BALONNE SHIRE COUNCIL

Submission to the Agriculture & Environmental Committee's Inquiry into Barrier Fences in Queensland.

Closing Monday 29 February 2016

Council makes the following comments in relation to the Terms of reference of the Inquiry.

1. The management of the Wild Dog Barrier Fence by DAF

   Council is of the opinion that since the management partnership between DAF and local government commenced, processes have improved significantly, and overall management of the fence has improved, including asset maintenance and equipment availability.

2. The management of the Darling Down – Moreton Rabbit fence by the DDMRB

   Council submits that recent changes to management have improved the outcomes.

3. The effectiveness of barrier fences at protecting stock and corps from wild dogs, rabbits and other introduced species.
   Council submits that as older style cluster fencing deteriorated and was replaced by cattle fencing, dog number have been on the increase. This leads to the conclusion that barrier fencing is effective. This is supported by the observations that, as the current practice of construction of cluster fencing is being embraced by landowners, a marked reduction in dog numbers within these areas is evident.

4. The unintended impact of barrier fences on native species.

   Council submits that a positive outcome is produced, as the smaller native animals and reptiles that are preyed upon by wild dogs benefit from the fencing.

5. Recent upgrades to sections of the Wild Dog Barrier Fence by DAF
   Council submits that the current construction style of the barrier fence has proved to be effective and that until such time that trials of alternative fencing types are proven to be effective, the current construction style, and materials used should be continued.

6. Whether barrier fences should be expanded to other areas of the State to protect stock.
   Council submits that, given the effectiveness of the current fence, and trials of cluster fencing providing evidence based outcomes, then due consideration should be given to expansion of the barrier fence, starting in areas of higher stock protection, for the best cost benefit outcome.

   A model of a single check fence has been developed, linking cluster areas, creating an effective barrier that prevents reinfestation, and allowing more positive controls.
   Council believe that the barrier fence enables diversification of industry. Properties have gone

from sheep to cattle in areas that are not suitable for cattle grazing. Fencing would allow a return to sheep production in optimum areas, thereby reducing the impacts of drought, and the need for government assistance for solely cattle producing areas. The sheep industry is more labour intensive and improving employment opportunities.

Council also provides as an attachment, a document recently sourced by Council titled "Economic Feasibility Analysis on the implementation of a Cluster Exclusion Fencing Model in the Balonne region, prepared by Grant Consultants.

The contents of this Report provides the evidence to support the statements made by Council in its submission.

Economic Feasibility Analysis on the implementation of a Cluster Exclusion Fencing Model in the Balonne Region

A broad economic evaluation of the model as a mitigation strategy for wild dog control across the Balonne region.

GRANT
CONSULTANTS

Credits

Credit should be given to the various people and organisations who contributed their information to allow this report to be produced.

Disclaimer

Analysis within this report has been conducted from a broad desktop perspective, and should not be used for decision making in individual circumstances. Exact and long-run figures have been used in calculations where possible, however when necessary a number of assumptions have been made which may not represent the true accuracy on ground.

Report prepared by

J. Grant
December, 2015

1 Executive Summary

This report provides an economic analysis of the potential for cluster exclusion fencing on rural enterprises within the Balonne Shire Council area. The project focuses on mitigating impacts from invasive species on agricultural lands, and deriving private benefit to rural landholders. Financial and economic analysis has been undertaken to measure the economies of scale in implementing a project at multiple regionally specific scales, as well as their potential returns on investment.

Financial analysis demonstrates that invasive animals such as wild dogs, pigs, and kangaroos present significant economic costs to the region's agricultural production. It is estimated throughout the Balonne region, these invasive animals collectively cost primary producers upwards of $57,808,804 in lost production. These costs encompass costs associated with land degradation and crop loss, severe livestock predation and devaluing, disease spread, and intense competition for grazing pasture.

The report identifies that when cluster exclusion fencing is implemented at its optimal sizing, the project has significant potential to be funded without government assistance. With an estimated payback period, across different production structures, ranging from 0.72 to 7.18 years without funding assistance; the project's payback however could be reduced to 0.54 to 5.39 years should 50% funding be sourced. Landholders involved with sheep production demonstrate the strongest capacity to reduce payback periods given the current impact of invasive animals, and the potential productivity and profitability of the exclusion fence model.

Based on the analysis conducted, the report finds that the implementation of cluster exclusion fencing in the region is a very economically feasible option. The major weakness of the project is that due to the variety of agricultural lands (grazing compared to cropping, and multiple property scales), different cluster sizes, fence designs and structures may need to be established to reflect the varying impacts and intensities on invasive animals.

Contents

2 Situation analysis

The Balonne Shire Council, in conjunction with the Murray Darling Basin Regional Economic Diversification Program, are seeking an economic evaluation on the effectiveness of cluster exclusion fencing throughout the region. The intention of these clusters are to be positioned throughout Balonne shire as a method of improving the sustainability and long-term resilience of primary production and rural enterprises in the region.

Over recent years, the region has been severely impacted, socially, economically and environmentally, as a result of excessive grazing pressure, predation of managed livestock, and a significant degradation of landscape and cropping.

Reduced carrying capacity and pressure on land condition has resulted from an inability to effectively control total grazing pressure and manage the resource base. In addition, these pressures have also altered the socio-economic and biophysical context of the area. Agricultural business profitability and productivity is now under serious pressure.

This report provides an economic analysis of the potential for cluster exclusion fencing on rural enterprises within the study area identified in Section 2.1. The project focuses on mitigating impacts from wild dogs and feral pigs on agricultural lands, and deriving private benefit to rural landholders. The report will assist decision makers in determining if cluster exclusion fencing is best suited to the region, and assist in prioritising funding allocations to the region based on their potential return on investment.

2.1 Review area

The effective study area encompasses the Balonne Shire Council area. The total area size is approximately 3,036,482ha. The region is one of the most diverse rural production and value adding areas in Australia, producing a variety of grazing (both sheep and cattle), dryland and irrigated cropping products.

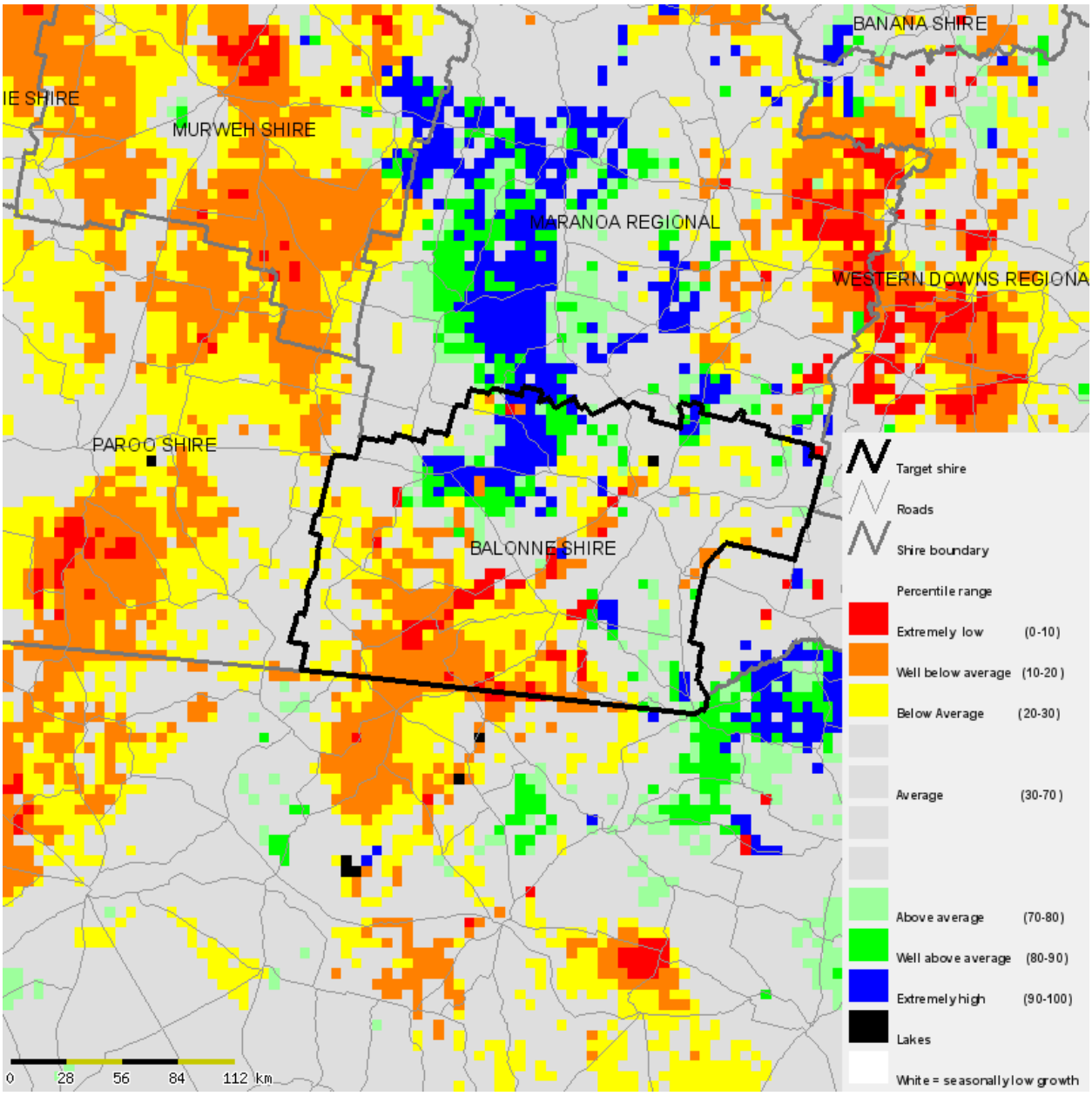
Significant portions of grazing lands in the region are currently inundated with wild dogs; and as a result, are rapidly depleting sheep populations, and eliminating any opportunity to return the area back to predominately sheep production. The region is now suffering a significant reduction in productivity and profitability.

For the purpose of this report, the reviewed area has been narrowed to include horticultural or agricultural properties as defined by the Department of Natural Resources and Mines. This area represents 91% (2,750,706ha) of the Balonne Shire Council.

The region is classified as drought declared. Significantly low rainfall and ongoing grazing pressure from kangaroos has reduced pasture growth in the region's south to well below average, and extremely low, compared to historical records[1].

[1] Department of Science, Information Technology and Innovation, 2015

Map 2.1.1 - Year pasture growth relative to historical records - Nov 2014 to Oct 2015



Map 2.1.2 - Review area

Agricultural industry

In 2011, the region produced $501.5 million in agricultural commodities, representing 48% of the South West's total production[2]. Compared to 2006, the region's total gross value of agricultural production has increased by approximately 126.9%, primarily due to a 209% increase in cropping production (with value per hectare of crop increasing by 76%). Conversely, production from slaughtered livestock has reduced by 13% (with value per hectare of livestock decreasing by 17%) during the same period.

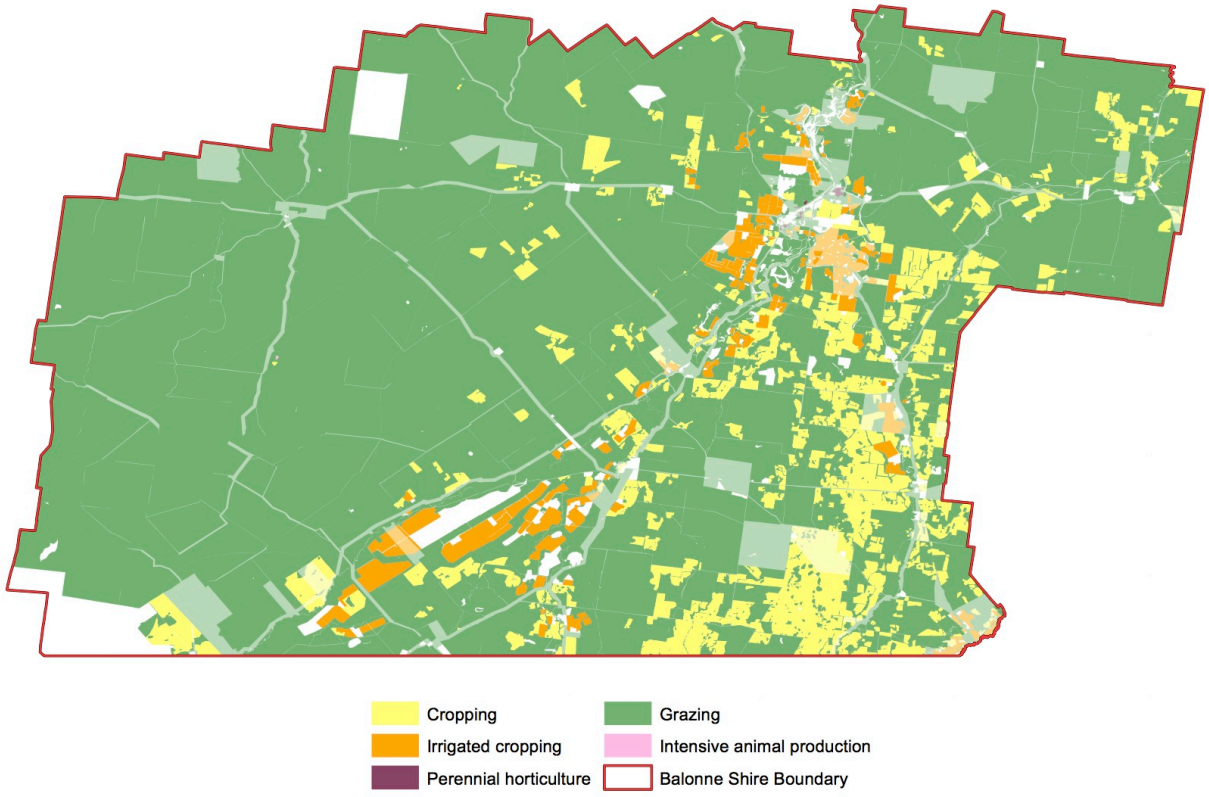
Agricultural land use across the Balonne Shire Council area is considered diverse. The majority of the region (96% of land use) is under agricultural production, with grazing and broadacre cropping being the predominant industries. Grazing is the dominant land use across the region (83.1% of agricultural land), followed by cropping (9.76% of agricultural land). The region has previously witnessed (and still continues to occur) a major livestock transfer from sheep to cattle, and more recently is experiencing a shift from livestock production to cropping.

[2] Australian Bureau of Statistics, 2012

Table 2.1.3 - Current land use[3]

Queensland Land Use Mapping (2015)	Area (ha)	Percentage of region (%)
Cropping	296,360	9.76
Grazing	2,523,210	83.10
Perennial horticulture	604	0.02
Irrigated cropping	92,617	3.05
Intensive animal production	78	0.00
Other land use *(non-agricultural land uses and forestry)*	123,613	4.07
Total	**3,036,482**	**100**

Map 2.1.4 - Current agricultural land use



[3] Queensland Department of Science, Information Technology and Innovation, 2015

Existing wild dog barrier fence

The review area is within the protection zone of the existing Wild Dog Barrier Fence, administered by Biosecurity Queensland; however, the area does not contain any sections of the fence. For the purpose of this report, it is concluded that the existing Wild Dog Barrier Fence provides no financial or scale benefit to cluster projects.

The Balonne Shire Council continues to financially contribute to the maintenance of the barrier fence annually.

Economic diversity index

The Economic Diversity Index (EDI), also referred to as the Hachmann Index, gives an indication of the vulnerability of communities to changes in economic circumstances[4]. In theory, a region with a relatively diverse local economy is better able to adjust to changes that have a significant impact on a particular sector or sectors of employment, as employment is available in a range of sectors. In a less diverse local economy, the community may be especially sensitive to change in certain industry sectors.

The EDI compares the proportion of the workforce employed in each sector to that of a larger geographic unit (in this case, Queensland as a whole). The closer the EDI score of a particular geographic unit is to 1.0, the closer its employment distribution is to that of Queensland, and the more diverse is its economy is considered to be. Conversely, the closer its score is to zero, the less diverse is its economy.

The area within Balonne Shire Council identifies as very unstable with an EDI = 0.1823. The Economic Diversity Index demonstrates that the Balonne Shire is particularly vulnerable to economic impacts in the agricultural industry given it employs 36.7% of the population[5]. In the event of market failure (resulting from failed business, impacts from invasive species, drought and flood etc.), the region would have a reduced ability to recover its limited diversity of employment opportunities.

[4] Moore, E., 2001
[5] Australian Bureau of Statistics, 2011

3 Methodology

The analysis conducted throughout this report relates to two (2) fundamental concepts; the cluster exclusion fencing model, and economies of scale.

Analysis has been conducted broadly from a desktop perspective, and as such, a number of assumptions and approximations have been used. Regional and state averages have been used in populating data in some instances.

3.1 Cluster exclusion fencing model

Conventionally, exclusion fencing has been utilised for the management of wild dog predation, land degradation from feral pigs, and overall total grazing pressure throughout surrounding region.

The cluster exclusion fencing model is centred on the control of total grazing pressure through the construction of a high integrity exclusion fence surrounding a “cluster” of rural properties. The fence is intended to restrict invasive animals entering the protected area. The project builds on the collaborative action of a cluster to develop and implement strategic plans and actions for the management and eradication of invasive species and their impacts, within and surrounding the cluster area.

Targeting the issues of invasive species both internally on individual properties, as well as externally on those surrounding, the project demonstrates an additional level of protection and resilience. Economy of scale is achieved by grouping properties into clusters rather than building exclusion fencing around individual properties.

Following consultation with rural landholders in the region, it is identified that issues (and therefore solutions) facing those involved in grazing versus cropping operations vary significantly. For this reason, the model has been used in two (2) variants; a full strength exclusion fence, and an electric exclusion fence.

Analysis from the Wild Dog Management Strategy 2011-2016[6] shows the existing wild dog barrier fence has a positive benefit-cost ratio of 1.84:1, with $1.84 in benefit generated for each dollar outlaid in fence administration and maintenance. Through a $1.9 million investment into the barrier fence, net benefits equate to approximately $3.5 million during the 2011-2016 period. The fence also provides significant flow-on contributions to the regional economy through employment, household income and regional output.

3.2 Economies of scale

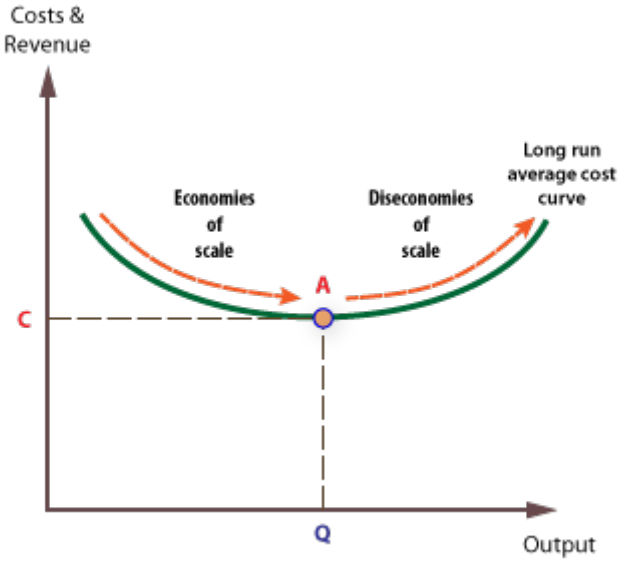
The concept of scale economies provides a way of characterising the production processes that underlie the transformation of inputs (e.g. labour, capital) into a flow of outputs (e.g. invasive animal protection). This characterisation of production can be used to inform the most economically efficient structure for the construction of exclusion fencing.

[6] Queensland Department of Employment, Economic Development and Innovation, 2011

Economies of scale exist when an increase in output is associated with a less than proportionate increase in cost. Equivalently, diseconomies of scale exist when an increase in output is associated with a more than proportionate increase in the cost of production.

The most productive scale size (MPSS), identified as point A in Graph 3.2.1, is the point on the efficiency frontier that maximises the average productivity for its given input-output mix and after which decreasing returns to scale set in.

Graph 3.2.1 - Economies of scale



4 Economic impacts

Invasive animal pests have a wide variety of impacts on the economy, the environment and society. The Balonne Shire Council area has witnessed increasing agricultural losses as a result of vertebrate pests such as wild dogs, feral pigs and kangaroos.

This section identifies the broad economic impacts of these invasive animals on agriculture in the region. A summary of potential regional economic costs are provided below.

Table 4.0.1 - Summary of potential regional economic costs[*]

Economic impact	Estimated annual cost ($)
Feral pigs	
Crop losses	15,803,135
Livestock losses	1,331,661
Disease losses	221,327
Local government management	20,000
Wild dogs	
Livestock losses	2,249,287
Disease losses	87,019
Community losses	9,703,070
Local government management	350,000
Kangaroos	
Livestock production losses	28,043,305
Total economic costs	**57,808,804**

* The above estimated costs only take into consideration those costs associated directly with production and do not include management and administrative costs by landholders or costs associated with individual management syndicates.

4.1 Feral pig impacts

Recognised as one of the most widespread and damaging pest animals in Queensland, feral pigs populations are estimated at 24 million throughout Australia[7]. Aerial surveys by QMDC[8] in 2010 in the adjacent shire of Goondiwindi, estimate a density of 1 feral pig per square kilometre, however earlier

[7] Queensland Department of Agriculture and Fisheries, 2015
[8] Marshall, D., 2010

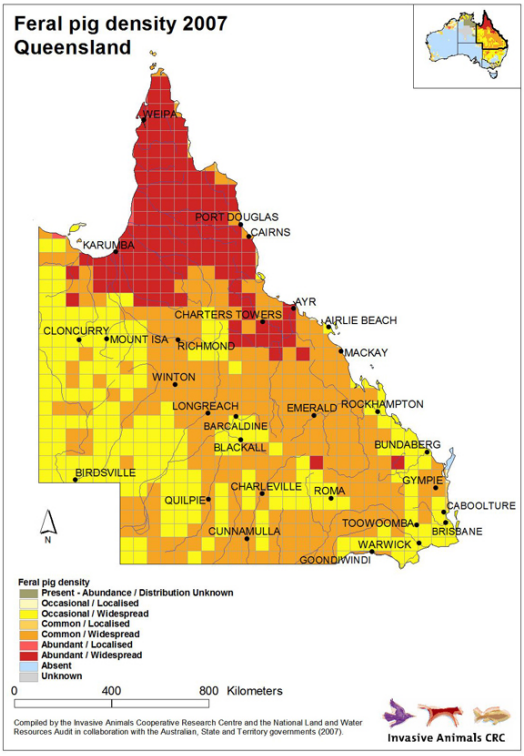
studies[9] suggest densities can reach up to 3.9 pigs per square kilometre in mature wheat crops. Taking an average of previous surveys indicates the review area may contain approximately 74,393 feral pigs.

Feral pigs cause direct losses on the agricultural industry through predation of newborn animals, reduce cropping yields by devouring and destroying crops, compete with livestock for pasture land, and damage infrastructure such as fences. Studies by the Invasive Animal CRC in 2004[10] estimate Australian agricultural losses at $100 million per annum (approximately $131,280,940 in today's value).

Consultation with the Balonne Shire Council indicates local government expenditure is budgeted at $20,000 for feral pig control including coordinated baiting. It is expected that should a cluster exclusion fencing model be adopted; local government expenditure should remain, or increased temporarily, as feral pig numbers will heavily concentrate to areas not within the cluster zones. The removal of invasive animals from within the protected cluster area is critical to its success, and therefore ongoing feral animal control should be a priority.

An analysis of local government feral pig expenditure over time has not been completed, however it is expected that expenditure has increased during the previous 5 years, consistent with surrounding local governments.

Figure 4.1.1 – Feral pig distribution in Queensland 2007[11]



[9] Wilson et. al., 1987
[10] McLeod, R., 2004
[11] West, P., 2008

Cropping losses

Both dryland and irrigated crops are heavily impacted by feral pigs from sowing through to harvest. During 2011, cropping within the Balonne Council Council area produced a total gross value of approximately $415 million[12]. Queensland Land Use mapping[3] identifies 389,581ha of cropping and horticulture lands in the review area, reflecting a yield of approximately $1,064.73 per hectare.

A previous study on Queensland crop production losses[13], estimate yield reductions from pig damage ranges between 1-5% depending on the crop. These estimates are consistent with preliminary findings by QMDC, and were further reported by producers in the Balonne Shire region. Assuming an average reduction in yield of 3.67%, feral pigs account for $15,803,135 in lost production per annum in the review area, or approximately a loss of $40.56 per hectare of cropping and horticultural land.

Assuming the upper threshold of pig densities (3.9/sq km) occur in cultivated and horticultural lands resulting in an estimated 74,393 feral pigs in the region; it can be *inferred* that a single feral pig is costing crop producers approximately $1,040.11 per year, or the equivalent of 98% of the gross value of a hectare of productive cropping land in 2011.

Table 4.1.2 - Estimated value of lost crop production for Queensland

Crop	% Reduction in yield
Sorghum	5
Wheat	3
Barley	1
Chickpea	3
Peanut	5
Lucerne	5
Average	**3.67**

Livestock production losses

The costs resulting from damage to pasture and competition with domestic stock are difficult to estimate, as there is considerable variation across pasture types and their respective biomasses. It has been shown that pig activity reduces pasture availability and can lead to the establishment of less desirable pasture species, including weeds[14].

Studies on lamb predation indicate the rate of lamb predation increases with feral pig density, ranging from 15% to 38% in circumstances of limited alternative food sources and pig densities greater than 5 per square

[12] Australian Bureau of Statistics, 2011
[13] McGaw, C. & Mitchell, J., 1998
[14] Hone, 1980

kilometre[15,16]. Given the review area contains significant cropping lands as a food source, it can be assumed that lamb predation as a result of feral pigs on sheep grazing country would be at the lower threshold.

Assuming a standard distribution of age and sex in the region's 449,506 sheep during 2011[12], with a lambing rate of 80% and predation rate by pigs of 15%, the region could incur losses of $1,078,814 per year where lambs are valued at $80/head.

In addition to an economic loss of the lamb sales, predation by feral pigs also create an opportunity loss due to an inability to generate income through wool production. Given the above assumption of predation, the region has an opportunity loss of 33,713kg of wool, equating to $252,847 each year.

Table 4.1.3 - Estimated opportunity loss of wool production due to feral pig predation

Assumptions	
Estimated loss of lambs annually	13,485
Average kilograms of wool per head	2.5kg
Estimated kilograms of wool from predated lambs	33,713kg
Eastern market indicator	1,250c/kg
Total opportunity loss of wool production due to feral pig predation	**$252,847**

Disease losses

Feral pigs pose a serious threat to Queensland's livestock industries through being a potential carrier, or amplifier, of many endemic and exotic diseases. Whilst the Department of Primary Industries and the Commonwealth have a strong national approach to exotic disease management, feral pigs potentially present a significant economic cost through disease spread. In the event of a Foot and Mouth Disease outbreak, it is expected that the economic impact would exceed $3 billion nationally, and should it persist, between $0.3 - $4 billion annually[13].

On-ground surveys conducted in the adjacent shire of Goondiwindi, by QMDC in 2010[8], identify 45% of feral pigs killed carried the contagious disease, *Leptospirosis*. It has not been determined that this disease is present in livestock within the Balonne Shire, however given its close proximity to other areas with positive cases, and the number of feral pigs estimated in the area, it is considered likely that the disease is present. Studies indicate that the disease can cause a significantly decreased calving percentage due to abortions and high death rate in calves[17]. Due to a lack of measurable data, this economic cost for the region has not been concluded; however, the preventative option of a seven-in-one vaccine (combined *Leptospirosis* and

[15] Choquenot et al, 1997
[16] Animal Control Technologies, 2013
[17] Queensland Department of Agriculture and Fisheries, 2010

Clostridial vaccine) at a cost of $1 per dose, is assumed to cost the region $221,327 per year based on meat and dairy cattle numbers from 2011.

Table 4.1.4 - List of endemic and exotic diseases carried by feral pigs

Endemic	Exotic
Brucellosis (*Brucella suis*)	Foot and Mouth Disease
Tuberculosis (*Mycobacterium spp.*)	Classical Swine Fever
Porcine Parvovirus	Aujeszky's Disease
Leptospirosis (*Leptospira spp.*)	Japanese Encephalitis
Melioidosis (*Pseudomonas pseudomallei*)	Swine Vesicular Disease
Sparganosis (*Spirometra erinacei*)	African Swine Fever
Murray Valley Encephalitis	Trichinosis
	Rabies
	Screw-worm Fly infestations

4.2 Wild dog impacts

Wild dogs continue to spread throughout Australia, and present significant production and social impacts on rural industries in Queensland, estimated at more than $67 million annually[18]. Studies indicate that whilst local and state government contributed $6,247,859 in 2008, and continue funding annually to eliminate wild dogs, economic losses in Queensland exceeded $60 million during 2008-2009.

Consultation with the Balonne Shire Council indicates local government expenditure is budgeted at $350,000 per annum (including a $200,000 precept to the maintenance of the wild dog barrier fence), plus a contribution to the overall feral animal control program mentioned in section 4.1. It is estimated that individual management syndicates within the region also spend a further $80,000 annually on holistic control measures. It is expected that should a cluster exclusion fencing model be adopted; local government expenditure should remain, or increased temporarily, as wild dog numbers will heavily concentrate to areas not within the cluster zones. The removal of invasive animals from within the protected cluster area is critical to its success, and therefore ongoing feral animal control should be a priority.

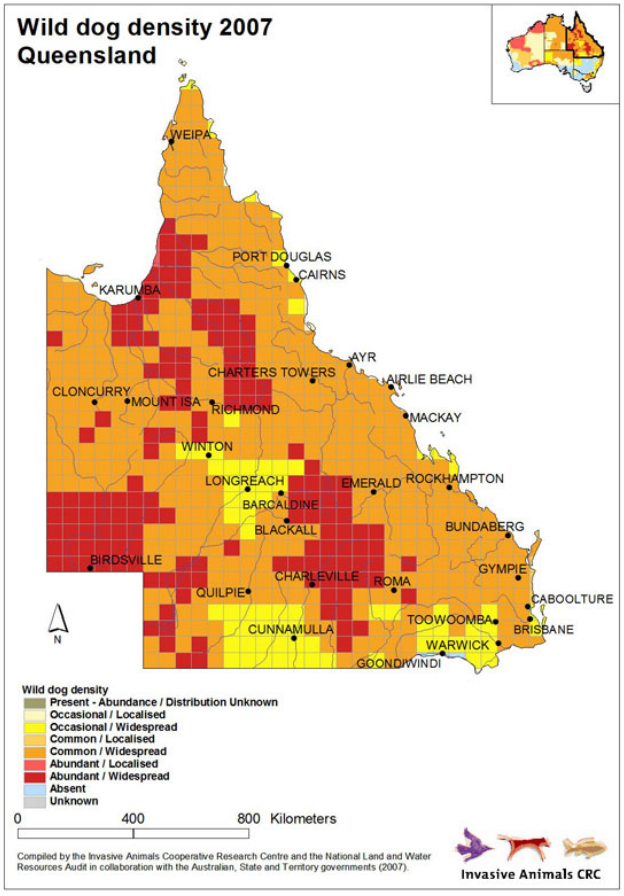
An analysis of local government wild dog expenditure over time has not been completed, however it is expected that expenditure has increased substantially during the previous 5 years, consistent with surrounding local governments.

[18] Hewitt, L. 2009

Table 4.2.1 - Summary of major economic costs of wild dogs in Queensland in 2008

Expenditure Category	Expenses (2008-2009)
Cattle producers	$41,570,074
Sheep/goat producers	$19,198,642
Local government	$2,623,543
Wild dog barrier fence	$1,870,316
Queensland government	$1,754,000
Total cost	**$67,016,575**

Figure 4.2.2 - Wild dog distribution in Queensland 2007[11]



Livestock production losses

Although recent economic data is not available on the effects of wild dog management in the Balonne Shire Council area; Queensland as a whole has witnessed a significant increase in wild dog prevalence and predation. Statistics captured in 2000-2001 estimate the Balonne Shire region suffered an economic loss of $620,895 (equal to $882,565 in real terms) due to the predation of lambs and calves[19].

Consultation with sheep graziers throughout the reviewed area suggest that predation from wild dogs now affects approximately 8.2% of sheep annually, with the potential to increase should wild dog populations move to more productive breeding areas. Based on 2011 sheep numbers, wild dogs are killing approximately 19,770 sheep annually throughout the region, at an annual cost of $1,581,596 (factored on average sheep cost of $80/head).

In addition to an economic loss of the sheep sales, predation by wild dogs also create an opportunity loss due to an inability to generate income through wool production. Given the assumption of a loss of approximately 19,770 sheep annually, the region has an opportunity loss of 69,195kg of wool, equating to $518,963 each year.

Table 4.2.3 - Estimated opportunity loss of wool production due to wild dog predation

Assumptions	
Estimated loss of sheep annually	19,770
Average kilograms of wool per head	3.5kg
Estimated kilograms of wool from predated sheep	19,770kg
Eastern market indicator	1,250c/kg
Total opportunity loss of wool production due to wild dog predation	**$518,963**

In 1972, sheep and cattle populations throughout the Balonne Shire were estimated to be 1,312,000 and 110,000, respectively[20]. Sheep numbers have reduced by 66% to 449,506 head in 2011, whilst cattle numbers have increased by 101%. Given that sheep, through increased labour requirements, produce a regional benefit of approximately 6 times that of cattle, the understatement of wild dog impacts is expected to be significant.

Calf losses and dog-bitten weaners and older cattle can cost the industry considerably. Studies indicate on average that 1.92% of Queensland cattle were bitten in 2009[18]. Using 2011 cattle numbers for the region, and assuming 50% of cattle are sold annually at an average of $700/head, with a value loss of 10% due to being dog-bitten; the potential economic loss to the region is $148,728.

Following consultation with rural landholders in the region, calf losses as a result of wild dogs has not been significantly reported. As a result, this economic cost has not been formulated.

[19] Rural Management Partners, 2004
[20] Queensland Department of Primary Industries, 1973

Disease losses

Wild dogs are a host of the parasites *Neospora caninum* and *hydatidosis*. Predation of livestock as a result of disease spread by wild dogs is less apparent due to many landholders not being fully conscious of the costs at stake.

During the 2000-2001 period, *Neospora caninum* was found to be prevalent throughout Queensland beef herds, with the rate approaching 15%. Assuming that 25% of infections can be attributed to wild dogs, and the region currently has approximately 110,661 breeders (50% of total livestock in 2011), it can be estimated that the disease costs the region $62,247 annually[19]. Implicitly, the costing analysis assumes that the size of this loss is directly proportional to the wild dog population and given wild dog populations have noticeably increased since 2001, it is expected that this cost may be understated.

Table 4.2.4 - Estimated cost of calf losses due to Neospora caninum

Assumptions	
Percentage of breeding cattle affected	3.75%
Estimated breeding cattle in region	110,661
Abortion rate	10%
Calf value	$150/head
Total cost of calf loss due to Neospora caninum in region	**$62,247**

In Queensland, wild dogs are the main source of *hydatidosis*, with the disease now being widespread in the cattle population. Affecting approximately 5.74% of cattle[18] in 2009, the disease reduces the market value of the beast due to the liver not being sold at the higher human consumption rate. Assuming the region processes 30% of cattle, it is estimated that the disease produces an economic loss to the region of approximately $16,127 annually.

Table 4.2.5 - Cost of product loss due to Hydatids

Assumptions	
Percentage of processed cattle with hydatids-condemned livers	5.74%
Estimated processed cattle in region	66,396
Average weight of liver	6.5kg
Reduced market value per kilogram	$1.00
Total cost of reduced value of processed cattle in region	**$24,772**

Cropping losses

Following consultation with rural landholders in the review area and from analysis of surrounding regions, it is not conclusive that wild dogs present an economic loss to cropping lands.

Community losses

Prior to the wool industry collapse and the increase in wild dog populations, the Department of Primary Industries[20] estimate 70-75% of properties were sheep dominant with a small herd of cattle, and the 5-10% of properties operated with cattle only. In comparison to 2011 livestock numbers, the sheep industry in the Balonne Shire has reduced by 66% since 1972, impacting the community significantly.

Based on a study by Counsell[21] which quantifies the financial impacts on local communities from a sheep to cattle enterprise shift; it is estimated the Balonne Shire region has lost approximately 110 full time jobs (equating to $5,045,596 in wages annually), and between 86-97 families, reducing opportunities for increased education and healthcare facilities. Additionally, it is valued that total agency income (merchandise sales plus livestock and wool sale commissions) has decreased by $1,423,177 per annum.

Reduced spending in the communities generates a multiplier effect, whereby additional economic return may have been generated should that money be spent locally. Factoring in a regional economic multiplier of 1.5 (based on a study by Stoeckl et. al[22]), the total loss to the region's communities is estimated at $9,703,070 annually.

Table 4.2.6 – Estimated opportunity loss to communities

Opportunity loss	
Full time employment reduction	$5,045,596
Agency income (merchandise sales, livestock and wool sale commission)	$1,423,177
Multiplier effect	1.5 times
Total opportunity loss to communities (annually)	**$9,703,070**

4.3 Kangaroo impacts

Discussions with rural landholders throughout the review area identify significant concerns to profitability as a result of increasing kangaroo populations, and the ongoing struggle for pasture performance due to a lack of control in total grazing pressure.

[21] Counsell, D., 2008
[22] Stoeckl et. al., 2007

Figures available on 31 July 2014[23] estimate overall kangaroo populations have declined across the entire central Queensland macropod harvesting zone by 22% between 2013 and 2014. It should be recognised that a significant portion of this reduction is identified by declining Common Wallaroo (*Macropus robustus*) populations, which are not commonly located in the review area. A more suitable measurement of kangaroo populations in the region is reflected in the estimated populations of commercially harvested macropod species, which indicate approximately 1,374,919 kangaroos populate the Balonne Shire Council area, a marginal decrease of 8% during the 2013 to 2014 period.

Compared to the Queensland Wildlife Trade Management Plan for Export, kangaroo species could be reduced by an average of 70% before its first sustainable population trigger point is reached, whereby harvest quotas would be halved in the next calendar year. This potential reduction suggests an overpopulation of 81,824 Red Kangaroos (*Macropus giganteus*), 779,199 Eastern Grey Kangaroos (*Macropus robustus*), and 15,331 Common Wallaroos (*Macropus robustus*) across the region during 2014.

As identified in Section 2.1, the Balonne Shire region is classified as drought declared with the southern region having well below average, and extremely low, pasture growth. Combined with the regions' significant grazing pressure, as a result of excessive kangaroo populations, opportunity to recover and build resistance to drought is notably reduced. Given a significant portion of state and federal government drought relief funding is designated to fodder subsidisation and pasture improvement; any opportunity to reduce grazing pressure caused by excessive kangaroo populations should minimise necessity for government drought assistance.

Livestock production losses

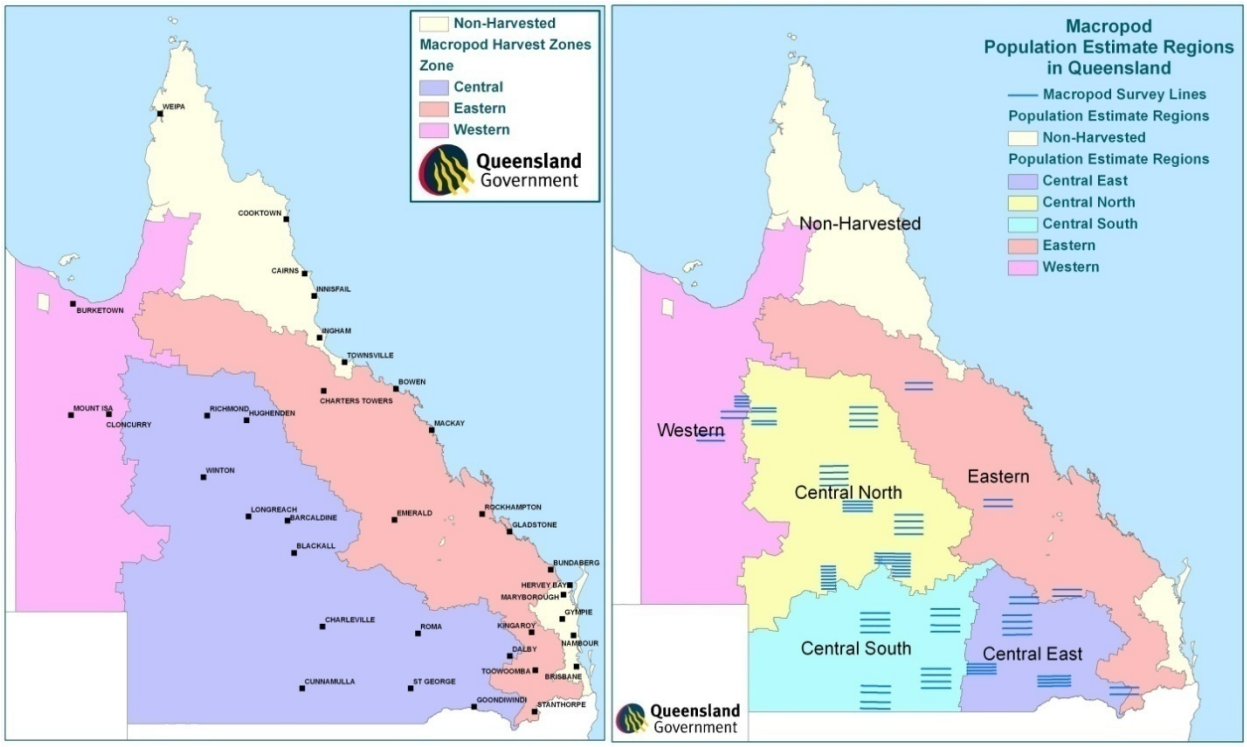
Based on studies by the University of New South Wales[24], kangaroos have the competitive grazing impact of 0.4 dry sheep equivalents (DSE) and therefore during the 2014 period, the overpopulation of kangaroo species equates to the loss of approximately 350,541 DSE. Alternatively, based on 8 DSE = 1 adult equivalent 500kg steer, kangaroo populations equate to a loss of 43,818 dry steers from the sustainable grazing base of the region. Queensland Land Use mapping[3] identifies 2,523,210ha of grazing lands in the review area, reflecting a lost production of 0.1389 DSE per hectare. Based on an estimate cost of $80DSE, this equates to an economic loss of $28,043,305, or $11.11 per hectare.

Cropping losses

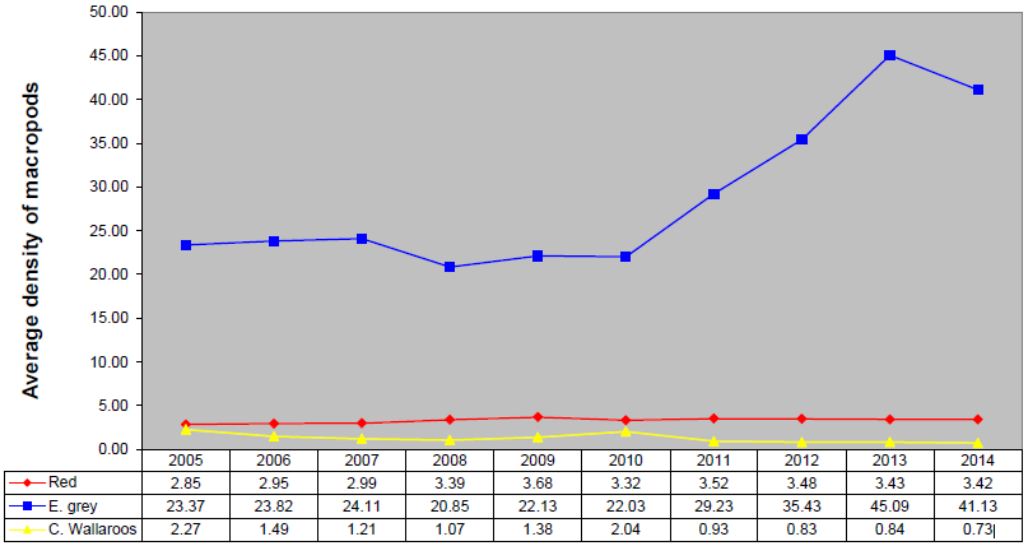
It is recognised that kangaroos cause an economic impact on cropping lands such as wheat and barley, however due to a lack of measurable data, this economic cost has not been concluded.

[23] Queensland Department of Environment and Heritage Protection, 2014
[24] Dawson, T. & Munn, A., 2007

Figure 4.3.1 - Queensland macropod harvest zones



Graph 4.3.2 - Average density km2 of commercially harvested macropods in the Central East population estimate region 2005–2014



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Red	2.85	2.95	2.99	3.39	3.68	3.32	3.52	3.48	3.43	3.42
E. grey	23.37	23.82	24.11	20.85	22.13	22.03	29.23	35.43	45.09	41.13
C. Wallaroos	2.27	1.49	1.21	1.07	1.38	2.04	0.93	0.83	0.84	0.73

Table 4.3.3 - Calculated trigger points for 2015 and estimated populations of commercially harvested macropod species in Central East region for 2014

Species	2014 Population Estimate	2015 1.5σ Trigger Point*	2015 2σ Trigger Point†
Red kangaroo	436,250	92,520	70,422
Eastern grey kangaroo	6,206,350	2,334,175	1,961,915
Common wallaroo	51,229	15,797	11,926
Total	**6,693,829**	**2,442,492**	**2,044,263**

* If population estimate falls below two SDs below the long-term average for that species in that region then the harvest quota will be halved for that region in the next calendar year.

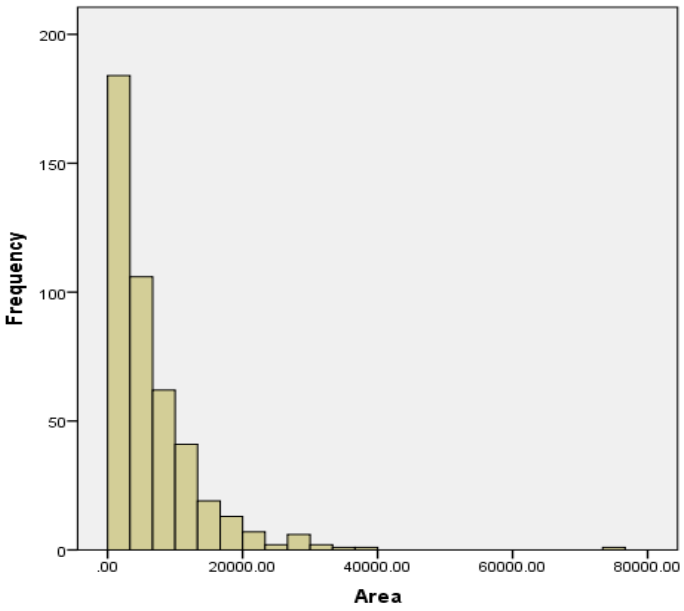
† If population estimate falls below two SDs below the long-term average for that species in that region then there will be no quota for the following year.

5 Optimal cluster sizing

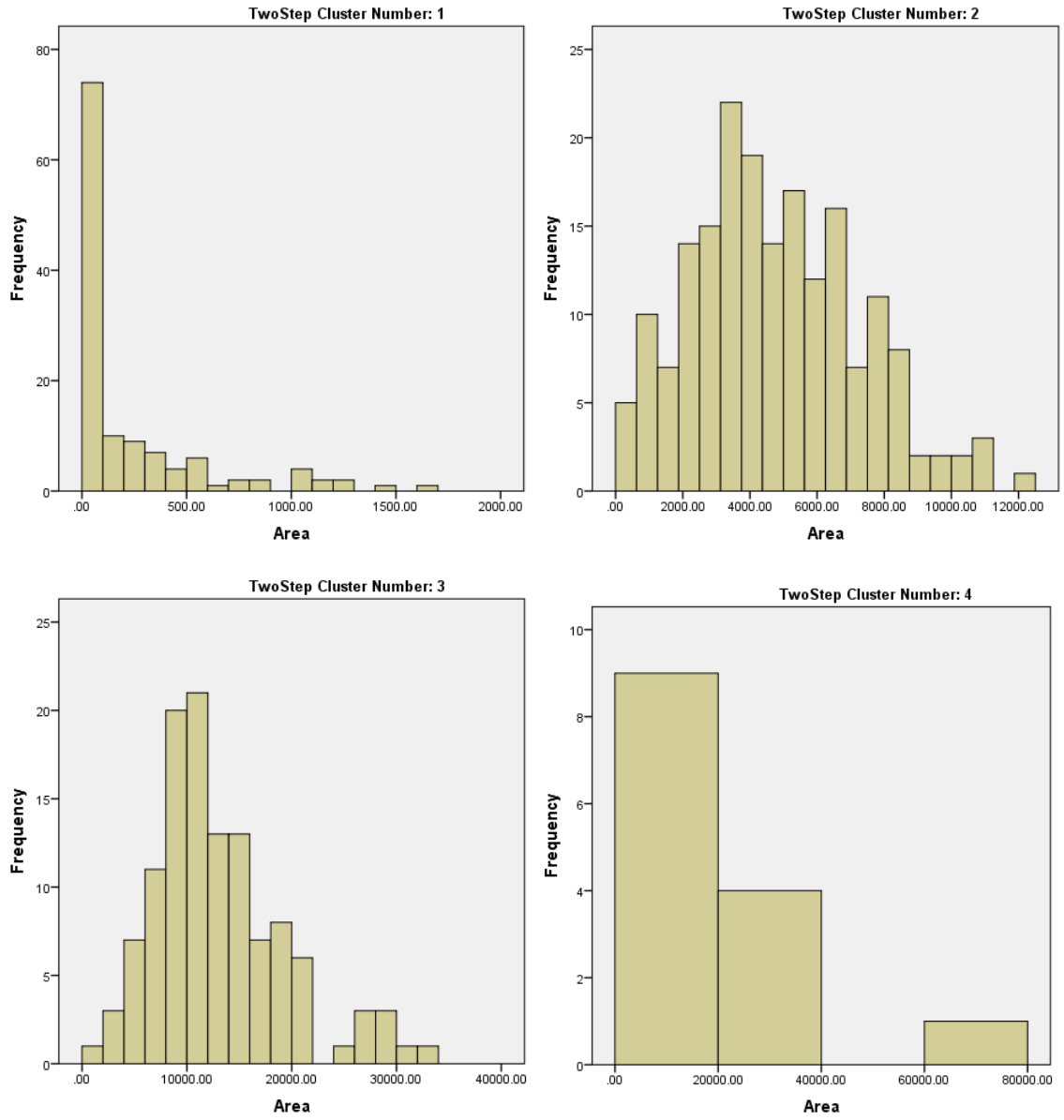
A broad most productive scale size analysis has been conducted on the review area to determine the appropriate scale of clusters within the region.

The frequency of large sized properties increases towards the review area's western boundary, with significantly smaller parcels occurring near the centre and eastern boundary. In the case of properties in the Balonne region, the distribution of areas is very negatively skewed, with the arithmetic mean (μ = 11,917ha) not accurately reflecting all properties. A TwoStep cluster analysis was conducted to identify any homogenous groups of property sizes. The cluster analysis identified that 42% of properties were in the range of 4,731ha ± 119ha and 27% properties were in the range of 13,079ha ± 301ha. For this reason, two (2) different optimal cluster size models have been developed, one based on properties averaging 4,750ha, and one based on properties averaging 13,000ha.

Graph 5.0.1 – Distribution of rural properties analysed



Graph 5.0.2 – Distributions of rural properties following TwoStep cluster analysis



5.1 Model assumptions

Following consultation with rural landholders in the region, it is identified that issues (and therefore solutions) facing those involved in grazing versus cropping operations vary significantly. For this reason, the model has been used in two (2) variants; a full strength exclusion fence, and an electric exclusion fence.

Whilst it is strongly believed that a full strength exclusion fence should be used in all circumstances (due to an increased demand for food by pigs following cluster fence completion), an electric option has been included in the analysis to demonstrate cost per hectare on cheaper alternatives.

An economies of scale analysis has been conducted based on an average property perimeter length of 29.5km and average area of 4,750ha for model A, and an average property perimeter length of 46km and average area of 13,000ha for model B. As identified in Section 6, the cost of the full strength exclusion fence is estimated at $7,500/km, and $4,500/km for an electric exclusion fence. Both estimates are at full market rate, including materials and labour.

Table 5.1.1 – Optimal cluster sizing model assumptions

Model	Length (Km)	Width (Km)	Perimeter (Km)	Area (Ha)
Model A	4.75	10.00	29.50	4,750
Model B	10.00	13.00	46.00	13,000

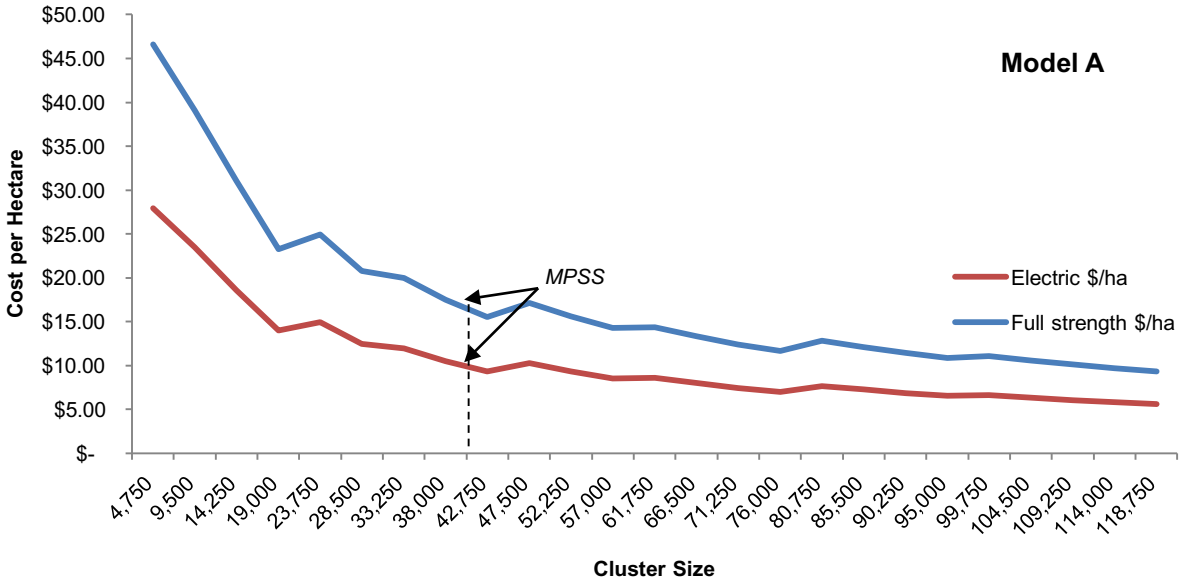
5.2 Findings

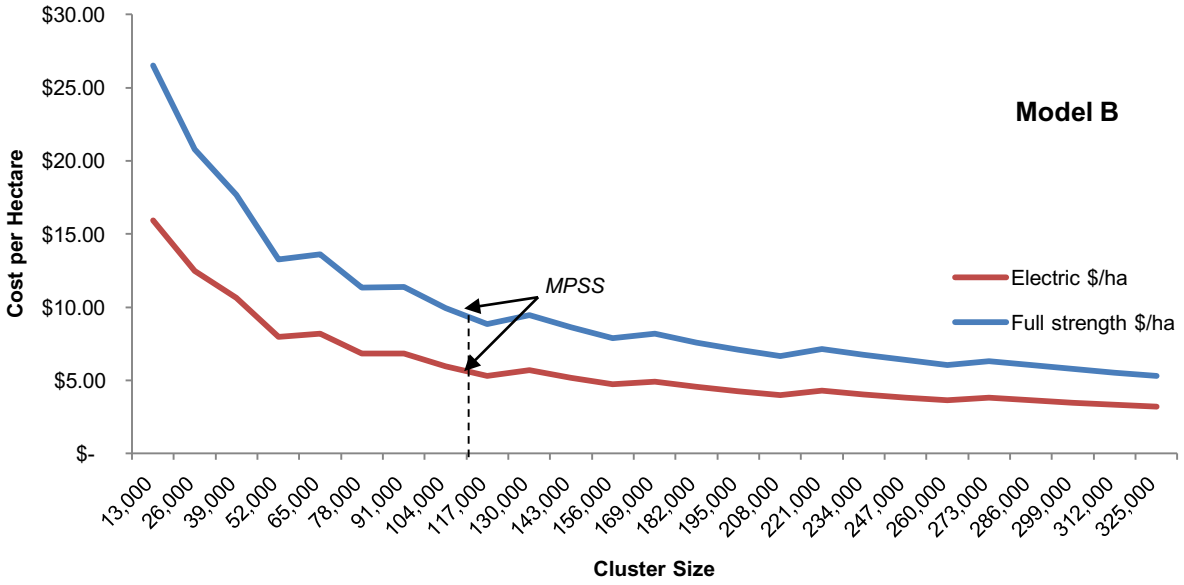
The model indicates significant economies of scale exist for cluster exclusion fencing in the review area. Graphs 5.2.1 and 5.2.2 identify the economies of scale evident as a result of decreased transactional costs associated with fencing materials, and the changes to the required fencing perimeter. As the number of involved properties increases, the cluster shape adjusts, therefore providing multiple points where the cluster size is optimised.

Using model A with a base property size of 4,750ha, increasing the cluster size to 9 properties reduces the cost per hectare by 66.66% from $46.58 to $15.53 for a full strength fence construction, and from $27.95 to $9.32 for an electric fence construction. Comparatively, under model B with a base property size of 13,000ha, the cost per hectare reduces by 66.65% from $26.54 to $8.85 for a full strength fence construction, and from $15.92 to $5.31 for an electric fence construction.

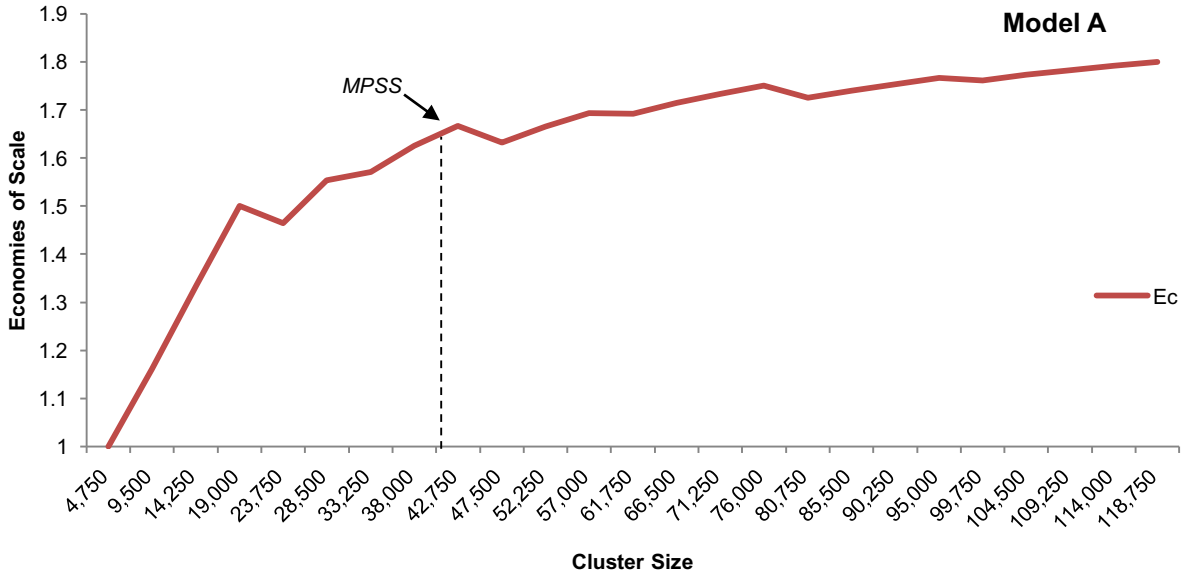
Economies of scale exponentially increases based solely on material costs, however the percentage change in economies of scale reaches its minimum after the point of 9 properties (42,750ha cluster size under model A, and 117,000ha cluster size under model B). Factoring in management costs and non-market costs of controlling a larger area, it is identified that where cluster properties are near to 4,750ha individually, a cluster of between 38,000-42,750ha is the most productive scale size (model A). Where cluster properties are near to 13,000ha individually, a cluster of between 104,000-117,000ha is the most productive scale size (model B).

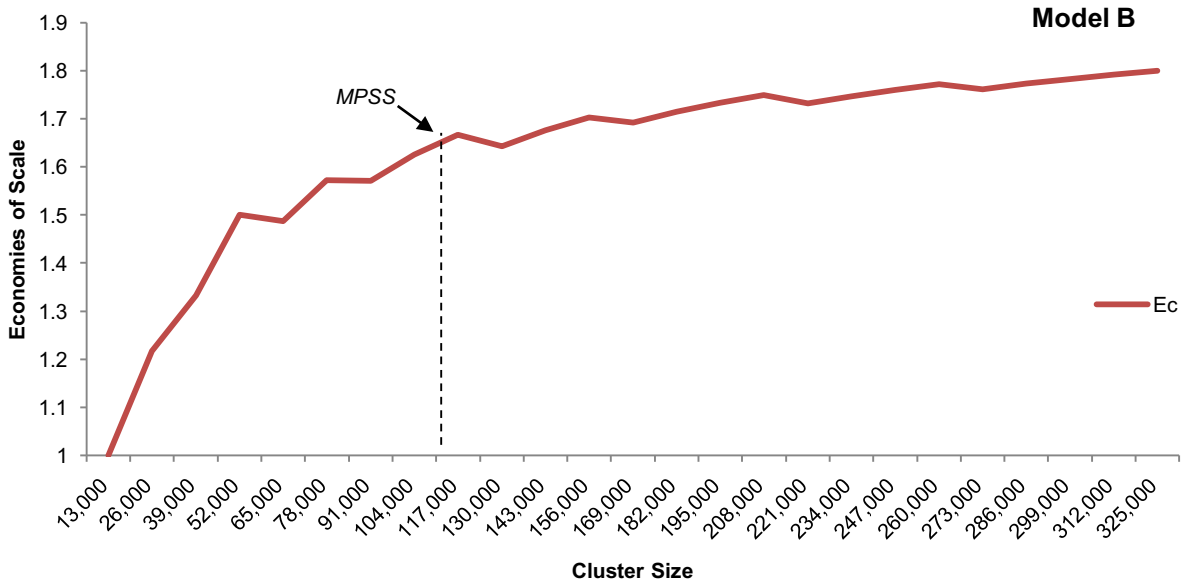
Graph 5.2.1 - Project cost per hectare for full and an electric fence construction





Graph 5.2.2 - Economies of scale assessment





6 Exclusion fencing structure

The cluster exclusion fencing model is based on the principle of protecting all land within the cluster from invasive species. As such, a robust fencing structure is required to minimise weak points. Following consultation with rural landholders in the region, it is identified that due to varying landscape issues, multiple fencing designs should be considered to ensure the region is protected cost effectively.

For the purpose of this report's analysis, two (2) fencing designs have been adopted; a high strength and an electric variant. Fencing designs have been identified from reviewed literature and discussions with current managers of exclusion fences in Australia. Cost estimates have been derived at full market rates, including materials and labour.

Whilst it is strongly believed that a full strength exclusion fence should be used in all circumstances (due to an increased demand for food by pigs following cluster fence completion), an electric option has been included in the analysis to demonstrate the cost effectiveness of cheaper alternatives.

6.1 High strength exclusion fence

Anecdotal evidence from other successful projects suggests that a high strength exclusion fence be implemented for clusters where wild dogs, pigs, and kangaroos are the strongest threat to grazing. Rural landholders within existing total grazing pressure clusters have experienced high success using 1800mm hinged joint prefabricated fencing coupled with a single barbed wire at the top, and a 300mm netted apron on the base. The fence is reinforced with heavy duty galvanised steel pickets approximately every 8m. As a preventative for feral pigs, an electric wire can be placed at 150mm.

The above fence has been averaged at approximately $7,500/km.

6.2 Electric exclusion fence

Studies by Choquenot (1997)[15] suggest a more cost effective electric exclusion fence option may be suitable for clusters where pigs and kangaroos are the threat to dryland and irrigated cropping. Rural landholders with existing exclusion fences have experienced moderate success using five (5) plain wires separated by three (3) electric wires spaced evenly. The fence is reinforced with galvanised steel pickets approximately every 10m.

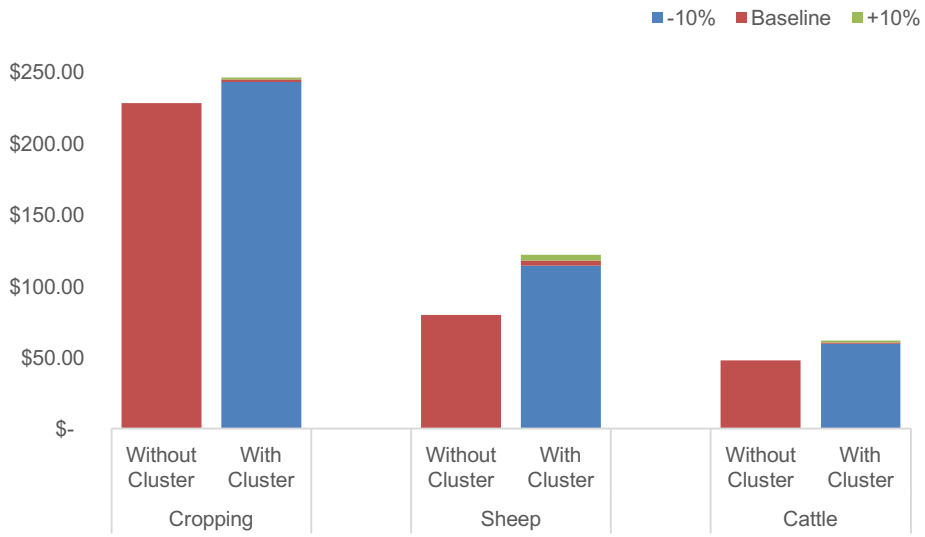
The above fence has been averaged at approximately $4,500/km.

7 Potential return on investment

Financial analysis has been conducted across the three (3) industries of cattle, sheep, and cropping to broadly assess the potential payback periods of a project, should it be implemented in the review area.

Long-term averages have been used where possible to minimise market fluctuations. It should be recognised that the below analysis is not individual specific, and only illustrates the performance of the assumptions listed below. Analysis should only be used for building a framework of the project's potential in the region.

Graph 7.0.1 - Comparison of business operation gross margin per hectare



7.1 Assumptions

A summary of assumptions used across all production style analysis are below:

Model A

- 4,750ha property, with post scenario of collaborating in a cluster structure of 9 properties, totalling 42,750ha and 88.5km in perimeter. Modelling assumes use of a high strength exclusion fence.

Model B

- 13,000ha property, with post scenario of collaborating in a cluster structure of 9 properties, totalling 117,000ha and 138km in perimeter. Modelling assumes use of a high strength exclusion fence.

7.2 Cattle production

A Year-in Year-out budget analysis has been conducted to provide a projected cash flow summary and profit analysis of a cattle production business in the region. Cattle specific production assumptions include:

- Property size 4,750ha is stocked at approximately 1,000 cattle (approximately 820 AE). Property of size 13,000ha is stocked at approximately 2,750 cattle (approximately 2,250 AE).
- Property predominately breeds cattle and sells store steers.
- Landscape impacted by wild dogs, feral pigs and kangaroos.
- Project cost is funded by loan at 4% interest only, and 30% of increased profits (EBIT) are allocated to repayment.
- Property eliminates predation of calves and spread of disease, marginally increases calving rates, and marginally increases carrying capacity post project implementation.

As a result of the moderate impacts of wild dogs and feral pigs on predation of livestock, disease and reduced calving rates, the implementation of cluster exclusion fencing surrounding cattle producers' results in a reasonably strong change to productivity and profitability. Gross margin per hectare increases significantly from $47.80 to an average of $60.67 as a result of managing wild dogs, feral pigs, and excessive kangaroo populations.

Model A – Property size based on 4,750ha

Based on a 25% funding contribution, it is forecasted that the payback period of the landholder's contribution to the project will be within 4.41-5.39 years (within 10% sensitivity). Comparatively, under full contribution by the landholder, payback period ranges from 5.87-7.18 years.

Model B – Property size based on 13,000ha

Based on a 25% funding contribution, it is forecasted that the payback period of the landholder's contribution to the project will be within 1.56-1.91 years (within 10% sensitivity). Comparatively, under full contribution by the landholder, payback period ranges from 2.08-2.55 years.

Table 7.2.1 – Summary of return on investment for cattle producers – Model A

		Sensitivity Analysis		
	Without Cluster	**-10%**	**Baseline**	**+10%**
Gross Margin (Per Ha)	$55.69	$62.90	$63.70	$64.50
Payback Period With Funding (Yrs)		5.39	4.85	4.41
Payback Period Without Funding (Yrs)		7.18	6.46	5.87

Table 7.2.2 – Summary of return on investment for cattle producers – Model B

		Sensitivity Analysis		
	Without Cluster	**-10%**	**Baseline**	**+10%**
Gross Margin (Per Ha)	$47.80	$59.39	$60.67	$61.96
Payback Period With Funding (Yrs)		1.91	1.72	1.56
Payback Period Without Funding (Yrs)		2.55	2.29	2.08

7.3 Sheep production

A Year-in Year-out budget analysis has been conducted to provide a projected cash flow summary and profit analysis of a sheep production business in the region. Sheep specific production assumptions include:

- Property size 4,750ha is stocked at approximately 8,000 sheep, including prodigy (approximately 7,500 DSE). Property of size 13,000ha is stocked at approximately 22,000 sheep, including prodigy (approximately 20,500 DSE).
- Property predominately sells lambs and wethers through a self-populating herd, and produces wool at an average of 22 microns.
- Landscape heavily impacted by wild dogs, feral pigs and kangaroos.
- Project cost is funded by loan at 4% interest only, and 30% of increased profits (EBIT) are allocated to repayment.
- Property eliminates heavy predation of sheep, moderately increases lambing rates, and marginally increases carrying capacity post project implementation.

As a result of the significant impacts of wild dogs and feral pigs on predation of livestock and reducing lambing rates, the implementation of cluster exclusion fencing surrounding sheep producers' producers substantial change to productivity and profitability. Gross margin per hectare increases significantly from $79.89 to an average of $117.99 as a result of managing wild dogs, feral pigs, and excessive kangaroo populations.

Model A – Property size based on 4,750ha

Based on a 25% funding contribution, it is forecasted that the payback period of the landholder's contribution to the project will be within 0.67-0.82 years (within 10% sensitivity). Comparatively, under full contribution by the landholder, payback period ranges from 0.90-1.1 years.

Model B – Property size based on 13,000ha

Based on a 25% funding contribution, it is forecasted that the payback period of the landholder's contribution to the project will be within 0.54-0.66 years (within 10% sensitivity). Comparatively, under full contribution by the landholder, payback period ranges from 0.72-0.88 years.

Table 7.3.1 – Summary of return on investment for sheep producers – Model A

		Sensitivity Analysis		
	Without Cluster	**-10%**	**Baseline**	**+10%**
Gross Margin (Per Ha)	$78.69	$125.92	$131.17	$136.42
Payback Period With Funding (Yrs)		0.82	0.74	0.67
Payback Period Without Funding (Yrs)		1.10	0.99	0.90

Table 7.3.2 – Summary of return on investment for sheep producers – Model B

		Sensitivity Analysis		
	Without Cluster	**-10%**	**Baseline**	**+10%**
Gross Margin (Per Ha)	$79.89	$114.18	$117.99	$121.80
Payback Period With Funding (Yrs)		0.66	0.59	0.54
Payback Period Without Funding (Yrs)		0.88	0.79	0.72

7.4 Crop production

A Year-in Year-out budget analysis has been conducted to provide a projected cash flow summary and profit analysis of a crop production business in the region. Crop specific production assumptions include:

- Property utilises 80% of land for cropping, with remaining land considered unused or forestry.
- Property has a 4-year crop sequence consisting of wheat, chickpea, and sorghum, fallowing 3 summers and 2 winters.
- Landscape heavily impacted by feral pigs.
- Project cost is funded by loan at 4% interest only, and 30% of increased profits (EBIT) are allocated to repayment.

The impacts of feral pigs on cropping lands is considered moderate, and therefore only reduces overhead costs and improves gross margin marginally. Gross margin per hectare for both scales, increases from $228.00 to an average of $244.43 as a result of managing feral pigs. Given the high profitability of the production style, payback periods for this operation occurs in a short time period.

Model A – Property size based on 4,750ha

Based on a 25% funding contribution, it is forecasted that the payback period of the landholder's contribution to the project will be within 2.15-2.64 years (within 10% sensitivity). Comparatively, under full contribution by the landholder, payback period ranges from 2.87-3.53 years.

Model B – Property size based on 13,000ha

Based on a 25% funding contribution, it is forecasted that the payback period of the landholder's contribution to the project will be within 1.23-1.51 years (within 10% sensitivity). Comparatively, under full contribution by the landholder, payback period ranges from 1.63-2.01 years.

Table 7.4.1 – Summary of return on investment for crop producers – Model A

		Sensitivity Analysis		
	Without Cluster	**-10%**	**Baseline**	**+10%**
Gross Margin (Per Ha)	$228.00	$242.68	$244.43	$246.05
Payback Period With Funding (Yrs)		2.64	2.36	2.15
Payback Period Without Funding (Yrs)		3.53	3.15	2.87

Table 7.4.2 – Summary of return on investment for crop producers – Model B

		Sensitivity Analysis		
	Without Cluster	**-10%**	**Baseline**	**+10%**
Gross Margin (Per Ha)	$228.00	$242.68	$244.43	$246.05
Payback Period With Funding (Yrs)		1.51	1.35	1.23
Payback Period Without Funding (Yrs)		2.01	1.79	1.63

8 Project funding

Analysis of the economic impacts of wild dogs, pigs, and kangaroos throughout the region, as well as the potential profitability to landholders through mitigation; clearly demonstrates the project would provide significant private benefit. The project also demonstrates an opportunity to assess feasibility across multiple agricultural industries. A significant number of public economic, social, and environmental benefits exist within the project's fundamentals, and therefore justifies a level of government/public involvement.

A number of similar structured cluster projects are currently being funded through NRM groups, and State and Federal Government sources, with funding contributions ranging from 20%-50%. Comparative to the review area's potential projects, it is expected that other cluster projects such as those back-boning a return of the sheep industry in south west Queensland, will present stronger economic, social, and environmental benefit; thus attracting greater funding opportunities.

Given any cluster project relies heavily on economies of scale to present an economically viable option; other clusters in larger scaled, yet less productive agricultural lands may be seen as a more affordable funding option for government, when dollars per hectare of 'protected area' are only considered. The Balonne Shire Council area differentiates itself from other rural areas through its history of sheep production at a relatively high stocking rate. The area can therefore generate a significantly higher income from sheep and wool production under a smaller area of cluster management, and derive a very strong public benefit when compared to total project costs.

As identified in Section 7, private payback periods, under full contribution by landholders, is not expected to exceed 8 years for cattle producers. Compared to other cluster regions where payback periods of up to 20 years can be expected, government funding may be restricted due to equity reasons. Comparatively, modelled scenarios for sheep producers suggest private payback periods of less than 2 years, indicating the high degree of disruption that is currently occurring as a result of invasive pests. Investing public funds in the Balonne Shire region as a priority can be argued is critical to its recovery and presents the higher return on investment.

The smaller cost of projects in the Balonne region may provide substantial opportunity to not limit funding to only government sources, but to also fully or partially include industry bodies (such as Meat and Livestock Australia and the Australian Wool Innovation), lobby and community groups (such as AgForce and Landcare), or universities seeking research and innovation studies.

Alternatively, implementation of the project under full payment by landholders still allows for a significantly short-term payback period, indicating the project has very strong economic merit even without any public funding contributions. Concessional loans with reduced interest rates and interest only options, such as those offered by the Queensland Rural Adjustment Authority (QRAA), can provide further reductions in overall project costs, and may provide more financial feasibility to private investment decisions.

Given the significant private benefits of cluster exclusion fencing, especially when compared to other sustainable management options available, there exists strong anecdotal evidence to suggest land values increase when included within a cluster.

9 Conclusions

This report concludes that there is a significantly strong economic incentive for all rural landholders in the Balonne Shire Council area to manage the impacts of wild dogs, pigs, and kangaroos. Impacts include land degradation and crop loss, severe livestock predation and devaluing, disease spread, and intense competition for grazing pasture. It is estimated throughout the region, invasive animals collectively cost the producers upwards of $57,808,804 in lost production, and should invasive animals such as wild dogs spread further throughout the region (i.e. south into stronger breeding areas), costs are expected to increase rapidly. This report highlights the immediate need to implement a long-term, economically viable option for managing and eliminating such threats to the agricultural industry.

Consultation with landholders identifies the need for a variety of structures and designs of cluster exclusion fencing in the region, due to varying pests and intensities affecting cropping and grazing lands. This report models the cost-effectiveness of two (2) potential exclusion fencing options, demonstrating both exhibit significant economies of scale; construction costs per hectare reduce to $8.85/ha and $5.31ha for high-strength and electric fencing respectively, when modelled on an average property size of 13,000ha. The regions differing property sizes suggests multiple cluster sizes should be used. Modelling at the 4,750ha and 13,000ha scale identifies the optimal sizing of clusters to be 11 properties totalling 42,750ha and 117,000ha, respectively.

This report has focused primarily on the benefits to private landholders, with minor analysis on the local community effect. Costs of the overall social and environmental impacts of invasive animals have not been conducted. As a result of previous studies, it is clear that such a project would present significant benefit to society and the environment. It is therefore recommended that further information be sought in this area to assist in presenting an overall representation of the project's public benefit potential to State and Federal government.

A key finding in the report's analysis identifies that the project has significant return on investment for rural landholders, demonstrating that the project could be paid without government assistance, especially when compared to other regions of western Queensland. Across both grazing and cropping enterprises, it is estimated that the project's payback period would range from 0.72 to 7.18 years without funding assistance; reducing to 0.54 to 5.39 years should 25% funding be sourced. Landholders involved with sheep production demonstrate the strongest capacity to reduce payback periods given the current impact of invasive animals, and the potential productivity and profitability of the exclusion fence.

Clearly any implementation of an exclusion fence will be a significant capital cost to landholders, however it is strongly evident that working collaboratively within a cluster provides substantial economies of scale, reducing costs to a viable option for the region. Whilst the ultimate success of the project relies heavily on working together with land managers in the cluster, the significant gain the project can have on reducing the impacts of invasive animals, and restoring a sustainable agricultural industry, makes it a serious option to be considered.

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Appendix

Appendix 1 - Economies of scale assessment

High strength exclusion fence – Model A

No. Properties	Total Perimeter (Km)	Total Area (Ha)	Project Cost	Project Cost per Ha
1	29.5	4,750	$221,250.00	$46.58
2	49.5	9,500	$371,250.00	$39.08
3	59	14,250	$442,500.00	$31.05
4	59	19,000	$442,500.00	$23.29
5	79	23,750	$592,500.00	$24.95
6	79	28,500	$592,500.00	$20.79
7	88.5	33,250	$663,750.00	$19.96
8	88.5	38,000	$663,750.00	$17.47
9	88.5	42,750	$663,750.00	$15.53
10	108.5	47,500	$813,750.00	$17.13
11	108.5	52,250	$813,750.00	$15.57
12	108.5	57,000	$813,750.00	$14.28
13	118	61,750	$885,000.00	$14.33
14	118	66,500	$885,000.00	$13.31
15	118	71,250	$885,000.00	$12.42
16	118	76,000	$885,000.00	$11.64
17	138	80,750	$1,035,000.00	$12.82
18	138	85,500	$1,035,000.00	$12.11
19	138	90,250	$1,035,000.00	$11.47
20	138	95,000	$1,035,000.00	$10.89
21	147.5	99,750	$1,106,250.00	$11.09
22	147.5	104,500	$1,106,250.00	$10.59
23	147.5	109,250	$1,106,250.00	$10.13
24	147.5	114,000	$1,106,250.00	$9.70
25	147.5	118,750	$1,106,250.00	$9.32

High strength exclusion fence – Model B

No. Properties	Total Perimeter (Km)	Total Area (Ha)	Project Cost	Project Cost per Ha
1	46	13,000	$345,000.00	$26.54
2	72	26,000	$540,000.00	$20.77
3	92	39,000	$690,000.00	$17.69
4	92	52,000	$690,000.00	$13.27
5	118	65,000	$885,000.00	$13.62
6	118	78,000	$885,000.00	$11.35
7	138	91,000	$1,035,000.00	$11.37
8	138	104,000	$1,035,000.00	$9.95
9	138	117,000	$1,035,000.00	$8.85
10	164	130,000	$1,230,000.00	$9.46
11	164	143,000	$1,230,000.00	$8.60
12	164	156,000	$1,230,000.00	$7.88
13	184	169,000	$1,380,000.00	$8.17
14	184	182,000	$1,380,000.00	$7.58
15	184	195,000	$1,380,000.00	$7.08
16	184	208,000	$1,380,000.00	$6.63
17	210	221,000	$1,575,000.00	$7.13
18	210	234,000	$1,575,000.00	$6.73
19	210	247,000	$1,575,000.00	$6.38
20	210	260,000	$1,575,000.00	$6.06
21	230	273,000	$1,725,000.00	$6.32
22	230	286,000	$1,725,000.00	$6.03
23	230	299,000	$1,725,000.00	$5.77
24	230	312,000	$1,725,000.00	$5.53
25	230	325,000	$1,725,000.00	$5.31

Electric exclusion fence – Model A

No. Properties	Total Perimeter (Km)	Total Area (Ha)	Project Cost	Project Cost per Ha
1	29.5	4,750	$132,750.00	$27.95
2	49.5	9,500	$222,750.00	$23.45
3	59	14,250	$265,500.00	$18.63
4	59	19,000	$265,500.00	$13.97
5	79	23,750	$355,500.00	$14.97
6	79	28,500	$355,500.00	$12.47
7	88.5	33,250	$398,250.00	$11.98
8	88.5	38,000	$398,250.00	$10.48
9	88.5	42,750	$398,250.00	$9.32
10	108.5	47,500	$488,250.00	$10.28
11	108.5	52,250	$488,250.00	$9.34
12	108.5	57,000	$488,250.00	$8.57
13	118	61,750	$531,000.00	$8.60
14	118	66,500	$531,000.00	$7.98
15	118	71,250	$531,000.00	$7.45
16	118	76,000	$531,000.00	$6.99
17	138	80,750	$621,000.00	$7.69
18	138	85,500	$621,000.00	$7.26
19	138	90,250	$621,000.00	$6.88
20	138	95,000	$621,000.00	$6.54
21	147.5	99,750	$663,750.00	$6.65
22	147.5	104,500	$663,750.00	$6.35
23	147.5	109,250	$663,750.00	$6.08
24	147.5	114,000	$663,750.00	$5.82
25	147.5	118,750	$663,750.00	$5.59

Electric exclusion fence – Model B

No. Properties	Total Perimeter (Km)	Total Area (Ha)	Project Cost	Project Cost per Ha
1	46	13,000	$207,000.00	$15.92
2	72	26,000	$324,000.00	$12.46
3	92	39,000	$414,000.00	$10.62
4	92	52,000	$414,000.00	$7.96
5	118	65,000	$531,000.00	$8.17
6	118	78,000	$531,000.00	$6.81
7	138	91,000	$621,000.00	$6.82
8	138	104,000	$621,000.00	$5.97
9	138	117,000	$621,000.00	$5.31
10	164	130,000	$738,000.00	$5.68
11	164	143,000	$738,000.00	$5.16
12	164	156,000	$738,000.00	$4.73
13	184	169,000	$828,000.00	$4.90
14	184	182,000	$828,000.00	$4.55
15	184	195,000	$828,000.00	$4.25
16	184	208,000	$828,000.00	$3.98
17	210	221,000	$945,000.00	$4.28
18	210	234,000	$945,000.00	$4.04
19	210	247,000	$945,000.00	$3.83
20	210	260,000	$945,000.00	$3.63
21	230	273,000	$1,035,000.00	$3.79
22	230	286,000	$1,035,000.00	$3.62
23	230	299,000	$1,035,000.00	$3.46
24	230	312,000	$1,035,000.00	$3.32
25	230	325,000	$1,035,000.00	$3.18

Appendix 2 – Cattle production cashflow analysis

Assumptions

Assumptions

- Property and cluster size:

  Model A - 4,750ha property with post scenario of collaborating in a cluster structure of 9 properties, totalling 42,750ha and 88.5km in perimeter of high strength exclusion fencing.

  Model B - 13,000ha property with post scenario of collaborating in a cluster structure of 9 properties, totalling 117,000ha and 138km in perimeter of high strength exclusion fencing.

- Stocking rate:

  Model A - Property is stocked at approximately 1,000 cattle (approximately 820 AE).

  Model B - Property is stocked at approximately 2,750 cattle (approximately 2,250 AE).

- Property predominately breeds cattle and sells store steers.
- Landscape impacted by wild dogs, feral pigs and kangaroos.
- Project cost is funded by loan at 4% interest only, and 30% of increased profits (EBIT) are allocated to repayment.
- Estimated sale prices:

  Cows: $1,000/head

  Replacement Heifers: $700/head

  Weaners: $550/head

  Steers: $1,000/head

  Bulls: $1,000/head

- Pre-scenario calving percentage of 75% for cows and 60% for replacement heifers. Post-scenario calving percentage of 85% for cows and 80% for replacement heifers.
- Pre-scenario predation rate averaged at 1%. Post-scenario predation rate at 0%.
- Estimated $35 average freight cost per beast when sold, and 3.5% sale price attributed to selling expenses.
- It is assumed that average rainfall has been received on the property and that pastures have not been affected.

Business cashflow analysis – Model A cattle production

	Without Cluster	Sensitivity Analysis		
		-10%	Baseline	+10%
Sales	312,957	344,496	348,000	351,504
Other Income	-	-	-	-
Total Gross Income	**312,957**	**344,496**	**348,000**	**351,504**
Less Purchases	9,000	9,000	9,000	9,000
Gross Value of Production	**303,957**	**335,496**	**$339,000**	**342,504**
Less Total Direct Costs	39,438	36,740	36,440	36,140
Gross Margin	**264,519**	**298,756**	**302,560**	**306,364**
Less Overheads	124,670	124,670	124,670	124,670
EBIT	**139,849**	**174,086**	**177,890**	**181,694**
Overhead Cost Ratio	**39.84%**	**36.19%**	**35.82%**	**35.47%**
Direct Cost Ratio	**12.60%**	**10.66%**	**10.47%**	**10.28%**
Gross Margin/Ha	**55.69**	**62.90**	**63.70**	**64.50**
Increase in Gross Margin/Ha	-	7.21	8.01	8.81

Payback period analysis with partial funding contribution – Model A

	Sensitivity Analysis		
With 25% Funding	-10%	Baseline	+10%
Cluster Fencing Cost	663,750	663,750	663,750
Per Hectare Cost	15.53	15.53	15.53
Individual Property Cost	73,750	73,750	73,750
Less Potential Funding Contribution	18,438	18,438	18,438
Total Scenario Cost	55,313	55,313	55,313
Interest Charged Per Year	2,213	2,213	2,213
Increased Profit	34,237	38,041	41,845
Less Contribution of Profit	10,271	11,412	12,554
Payback Period (years)	**5.39**	**4.85**	**4.41**

Payback period analysis with full payment by landholders – Model A

	Sensitivity Analysis		
Without Funding	**-10%**	**Baseline**	**+10%**
Cluster Fencing Cost	663,750	663,750	663,750
Per Hectare Cost	15.53	15.53	15.53
Individual Property Cost	73,750	73,750	73,750
Less Potential Funding Contribution	-	-	-
Total Scenario Cost	73,750	73,750	73,750
Interest Charged Per Year	2,950	2,950	2,950
Increased Profit	34,237	38,041	41,845
Less Contribution of Profit	10,271	11,412	12,554
Payback Period (years)	**7.18**	**6.46**	**5.87**

Business cashflow analysis – Model B cattle production

	Baseline	**Sensitivity Analysis**		
		-10%	**Baseline**	**+10%**
Sales	731,027	876,803	893,000	909,197
Other Income	-	-	-	-
Total Gross Income	**731,027**	**876,803**	**893,000**	**909,197**
Less Purchases	15,000	15,000	15,000	15,000
Gross Value of Production	**716,027**	**861,803**	**878,000**	**894,197**
Less Total Direct Costs	94,619	89,778	89,240	88,702
Gross Margin	**621,408**	**772,025**	**788,760**	**805,495**
Less Overheads	170,530	170,530	170,530	170,530
EBIT	**450,878**	**601,495**	**618,230**	**634,965**
Overhead Cost Ratio	**23.33%**	**19.45%**	**19.10%**	**18.76%**
Direct Cost Ratio	**12.94%**	**10.24%**	**9.99%**	**9.76%**
Gross Margin/Ha	**47.80**	**59.39**	**60.67**	**61.96**
Increase in Gross Margin/Ha	-	11.59	12.87	14.16

Payback period analysis with partial funding contribution – Model B

	Sensitivity Analysis		
With 25% Funding	**-10%**	**Baseline**	**+10%**
Cluster Fencing Cost	1,035,000	1,035,000	1,035,000
Per Hectare Cost	8.85	8.85	8.85
Individual Property Cost	115,000	115,000	115,000
Less Potential Funding Contribution	28,750	28,750	28,750
Total Scenario Cost	86,250	86,250	86,250
Interest Charged Per Year	3,450	3,450	3,450
Increased Profit	150,617	167,352	184,087
Less Contribution of Profit	45,185	50,206	55,226
Payback Period (years)	**1.91**	**1.72**	**1.56**

Payback period analysis with full payment by landholders – Model B

	Sensitivity Analysis		
Without Funding	**-10%**	**Baseline**	**+10%**
Cluster Fencing Cost	1,035,000	1,035,000	1,035,000
Per Hectare Cost	8.85	8.85	8.85
Individual Property Cost	115,000	115,000	115,000
Less Potential Funding Contribution	-	-	-
Total Scenario Cost	115,000	115,000	115,000
Interest Charged Per Year	4,600	4,600	4,600
Increased Profit	150,617	167,352	184,087
Less Contribution of Profit	45,185	50,206	55,226
Payback Period (years)	**2.55**	**2.29**	**2.08**

Appendix 3 – Sheep production cashflow analysis

Assumptions

Assumptions

- Property and cluster size:

  Model A - 4,750ha property with post scenario of collaborating in a cluster structure of 9 properties, totalling 42,750ha and 88.5km in perimeter of high strength exclusion fencing.

  Model B - 13,000ha property with post scenario of collaborating in a cluster structure of 9 properties, totalling 117,000ha and 138km in perimeter of high strength exclusion fencing.

- Stocking rate:

  Model A - Property is stocked at approximately 8,000 sheep (approximately 5,550 DSE).

  Model B - Property is stocked at approximately 22,000 sheep (approximately 20,500 DSE).

- Property predominately sells lambs and wethers through a self-populating herd.
- Landscape impacted by wild dogs, feral pigs and kangaroos.
- Project cost is funded by loan at 4% interest only, and 30% of increased profits (EBIT) are allocated to repayment.
- Estimated sale prices:

  Ewes: $140/head

  Lambs: $110/head

  Weaners: $90/head

  Wethers: $140/head

  Rams: $90/head

- Wool based on EMI at $1,250, 22 micron fleece.
- Pre-scenario lambing percentage of 70% for ewes and 50% for replacement ewes. Post-scenario lambing percentage of 100% for ewes and 90% for replacement ewes.
- Pre-scenario predation rate averaged at 10%. Post-scenario predation rate at 0%.
- Estimated $6 average freight cost per beast when sold, and 3.5% sale price attributed to selling expenses.
- It is assumed that average rainfall has been received on the property and that pastures have not been affected.

Business cashflow analysis – Model A sheep production

	Without Cluster	Sensitivity Analysis		
		-10%	Baseline	+10%
Sales	468,643	717,592	745,253	772,914
Other Income	-	-	-	-
Total Gross Income	**468,643**	**717,592**	**745,253**	**772,914**
Less Purchases	15,000	16,350	16,500	16,650
Gross Value of Production	**453,643**	**701,242**	**728,753**	**756,264**
Less Total Direct Costs	79,873	103,116	105,698	108,281
Gross Margin	**373,770**	**598,127**	**623,055**	**647,984**
Less Overheads	126,650	127,250	127,250	127,250
EBIT	**247,120**	**470,877**	**495,805**	**520,734**
Overhead Cost Ratio	**27.02%**	**17.73%**	**17.07%**	**16.46%**
Direct Cost Ratio	**17.04%**	**14.37%**	**14.18%**	**14.01%**
Gross Margin/Ha	**78.69**	**125.92**	**131.17**	**136.42**
Increase in Gross Margin/Ha	-	47.23	52.48	57.73

Payback period analysis with partial funding contribution – Model A

	Sensitivity Analysis		
With 25% Funding	-10%	Baseline	+10%
Cluster Fencing Cost	663,750	663,750	663,750
Per Hectare Cost	15.53	15.53	15.53
Individual Property Cost	73,750	73,750	73,750
Less Potential Funding Contribution	18,438	18,438	18,438
Total Scenario Cost	55,313	55,313	55,313
Interest Charged Per Year	2,213	2,213	2,213
Increased Profit	223,757	248,685	273,614
Less Contribution of Profit	67,127	74,606	82,084
Payback Period (years)	**0.82**	**0.74**	**0.67**

Payback period analysis with full payment by landholders – Model A

	Sensitivity Analysis		
Without Funding	**-10%**	**Baseline**	**+10%**
Cluster Fencing Cost	663,750	663,750	663,750
Per Hectare Cost	15.53	15.53	15.53
Individual Property Cost	73,750	73,750	73,750
Less Potential Funding Contribution	-	-	-
Total Scenario Cost	73,750	73,750	73,750
Interest Charged Per Year	2,950	2,950	2,950
Increased Profit	223,757	248,685	273,614
Less Contribution of Profit	67,127	74,606	82,084
Payback Period (years)	**1.10**	**0.99**	**0.90**

Business cashflow analysis – Model B sheep production

	Baseline	**Sensitivity Analysis**		
		-10%	**Baseline**	**+10%**
Sales	1,297,583	1,783,244	1,837,206	1,891,168
Other Income	-	-	-	-
Total Gross Income	**1,297,583**	**1,783,244**	**1,837,206**	**1,891,168**
Less Purchases	37,500	40,875	41,250	41,625
Gross Value of Production	**1,260,083**	**1,742,369**	**1,795,956**	**1,849,543**
Less Total Direct Costs	221,576	258,075	262,130	266,185
Gross Margin	**1,038,507**	**1,484,294**	**1,533,826**	**1,583,358**
Less Overheads	170,625	181,625	181,625	181,625
EBIT	**867,882**	**1,302,669**	**1,352,201**	**1,401,733**
Overhead Cost Ratio	**13.15%**	**10.19%**	**9.89%**	**9.60%**
Direct Cost Ratio	**17.08%**	**14.47%**	**14.27%**	**14.08%**
Gross Margin/Ha	**79.89**	**114.18**	**117.99**	**121.80**
Increase in Gross Margin/Ha	-	34.29	38.10	41.91

Payback period analysis with partial funding contribution – Model B

	Sensitivity Analysis		
With 25% Funding	**-10%**	**Baseline**	**+10%**
Cluster Fencing Cost	1,035,000	1,035,000	1,035,000
Per Hectare Cost	8.85	8.85	8.85
Individual Property Cost	115,000	115,000	115,000
Less Potential Funding Contribution	28,750	28,750	28,750
Total Scenario Cost	86,250	86,250	86,250
Interest Charged Per Year	3,450	3,450	3,450
Increased Profit	434,787	484,319	533,851
Less Contribution of Profit	130,436	145,296	160,155
Payback Period (years)	**0.66**	**0.59**	**0.54**

Payback period analysis with full payment by landholders – Model B

	Sensitivity Analysis		
Without Funding	**-10%**	**Baseline**	**+10%**
Cluster Fencing Cost	1,035,000	1,035,000	1,035,000
Per Hectare Cost	8.85	8.85	8.85
Individual Property Cost	115,000	115,000	115,000
Less Potential Funding Contribution	-	-	-
Total Scenario Cost	115,000	115,000	115,000
Interest Charged Per Year	4,600	4,600	4,600
Increased Profit	434,787	484,319	533,851
Less Contribution of Profit	130,436	145,296	160,155
Payback Period (years)	**0.88**	**0.79**	**0.72**

Appendix 4 – Crop production cashflow analysis

Assumptions

Assumptions

- Property and cluster size:

  Model A - 4,750ha property with post scenario of collaborating in a cluster structure of 9 properties, totalling 42,750ha and 88.5km in perimeter of high strength exclusion fencing.

  Model B - 13,000ha property with post scenario of collaborating in a cluster structure of 9 properties, totalling 117,000ha and 138km in perimeter of high strength exclusion fencing.

- Property utilises 80% of land for cropping.
- Property has a 4 year crop sequence consisting of wheat, chickpea, and sorghum, fallowing 3 summers and 2 winters during the 4 year period.
- Landscape impacted by feral pigs.
- Project cost is funded by loan at 4% interest only, and 30% of increased profits (EBIT) are allocated to repayment.
- Estimated sale prices:

  Wheat: $275/tonne

  Chickpea: $650/tonne

  Sorghum: $275/tonne

- It is assumed that average rainfall has been received on the property.

Business cashflow analysis – Model A crop production

	Without Cluster	Sensitivity Analysis		
		-10%	Baseline	+10%
Sales	2,047,250	2,116,980	2,125,293	2,132,988
Other Income	-	-	-	-
Total Gross Income	**2,047,250**	**2,116,980**	**2,125,293**	**2,132,988**
Less Purchases	-	-	-	-
Gross Value of Production	**2,047,250**	**2,116,980**	**2,125,293**	**2,132,988**
Less Total Direct Costs	964,250	964,250	964,250	964,250
Gross Margin	**1,083,000**	**1,152,730**	**1,161,043**	**1,168,738**
Less Overheads	316,200	316,200	316,200	316,200
EBIT	**766,800**	**836,530**	**844,843**	**852,538**
Overhead Cost Ratio	**15.45%**	**14.94%**	**14.88%**	**14.82%**
Direct Cost Ratio	**47.10%**	**45.55%**	**45.37%**	**45.21%**
Gross Margin/Ha	**228.00**	**242.68**	**244.43**	**246.05**
Increase in Gross Margin/Ha	-	14.68	16.43	18.05

Payback period analysis with partial funding contribution – Model A

	Sensitivity Analysis		
With 25% Funding	-10%	Baseline	+10%
Cluster Fencing Cost	663,750	663,750	663,750
Per Hectare Cost	15.53	15.53	15.53
Individual Property Cost	73,750	73,750	73,750
Less Potential Funding Contribution	18,438	18,438	18,438
Total Scenario Cost	55,313	55,313	55,313
Interest Charged Per Year	2,213	2,213	2,213
Increased Profit	69,730	78,043	85,738
Less Contribution of Profit	20,919	23,413	25,721
Payback Period (years)	**2.64**	**2.36**	**2.15**

Payback period analysis with full payment by landholders – Model A

	Sensitivity Analysis		
Without Funding	**-10%**	**Baseline**	**+10%**
Cluster Fencing Cost	663,750	663,750	663,750
Per Hectare Cost	15.53	15.53	15.53
Individual Property Cost	73,750	73,750	73,750
Less Potential Funding Contribution	-	-	-
Total Scenario Cost	73,750	73,750	73,750
Interest Charged Per Year	2,950	2,950	2,950
Increased Profit	69,730	78,043	85,738
Less Contribution of Profit	20,919	23,413	25,721
Payback Period (years)	**3.53**	**3.15**	**2.87**

Business cashflow analysis – Model B crop production

	Without Cluster	**Sensitivity Analysis**		
		-10%	**Baseline**	**+10%**
Sales	5,603,000	5,793,840	5,816,590	5,837,650
Other Income	-	-	-	-
Total Gross Income	**5,603,000**	**5,793,840**	**5,816,590**	**5,837,650**
Less Purchases	-	-	-	-
Gross Value of Production	**5,603,000**	**5,793,840**	**5,816,590**	**5,837,650**
Less Total Direct Costs	2,639,000	2,639,000	2,639,000	2,639,000
Gross Margin	**2,964,000**	**3,154,840**	**3,177,590**	**3,198,650**
Less Overheads	401,200	401,200	401,200	401,200
EBIT	**2,562,800**	**2,753,640**	**2,776,390**	**2,797,450**
Overhead Cost Ratio	**7.16%**	**6.92%**	**6.90%**	**6.87%**
Direct Cost Ratio	**47.10%**	**45.55%**	**45.37%**	**45.21%**
Gross Margin/Ha	**228.00**	**242.68**	**244.43**	**246.05**
Increase in Gross Margin/Ha	-	14.68	16.43	18.05

Payback period analysis with partial funding contribution – Model B

	Sensitivity Analysis		
With 25% Funding	**-10%**	**Baseline**	**+10%**
Cluster Fencing Cost	1,035,000	1,035,000	1,035,000
Per Hectare Cost	8.85	8.85	8.85
Individual Property Cost	115,000	115,000	115,000
Less Potential Funding Contribution	28,750	28,750	28,750
Total Scenario Cost	86,250	86,250	86,250
Interest Charged Per Year	3,450	3,450	3,450
Increased Profit	190,840	213,590	234,650
Less Contribution of Profit	57,252	64,077	70,395
Payback Period (years)	**1.51**	**1.35**	**1.23**

Payback period analysis with full payment by landholders – Model B

	Sensitivity Analysis		
Without Funding	**-10%**	**Baseline**	**+10%**
Cluster Fencing Cost	1,035,000	1,035,000	1,035,000
Per Hectare Cost	8.85	8.85	8.85
Individual Property Cost	115,000	115,000	115,000
Less Potential Funding Contribution	-	-	-
Total Scenario Cost	115,000	115,000	115,000
Interest Charged Per Year	4,600	4,600	4,600
Increased Profit	190,840	213,590	234,650
Less Contribution of Profit	57,252	64,077	70,395
Payback Period (years)	**2.01**	**1.79**	**1.63**