free of serious threatening weeds (Kimberley, NT, Northern Qld) and potential weed control costs exceed land values. Consequently, Thorp concluded, MLA should invest in prevention programs – early detection, vehicle wash down, limiting contaminated stock movements, vendor declarations, farm hygiene programs, etc. Climate change will positively and negatively impact weed populations. Thorp 2011 noted that management maps are available for the 20 WONS.

Table 2.3 Top 10 grazing weeds – cost and distribution

Species	Cost to Agriculture 1998 ($M pa)	Cost to Forestry 1998 ($M pa)	Enviro Score (n)	Negative Social Impacts	Positive Social Impacts	States Present
Blackberry	22.5	3.6	3.1	Fire loads Access to amenities	Edible fruits	SA, NSW, Tas, Vic
Ragwort	4.0	0	1.4	Land values Dermatitis	Chinese herbal	Tas
Gorse	3.6	3.4	2.0	Access Fire loads	Beekeeping	SA, Tas, Vic
Paterson's Curse	3.4	4.1	2.6	Allergic Dermatitis	Beekeeping	SA, NSW, Vic
Serrated Tussock	2.8	0	2.1	Fire loads	Nil	NSW, Tas, Vic
Sicklepod	2.6	1.0	1.4	?	?	Qld, NT
Parthenium	2.4	0	1.5	Major allergic reactions. Taints milk	Nil	Qld
Prickly Acacia	2.2	0	1.3	Stock move Mustering	Fodder Shelter	Qld
Rubber vine	2.1	0	1.6	Access to creeks, aesthetics, tourism	Nil	NSW, Qld
Mesquite	1.7	0	1.5	Spiny Amenity value	Shade Fodder Firewood Land rec Ornamental	Qld, WA

Source: Thorp 2011 (includes data on another 15 weeds) NB: costs are only control costs

Sindel 2008 (in Weston 2011)
Identified the weed species of concern to graziers: thistles, perennial grasses, woody weeds, Paterson's curse, blackberry, Bathurst burr, Capeweed, ragwort, Parthenium and Gorse.

ABS 2006-07 (Cat No 4620.0)
ABS data relevant to benefit cost analysis of weed control includes:

- Total area of agricultural land 425 million hectares
- Total cost of weed management on agricultural holdings was $1.6 billion
- Average expenditure on weeds per agricultural business was $11,785
- Farmers spent $7.50/ha on NRM, of which $2.46/ha was on herbicides (crops dominate)
- Farmers spent 0.024day/ha on labour in NRM (at $20/hr this is $3.80/ha on NRM or $1.25/ha on herbicides)
- 150,403 agricultural businesses in Australia, 99,222 reported weed problems, 133,578 spent money on weed control.
- Cat No 4620 also has a breakup of the total expenditure by state on weeds with detail on herbicides, payments to contractors, labour, and other expenses
- 69% of beef and sheep enterprises reported weed problems, 93% invested in weed control

The above literature and data informs the Benefit Cost Analysis of proposed MLA weed themes.

6 Benefit cost analysis by LPI weed theme

Benefit cost analysis (BCA) of each weed theme includes a description of the theme and an outcome statement; theme investment; economic benefits generated from theme delivery; description of data used in the analysis (drawing on the above literature review); analysis results and sensitivity testing.

All analyses were completed over a 30 year period using a discount rate of 7%.

6.1 Theme 1 BCA: Weed management in production systems

Theme description and outcome statement

The Weed Management in Production Systems theme sets out to improve the timeliness of livestock producer weed intervention decisions and in so doing lower the cost of weed control. Initiatives proposed under this theme include:

- Investigate remote and objective tools to assist intervention decisions
- Devise thresholds and lead indicators for weeds in production systems
- Understand and package the financial implications of weed management
- Determine biophysical and decision based drivers of successful weeds management
- Improve guidelines by researching system implications in 4 agro-ecological zones

Theme investment

An MLA investment of $450,000 pa for five years was modelled.

Benefit estimation

Delivery of this theme will decrease the cost of weed control. Data used to estimate this benefit to livestock producers was:

- The financial cost of weed control in agriculture estimated by Sinden et al 2004 at between $1.4 and $1.5 billion per annum in 2001-02.
- ABS Cat No 4620 estimates the financial cost of weed control in agriculture at $1.6 billion per annum in 2006-07.
- Sinden et al 2004 attributed 23% of the total cost of weed control in agriculture to livestock production, a total cost of around $368 million per annum.
- Improved timeliness of livestock producer weed intervention is hypothesised to decrease the cost of weed control by 5% across the livestock production sector (AgEconPlus assumption informed by literature review).
- Benefits are assumed to flow to livestock producers 10 years after the fifth MLA annual investment is made (year 2029), take five years to peak, maintain this peak for 5 more years before deteriorating to zero by 2041. New technology will then replace returns from this investment.

Analysis results

The table below summarises BCA results for Theme 1 Weed Management in Production Systems for 'core' assumptions and a sensitivity test based on the known performance of biocontrols.

Table 3.1 Theme 1 BCA weed management in production systems

Investment Criteria	Result
PV Benefits ($' million)	33.30
PV Costs ($' million)	1.51
NPV ($' million)	31.79
BCR (X:1)	22.11
IRR (%)	20
Sensitivity Test	
Reduction in the cost of weed control assumed	5%
Reduction in the cost of weed control required to deliver a BCR equivalent to the biocontrol 'yardstick'	3%

Theme 1 delivers a NPV of $31.79 million and a BCR of 22.11 i.e. for every one dollar invested by MLA, livestock producers receive a benefit of $22.11. The reduction in the cost of weed control resulting from delivery of this theme could fall from 5% to 3% and this theme would still deliver a return for livestock producers equivalent to investment in biocontrols (i.e. BCR of 17.4). A 5% reduction in the cost of weed control, the core assumption, would seem to be achievable and the investment appropriate.

6.2 Theme 2 BCA: Biocontrol of impacting weeds

Theme description and outcome statement

The Biocontrol of Impacting Weeds theme sets out to provide new biocontrol agents for dissemination by livestock producer groups such as Landcare. Initiatives proposed under this theme include:

- Maximise relevance through improved prioritisation
- Invest in species with greatest relevance to provide broadest industry benefit
- Increase delivery of agents utilising a broader array of networks

Theme investment

An MLA investment of $345,000 pa for five years was modelled.

Benefit estimation

Delivery of this theme will decrease the cost of weed control and reduce the rate of pasture loss caused by weeds. Data used to estimate this benefit to livestock producers was:

- Known return on biocontrol investments estimated by Page and Lacey 2006 across thirty six studies which showed an aggregate impact of biocontrol of 23:1 of which 17.4:1 accrued to agriculture.
- Based on this known rate of return for biocontrol, an annual investment in biocontrol of $345,000 will generate an annual return that includes both weed control savings and a reduced rate of pasture loss of approximately $6 million (based on the ratio developed and applied by Page and Lacey 2006).

- Benefits are assumed to flow to livestock producers 15 years after the fifth MLA annual investment is made (year 2034), take five years to peak, maintain this peak for 15 more years.

Analysis results

The table below summarises BCA results for Theme 2 Biocontrol of Impacting Weeds for 'core' assumptions. Biocontrol is the yardstick by which other weed investments are measured. Sensitivity testing is not appropriate.

Table 3.2 Theme 2 BCA biocontrol of impacting weeds

Investment Criteria	Result
PV Benefits ($' million)	20.00
PV Costs ($' million)	1.15
NPV ($' million)	18.84
BCR (X:1)	17.4
IRR (%)	13

Theme 2 delivers a NPV of $18.84 million and a BCR or 17.4 i.e. for every one dollar invested by MLA livestock producers, livestock producers receive a benefit of $17.4.

6.3 Theme 3 BCA: New approaches to management and monitoring

Theme description and outcome statement

The New Approaches to Management and Monitoring theme sets out to reduce pasture loss caused by weeds. Initiatives proposed under this theme include:

- Investigate new technologies e.g. thermal, microwave, electrical
- Explore approaches to better utilise existing on-farm resources in weed management
- Develop monitoring methods and a compelling case for early action on emerging weeds

Theme investment

An MLA investment of $405,000 pa for five years was modelled.

Benefit estimation

Delivery of this theme will reduce the rate of pasture loss caused by weeds. Data used to estimate this benefit to livestock producers was:

- The loss in pasture yield in the livestock sector was estimated by Sinden et al 2004 at $1.87 billion pa in 2001-02.
- New technologies, better application of existing on-farm resources and new monitoring technologies are hypothesised to decease the rate of pasture loss caused by weeds by up to 1% pa across the livestock production sector (AgEconPlus assumption informed by literature review).
- Benefits are assumed to flow to livestock producers 10 years after the fifth MLA annual investment is made (year 2029), take five years to peak, maintain this peak for 5 years before deterioration sets in. New technology will then replace returns from this investment.

Analysis results

The table below summarises BCA results for Theme 3 New Approaches to Management and Monitoring for 'core' assumptions and a sensitivity test based on the known performance of biocontrols.

Table 3.3 Theme 3 BCA new approaches to management and monitoring

Investment Criteria	Result
PV Benefits ($' million)	32.40
PV Costs ($' million)	1.36
NPV ($' million)	31.04
BCR (X:1)	23.90
IRR (%)	19
Sensitivity Test	
Reduction in pasture loss assumed – maximum of	1%
Reduction in pasture loss required to deliver a BCR equivalent to the biocontrol 'yardstick'	0.6%

Theme 3 delivers a NPV of $31.04 million and a BCR of 23.9. The reduction in the loss of pasture yield resulting from delivery of this theme could fall from a maximum of 1% to a maximum of 0.6% and this theme would still deliver a return for livestock producers equivalent to investment in biocontrols (i.e. BCR of 17.4). A 1% reduction in the productivity of pasture would seem to be achievable and the investment appropriate.

6.4 Theme 4 BCA: Improving recommended practices

Theme description and outcome statement

Theme 4, Improving Recommended Practices sets out to hasten the rate of adoption of weeds research outputs and decrease the cost of weed control. Initiatives proposed under this theme include:

- Improve regionalisation of messages and sharing of local experiences in weed management and R&D output by developing communities of interest.

Theme investment

An MLA investment of $300,000 pa for five years was modelled.

Benefit estimation

Delivery of this theme will reduce the cost of weed control. Data used to estimate this benefit to livestock producers was:

- ABS Cat No 4620 estimated agricultural weed control cost at $1.6 billion.
- Sinden et al 2004 attributed 23% of the total cost of weed control in agriculture to livestock production, a total cost of around $368 million per annum.
- Improving recommended practices is hypothesised to decrease the cost of weed control by 3% across the livestock production sector (AgEconPlus assumption informed by literature review).
- Benefits are assumed to flow to livestock producers 5 years after the fifth MLA annual investment is made (year 2024), take five years to peak, maintain this peak for 5 more years before deteriorating to zero by 2036.

Analysis Results

The table below summarises BCA results for Theme 4 Improving Recommended Practices for 'core' assumptions and a sensitivity test based on the known performance of biocontrols.

Table 3.4 Theme 4 BCA improving recommended practices

Investment Criteria	**Result**
PV Benefits ($' million)	29.27
PV Costs ($' million)	1.00
NPV ($' million)	28.27
BCR (X:1)	29.15
IRR (%)	32
Sensitivity Test	
Reduction in the cost of weed control assumed	3%
Reduction in the cost of weed control required to deliver a BCR equivalent to the biocontrol 'yardstick'	1.5%

Theme 4 delivers a NPV of $28.27 million and a BCR of 29.15. The reduction in the cost of weed control from delivery of this theme could fall from a maximum of 3% to a maximum of 1.5% and this theme would still deliver a return for livestock producers equivalent to investment in biocontrols (i.e. BCR of 17.4). A 3% reduction in the cost of weed control would seem to be achievable and the investment appropriate.

7 Whole of weeds portfolio benefit cost analysis

Results from analysis of the four individual Weed themes are aggregated in Table 4.1.

Table 4.1 Weeds Pillar ROI - MLA investment of $1.5 million pa

Theme	**PV Costs ($'million)**	**PV Benefits ($'million)**	**NPV ($'million)**	**Benefit Cost Ratio (BCR)**
Weed Management in Production Systems	1.51	33.30	31.79	22.11
Biocontrol of Impacting Weeds	1.15	20.00	18.84	17.40
New Approaches to Management and Monitoring	1.36	32.40	31.04	23.90
Improving Recommended Practices	1.00	29.27	28.27	29.15
Weeds Pillar Total	**5.02**	**114.96**	**109.94**	**22.90**

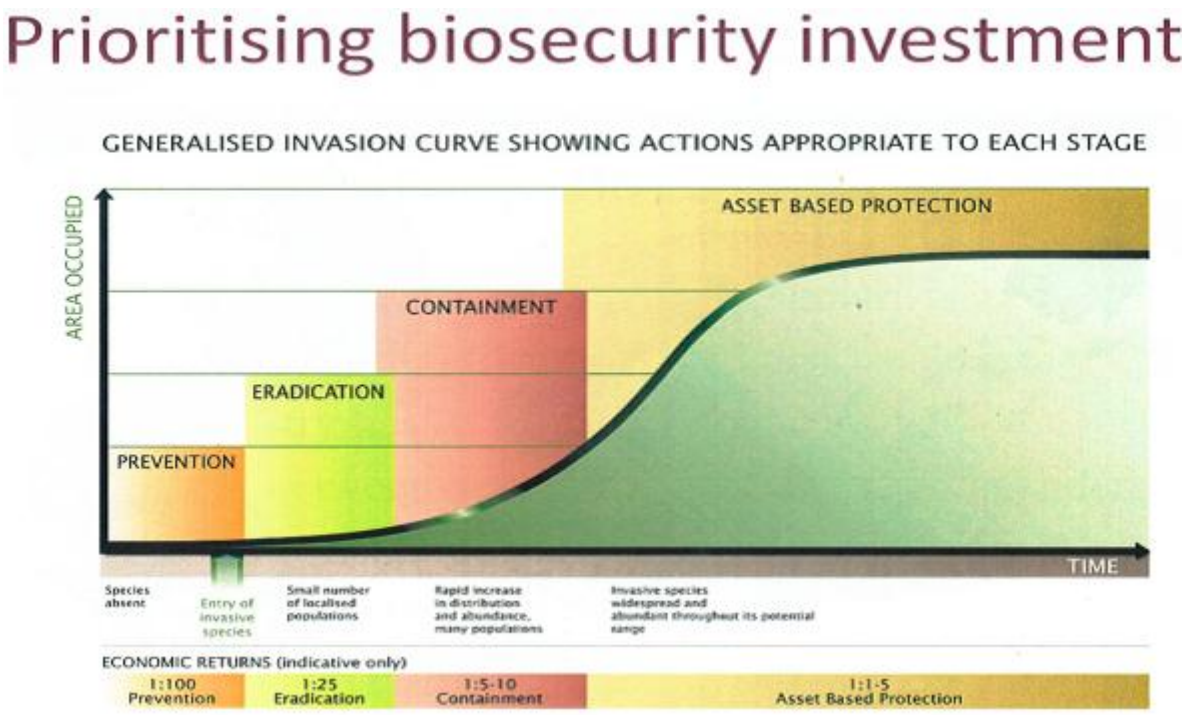
Total MLA investment in LPI Strategy 4.1.1 NRM Weeds Pillar of $1.5 million per annum, at a discount rate of 7%, has a present value cost of $5.02 million and generates present value benefits of $114.96 million. Net present value is $109.94 million. The benefit cost ratio is 22.9:1 i.e. for every dollar invested by MLA a return of $22.90 is forecast for livestock producers. This return on investment is net of spillover benefits to the broader Australian community.

7.1 Returns at alternative MLA investment levels

The original terms of reference required a whole of Weeds portfolio analysis for alternative MLA investments i.e. a total MLA investment of $1 million and $2 million per annum. More detail is needed on the portfolio before these analyses can be completed. Additional insight might include the link between additional MLA investment and the shortening of lapsed time before benefits are generated. This type of information might be generated from consultation with researchers once projects within the Portfolio are better understood.

8 Conclusions from the analysis

The portfolio is balanced, with all themes achieving BCRs that exceed the biocontrol investment yardstick of 17.4. The highest BCR is achieved by theme 4 the analysis of which assumes a shortening of the period before benefits commence. Analysis results are consistent with ex poste BCAs completed for other weed investments and the literature which shows higher returns for incursion prevention – Figure 5.1.



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