



A prospective evaluation of contingent loans as a means of financing wild dog exclusion fences

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1 **A prospective evaluation of contingent loans as a means of financing wild**
2 **dog exclusion fences**

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1 **Summary Text**

2 Fencing to exclude predators of livestock in rangelands grazing enterprises can have both
3 private and public benefits and Australian governments have shown some willingness to
4 contribute to the construction of such fences on those grounds. This study shows how
5 contingent loans might be used to manage a public-private cost sharing arrangement that
6 allows for the recovery of some or even all public investment over time and yet limits the
7 financial risks to landholders.

For Review Only

1 **Abstract**

2 Invasive species, such as wild dogs can be considered an externality arising from the
3 activities of pastoral enterprises, with producers having limited responsibility for the
4 problem and limited capacity to mitigate it. There are therefore arguments for
5 government intervention through encouraging both individual and collective control
6 measures. Governments are however increasingly inclined to ensure recipients of
7 support make some contribution where there are private benefits. An example of this,
8 in Australia, is the requirement that students repay some of the cost of their tertiary
9 education. Using the issue of wild dog exclusion fencing in southwest Queensland as
10 a case study, this paper considers if and how a policy instrument adopted for higher
11 education (HECS-HELP), contingent loans, could be adapted to address problems of
12 externalities in rural Australia. Central to the issue of exclusion fences are high
13 upfront costs and highly variable incomes that limit the ability to recoup those costs
14 according to a predictable timeline. Considering a range of incomes and a variety of
15 private/government shares of the cost of the fences, we examine the effects of revenue
16 contingent loans for the construction of these fences, using model farms developed
17 from survey data for farm businesses in Southwest Queensland. We find that
18 contingent loans could mitigate the hardship effects of additional debt and variable
19 incomes. Businesses with smaller properties and relatively lower incomes may
20 however struggle to pay back larger loans. Using Southwest Queensland as a case
21 study, we show how different shares of contributions change the time to pay back
22 loans, outline how a contingent loan scheme might be administered and note some
23 issues with integrating personal contingent loans into a collective fence arrangement.

24

25 **Additional keywords**

- 1 Rangelands grazing, predation on livestock, public benefit, collective action

For Review Only

1 **Introduction**

2 Wild dog predation on livestock has significant direct and indirect costs for landholders in the
3 pastoral zones of Australia. ‘Wild dogs’ include dingoes, feral dogs native to Australia; more
4 recently introduced breeds released, lost or fled from domesticated situations; and, hybrids of
5 the two. Wool Producers Australia (2014) reported that in Queensland in 2009, production
6 losses due to wild dog predation were \$A16.9 million for the sheep and goat industries alone.
7 The most significant losses are from predation on young livestock, especially in the case of
8 sheep where lambs are particularly vulnerable. As an example of the financial effects, for a
9 flock of 5000 meat sheep, a decrease in weaning rate, from 90% to 30% would result in
10 approximately 3000 fewer lambs each year. Under prices at the time of writing, that would be
11 an estimated annual loss to revenue of more than \$300,000 after variable costs are excluded.
12 Second, predation may contribute to livestock disturbance and stress which then affects
13 grazing patterns and efficiency, resulting in overall lower wool or meat production. Third,
14 there may be an opportunity cost of predation for some landholders, as they choose, for
15 example, to run cattle rather than sheep. Figure 1 shows a trend reduction in wool as a share
16 of income amongst participants in regular sample surveys in a region of south west
17 Queensland (Meat & Livestock Australia 2017). With some land types, more suited to sheep
18 than cattle, this trend may mean a reduction in income over time.

19
20 INSERT FIGURE 1 ABOUT HERE

21
22 Wild dog predation on livestock is a long-standing concern, and colonial governments started
23 constructing a major dingo ‘barrier’ in the 1880s, a fence that eventually ran through
24 Queensland and South Australia, ostensibly protecting the south-eastern cropping and
25 pastoral areas. Resourcing the maintenance of this fence decreased, notably in the 1980s in

1 Queensland. Concern about declining sheep numbers and producer reports of dog attacks
2 contributing to that decline increased over time, leading to a report that produced a
3 'conservative' estimate of annual losses of \$33 million in Queensland, including the costs of
4 urban wild dogs (Department of Natural Resources and Mines 2004). Queensland's major
5 agricultural industries lobby group, Agforce, then continued to lobby the State Government
6 on this issue and was funded to commission a report focussing on impacts on the grazing
7 industries (Agforce 2018). This report estimated a cost to those industries in Queensland of
8 \$67 million for the financial year 2008/09 (Hewitt 2009). According to a survey for that
9 report, the primary control measures used by landholders were shooting, baiting (poisoning),
10 use of guard animals and some exclusion fencing (Hewitt 2009). Political attention did
11 however start to shift more towards fencing.

12
13 In 2015, the Federal Government announced a pest and weed management program as part of
14 a drought assistance package. The Queensland Government recommended that money for the
15 State should go to cluster fences, which would enclose a cluster or number of properties.
16 Money from the Federal government was subsequently supplemented by the Queensland
17 Government for additional work. Forms of financing under this program have included:
18 grants, no interest loans and low interest loans. The aim of exclusion fencing of properties is
19 to increase landholder production choices and effective livestock weaning and survival rates.
20 If constructed to address total grazing pressure (TGP), fences have the potential to also
21 reduce the grazing competition from kangaroos or goats, thereby enabling increased stocking
22 rates for domesticated livestock. Therefore, exclusion fencing could potentially deliver
23 significant private benefit to landholders who construct fences, whether just for their
24 individual property or as part of a cluster. The cost of fence construction is however, not
25 insignificant and, for many landholders, may be prohibitive.

1
2 There are several arguments that can be made for a public contribution to exclusion fencing,
3 as the advantages are not limited to the private benefits just described. First, the proliferation
4 of wild dogs is a function of factors largely external to individual landholders. People who
5 have lost or released domestic dogs, or landholders not participating in coordinated control
6 campaigns are effectively creating or exacerbating an externality for livestock producers, but
7 it is almost impossible to attribute the related costs to those responsible. Second, the mobility
8 of the dogs (and kangaroos and goats) means that collective or at least coordinated action of
9 some form will be more efficient and effective in constraining unwanted animals. Cluster
10 fencing reduces the cost per hectare and per livestock unit and reduces the “Swiss cheese”
11 effect of unfenced properties providing havens for predators. Therefore, governments could
12 provide incentives to encourage efficiency gains through collective action in a similar manner
13 to larger collective systems, such as sugar and grain storage, transport, and marketing systems
14 which have in the past been subsidised and cross-subsidised.

15
16 To date the main argument evident in public and political discussions to justify government
17 involvement is that exclusion fences could improve regional economic outcomes as a result
18 of the increase in livestock production. This would especially be the case with an increase in
19 the number of sheep for wool production, where the income and employment multipliers are
20 higher than managing sheep, cattle, or goats just for meat. The Queensland Government
21 estimated that its existing cluster fencing program, as at 2017, will result in an additional
22 400,000 sheep in the Longreach region, generating \$5.7m in flow-on wages in wool-related
23 industries such as shearing (Burton 2017). There are claims that such fences could contribute
24 to improved resource condition and even protection of endangered species (Long and Robley
25 2004). The evidence for this has however been disputed, or at least considered insufficient to

draw a conclusion (Allen *et al.* 2013; Hayward and Marlow 2014). Another environmental argument against exclusion fences might be that wild dogs are actually limiting numbers of livestock and thereby limiting land degradation. A reduction in the number of wild dogs would however not automatically lead to an increase in available pasture and by extension ground cover, as these would then be much more a function of grazing management decisions, assuming the fence also controls kangaroo and goat numbers, as discussed below. Either way it is, beyond the scope of this paper to examine the case for, and returns from, any such benefits. We are interested in how governments might facilitate the construction of wild dog exclusion fences rather than the justification for such intervention.

There are two related issues to address in providing government support to the financing of exclusion fencing. One concerns the most effective and efficient style of fence construction to be supported, that is, whether the fence should enclose individual properties or groups of properties through cluster fencing. The other, and main focus of this analysis, concerns the type of financing available to support fence construction. Institutional pathways for finance for fences have so far included regional NRM organisations, usually through grants to top up private investment, and a local council (Longreach) providing low-interest loans from state government finances. Even with little or no interest, loan repayments can however be difficult with highly volatile revenue flows. We begin with a discussion of a novel and innovative policy mechanism for supporting the financing of exclusion fences at the individual property level, the use of income contingent loans. To date contingent loans have only been applied in the context of higher education financing, although a range of other possible applications of the model have been discussed in the academic literature.

1 **Contingent loans: theory, application and design**

2 There are a number of ways in which governments can become involved in supporting the
3 financing of activities seen to have at least some element of public benefit. This can be done
4 through the direct provision of long-term low interest loans, or the provision of subsidies on
5 the interest paid on commercial finance. Both of these forms of government involvement
6 have been used by Australian governments to support activities in the agricultural sector, with
7 both used in the case of drought loans and the latter also in rural adjustment schemes. Grants,
8 whether in the form of lump sum payments or subsidies on interest payments, can be costly to
9 the taxpayer and the public benefit can be difficult to identify.

10

11 In the absence of government intervention commercial financing is available for farms, as for
12 other businesses, and is provided through conventional mortgage-style loans, which are
13 generally secured against a physical asset such as a farm. This security provides the lender
14 with some recourse to potentially reclaim funds should the borrower default. While this form
15 of financing is appropriate and successful across a range of applications where investors need
16 to borrow funds to supplement their own resources, there are circumstances under which it is
17 likely to deliver sub-optimal outcomes for either or both the borrower and the lender. In the
18 case of farm financing, farmers may be risk averse, resulting in reduced borrowing for
19 investment in agricultural activity. One reason for this reluctance to borrow relates to the risk
20 of defaulting on the loan in low income years, resulting in loss of the collateral against which
21 the loan is secured, that is, the farm itself. As the family farm is frequently also the family
22 home — which may have been in the family for several generations — many farmers are not
23 prepared to take this risk. There may then be some degree of ‘market failure’, with demand
24 for funds for investment but the supply of funds is not attractive to the prospective borrower
25 because of its form and conditions.

1
2 We propose an alternative approach – government-provided contingent loans – that are
3 something of a half-way house between the provision of grants to support desirable activities
4 and a free market approach that leaves investment decisions to individual business managers
5 supported by commercial finance. Contingent loans are linked to capacity to pay and are not
6 secured against an asset, in essence they are secured against future income (or revenue)
7 streams. Contingent loans are appropriate in a number of circumstances, including, but not
8 only: (i) where there are both public and private benefits associated with the activity being
9 financed; (ii) where there is risk aversion on the part of potential borrowers resulting in
10 economically suboptimal levels of investment in the activity; and (iii) where there is no
11 appropriate collateral for the loan linked to the activity. The best known contingent loan
12 system is Australia's Higher Education Contribution Scheme (HECS) which has been
13 emulated in a number of countries. Contingent loans are very flexible for governments since
14 the policy settings can be adjusted to reflect particular values and goals. For example, a
15 contingent loan for a particular investment could be subsidised through having no or low
16 interest rates or not seeking recovery of administration costs, if public benefit was assumed,
17 through to adding a commercial interest rate or some other surcharge for the capital to make
18 the scheme close to cost-neutral for public investment. Contingent loans have the advantage
19 over grants in that repayment and even a return on funding can be built in and government
20 can therefore expect to receive a proportion, if not all, of the expenditure back thereby freeing
21 up resources to direct to other government priorities.

22
23 Because standard loans, whether provided commercially or low interest loans provided by
24 government agencies, generally require a fixed, regular repayment they are insensitive to the
25 financial circumstances of the borrower, which can be a particular problem when incomes are

1 highly variable, as in agricultural production. A contingent loan ensures that the borrower
2 does not experience hardship in periods of low incomes and can make substantial inroads into
3 the debt in periods of high income. Farm incomes are notoriously volatile so a requirement to
4 make regular repayments of a fixed amount can result in considerable hardship in very low-
5 income years. Figure 2 illustrates the impact on farm cash flow of the two styles of loan.
6 These figures are derived from an annual survey of samples of pastoral businesses in
7 Southwest Queensland (Meat & Livestock Australia 2017). The figure compares the
8 proportions of revenue (farm cash income) required to service debt. A contingent loan
9 repayment plan has a constant proportion, whereas the mortgage loan would have
10 considerable variations in the proportion of income needed to service debt, with those
11 variations strongly associated with seasonal conditions. This could result in considerable
12 hardship to farmers and their families in low income years.

13 INSERT FIGURE 2 ABOUT HERE

14 Income volatility is apparent from data from a separate survey and review of farm businesses
15 in the same region (N=1243) which concluded that from 1989 to 2014, the proportion of
16 properties where the interest to receipts ratio exceeded 15%, ranged from less than 5% to
17 more than 40% (ABARES 2014). In 21 of 25 years, this ratio was above 20% and in eight
18 years more than 30%. That is, with dry conditions, especially in combination with lower
19 prices, more farm businesses have to pay a relatively high proportion of revenue to service
20 debt. Some businesses are especially vulnerable. For the south western pastoral region of
21 Queensland, approximately 57% of respondents had at least 90% equity but 14 percent had
22 equity of less than 70%, whereas for all of Queensland, 10% of farm businesses surveyed had
23 less than 70% equity (ABARES 2014). From the data used as the base of the modelling
24 below (Meat & Livestock Australia 2017), for the average of the properties (N=20-30) there

1 were eight out of 30 years in which farm cash income (net of direct costs) was negative.

2 Therefore, in the study region there are some properties that are likely to have relatively high
3 debt servicing costs with many more experiencing additional costs in the frequent dry years.

4 In addition, debt increases in dry years (ABARES 2014) with extra borrowing and perhaps an
5 escalating inability to meet repayments.

6
7 In this sense, contingent loans play the type of consumption smoothing role familiar to
8 farmers through schemes such as Farm Management Deposits. Farm Management Deposits
9 are an income smoothing mechanism for farmers, that provides favourable taxation treatment
10 for deposits into the scheme as an incentive for farmers to put aside money in high income
11 years to be accessed when needed in subsequent periods of low income, for example during
12 drought. For the contingent loans, borrowers enter into a commitment to repay a proportion
13 of future income or revenue until the loan is repaid. The repayments are therefore explicitly
14 linked to capacity to pay; the amount due varies as the borrower's circumstances vary. This
15 makes this style of loan attractive for investment in the agricultural sector as it addresses the
16 two limits on traditional forms of farm borrowing listed above by a) not putting the farm at
17 risk of foreclosure, and b) responding to fluctuations in farm incomes and therefore not
18 risking undue hardship in low income years.

19
20 Contingent loans generally require government involvement. This form of lending is likely
21 to be unattractive to private financial institutions looking for securities against loans and
22 predictable repayment schedules. In addition, only government has the power to compel the
23 financial reporting required to ensure that borrowers do not misrepresent their income in
24 order to minimise their repayment obligations. Government also has the mechanism through

1 the Australian Tax Office to enforce collection of repayments. Table 1 sets out the key
2 differences between conventional loans, grants and contingent loans.

3
4 INSERT TABLE 1 ABOUT HERE

5
6 In summary, then, there are two key features of income contingent loans that make them
7 appealing to policy makers and borrowers. These are:

- 8 (i) Consumption smoothing, since debtors pay nothing when incomes are low,
9 and proportionately more when incomes are relatively high;
10 (ii) Insurance against default which would otherwise result from low income.
11 (Chapman 2014)

12 Within the academic literature, the policy aspects of contingent loans have been considered
13 from the perspectives of a range of disciplines, including economics, political science,
14 anthropology and criminology. Policies or proposals have been associated with the financing
15 of: higher education (the HECS-HELP Scheme); drought relief (Botterill *et al.* 2017); the
16 payment of fines for both low level criminal offences and white-collar crime (Chapman and
17 Denniss 2005; Chapman *et al.* 2004); Indigenous land development projects (Altman and
18 Dillon 2004); and Research and Development investments (Denniss *et al.* 2009).

19
20 Other than the HECS-HELP scheme, the proposal for the provision of drought relief through
21 a revenue-contingent loan (RCL) is the most developed and of particular relevance to the
22 financing of other farm activities, such as the construction of exclusion fencing. The drought
23 relief case is instructive, as the problem is unpredictable, it contributes to significant revenue
24 volatility and it is beneficial for the farm businesses and the broader economy if post-drought
25 reinvestment is relatively rapid. Issues of moral hazard and adverse selection, whereby land

managers may arrange their affairs to minimise or avoid repayment obligations can be addressed in the policy design. Botterill *et al.* developed a policy instrument with respect to drought that addresses these and other issues (Botterill *et al.* 2017; Botterill and Chapman, 2004, 2006, 2009; Kelly *et al.* 2004). These could also apply to loans for particular projects, such as a wild dog fence.

As an established, successful and relatively efficient working contingent loan scheme, the HECS-HELP model provided the basis for our study of financing wild dog fencing. We incorporated modifications for the context of farm businesses, as set out by Botterill and Chapman (2009) in their consideration of contingent loans for drought relief. In the case of HECS-HELP, repayments are generated from *taxable income* and collected through the Australian Tax Office. Repayments are triggered when taxpayers reach a threshold level of taxable income. This is a relatively reliable indicator of the borrower's welfare, and the repayment rate can be determined with some precision in order to meet the public policy goal of timely repayment of loans without imposing undue hardship on the taxpayer. For the case of loans to primary producers there are however both moral hazard and capacity to pay issues. As to moral hazard, farm business managers have some scope to manipulate taxable income, given deductions for some forms of investment, and the use of Farm Management Deposits. Therefore, repayments could be delayed or minimised indefinitely with some particular arrangements. As was the case for the drought relief proposal, we model based on *revenue* rather than income, and discuss how this might be administratively managed later in the article. It should be noted, however, that revenue is a poorer indicator of the borrower's capacity to repay than income as it is a gross measure and therefore insensitive to factors such as differing farm cost structures. This has implications for the level of interest or surcharge (if any) to be applied to the loan amount and the proportion of revenue that forms the basis of

1 the repayment. Putting this aside at this stage, the first step is to explore some more
2 fundamental scenarios around capacity to pay.

3

4

5 **Methods**

6

7 The model developed for this paper is based on the provision of revenue contingent loans to
8 farm businesses for the purpose of constructing wild dog exclusion fences. In the first
9 instance, we are assuming that the fencing will be for individual farm properties, not in a
10 cluster arrangement, however the scale issues revealed by the modelling described below
11 suggest that cluster arrangements also warrant consideration. The modelling generates net
12 revenue for grazing enterprises that have at least some income from wool and sheep, with
13 farm finances derived from surveys of a sample of properties in south west Queensland (Meat
14 & Livestock 2017). The time series farm revenue and farm area data are from the Australian
15 Agricultural and Grazing Industries Survey. The survey is conducted annually and covers
16 farming establishments with revenues above a given threshold, which rose from \$22,500 in
17 1991 to \$40,000 since 2004. Area and financial data were downloaded for *Specialist Sheep*
18 *Farms*, *Mixed Enterprise Sheep Farms*, and *All Sheep Industries Combined* in two
19 Queensland regions — the *West & South West* and the *Charleville–Longreach* regions (Meat
20 & Livestock Australia 2017). Average revenue per hectare data from 1996–97 through 2015–
21 16 were used to develop projected years 1 through 20. Data from the last 10 years (2006–07
22 to 2015–16) were then repeated for projected years 21 through 30. The reason for the
23 repetition was to reflect more closely recent years’ prices and conditions. This does mean
24 however, that the effects of the ‘Millennium’ drought (2002-2009), a very severe period of
25 dry years, will be repeated. There might therefore be an argument that long-term production

could be greater than this constructed period but against that is an argument to consider the effects of climate change. The repayments for the contingent loans are then modelled as varying proportions of that revenue and, from that, repayment schedules can be estimated.

The objectives of modelling were to examine five factors in relation to the payment schedules associated with a revenue contingent loan provided for the purpose of fence construction:

- Property scale (area);
- Level of revenue (farm business performance);
- Productivity gains when factored into historical revenues;
- Different interest rates or surcharges; and
- Levels of private and public contributions.

For the scale analysis, three initial borrowing scenarios were:

- A 13,000 ha property with a \$350,000 fence;
- A 26,000 ha property with a \$500,000 fence; and
- A 40,000 ha property with a \$620,000 fence.

These were chosen to reflect different property sizes, economies of scale, revenue levels and fencing project costs. In the initial scenarios, the full cost of the fence is included in the loan and the cost of fencing was based on simple rectangular perimeter calculations for each property by the cost of fencing (\$7000/km), as advised through consultation with key informants from South West NRM, a regional natural resources management organisation that has been involved with collaborative fencing projects. So, for example, enclosing a rectangular 13,500 ha would require around 48 kms of fencing, rounded up to acknowledge that such neat symmetries would be rare. Hence, 50 kms by \$7000 is a \$350,000 loan.

1 To show the effects of different levels of farm performance, as indicated by revenue, three
2 types of farms for each of the property sizes were created: low, mean, and high revenue,
3 represented in the figures below as Low Total Cash Receipts (TCR); Mean TCR; and High
4 TCR. A farm with a ‘low’ revenue is defined as a farm with revenue equal to half the mean
5 total cash receipts for that year. A farm with a ‘high’ revenue is defined as a farm with
6 revenue equal to 1.5 times the mean total cash receipts for that year. A farm with a ‘mean’
7 revenue is defined as a farm with revenue equal to the mean total cash receipts for that year.
8 The basis for the sub-scenarios of 0.5 and 1.5 times mean cash receipts is shown in Table 2.

9
10 INSERT TABLE 2 ABOUT HERE

11
12 Table 2 shows the average variation from the mean of revenue of Queensland sheep farms by
13 percentile over the period 2000 to 2015. These distributional data were provided by ABARES
14 for a related project (Botterill *et al.* 2017). To help explain the table, consider a farm that has
15 revenue where half the other sheep farms in Queensland have more and half have less. This
16 farm is on the 50th percentile (P50). This P50 farm averaged 14 per cent less revenue than the
17 mean over the years 2000 to 2015. A farm having an average revenue of 0.5 times the mean
18 approximates to a farm at the 25 percentile, while a farm with 1.5 times the mean is
19 approximately at the 75 percentile.

20
21 Exclusion fencing is justified on the basis of (potentially significant) productivity
22 improvement. Our model therefore considered three scenarios to reflect increased revenue
23 following fence construction: 10, 25 or 40% increases. These are based on three potential
24 benefits to production from an exclusion fence:

- 1 • an increase in lambing and weaning rates as a result of reducing or eliminating wild
- 2 dog predation;
- 3 • a slight decrease in overall adult sheep death rates; and
- 4 • an increase in sheep stocking rates over time as kangaroo numbers inside fences
- 5 decrease.

6 The base data for this part of the analysis were again from the MLA/ABARES farm survey
7 price and production data for each of the Charleville-Longreach and the West and South West
8 regions of Queensland. Carrying capacity and lambing and death rates vary with seasonal
9 conditions, decreasing and increasing respectively in drought years. For example, from the
10 survey data, reported lambing rates for Charleville-Longreach over the last 30 years have
11 varied from 40% to almost 75%. Given that some degree of variation is inevitable, we
12 modelled proportionate changes for stocking rates, lambing rates and livestock death rates.
13 That is, these were assumed to improve in all years, but would still vary proportionately
14 according to historical rates.

15
16 For the kangaroo exclusion effect, we assumed a pre-fence kangaroo density of 15 dry sheep
17 equivalent (DSE)/Km² (0.15 DSE/ha), based on the reports from south west Queensland from
18 the Australian Collaborative Rangelands Information Systems (ACRIS) (Bastin 2012). That
19 rate is higher than reported in 2012 (11-12 DSE/km²) but the trend was upward in this
20 decade. Exclusion of most of these kangaroos would allow sheep flock numbers to increase,
21 for example on a 20,000 ha property, by 1500 DSE. Tables 3 and 4 show one scenario for
22 each of the two study regions, with the result close to the 40% one, primarily used for the
23 modelling.

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25 INSERT TABLES 3 AND 4 ABOUT HERE

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It would be a matter for policy decision as to the level of subsidy that a government might be prepared to offer for a contingent loan scheme for wild dog fencing. In order to minimise the cost to the budget, either an upfront surcharge could be added to the debt or an interest rate applied over the lifetime of the loan. Either of these measures could help cover the cost of government borrowing to finance and administer the scheme and therefore could indeed be structured to ensure that there was no net cost to the budget at all. To examine the effects of different interest rates (one and two percent), or the application of a surcharge, we incorporated those into the modelled repayment schedules. The model also allowed for the inclusion of a farmer contribution to the cost of the fence of 0 per cent, 25%, 50% or 75%. To date, other funding mechanisms have been based on or about a 50% landholder direct contribution.

Results

As discussed in the introduction, public funding of exclusion fences is being promoted as regional development policy but with private benefits. Given this, the results presented below assume that half of the cost of exclusion fencing would be funded publicly and half would be borrowed by the farm. A small farm (13,000 ha) borrowing half the cost would require a \$175,000 loan and a large farm (40,000 ha) would require a loan of \$310,000. Other options ranging from 100% farm contributions to 0% contributions are considered later in the paper. Figure 3 shows differences based on scale and on revenue generation. In summary, larger farms will have a greater capacity to repay the loan. Second, there will be considerable differences in repayment times.

INSERT FIGURE 3 ABOUT HERE

1

2 The large farm could repay the full fence cost in 6 years with the mean size repaying in 10
3 years, compared with the best case for the small farm being 11 years, with the mean being 16
4 years, and small farms with a low TCR would take greater than 30 years. Increasing
5 productivity (Figure 4) will decrease the repayment time, but this would not necessarily offset
6 adding either interest or a surcharge.

7

8 INSERT FIGURE 4 ABOUT HERE

9

10 With productivity improvements, even a modest interest rate of 2% increases the repayments
11 for low revenue farms beyond 30 years and in the case of small farms with low revenue
12 would require a very long repayment period. A surcharge seems to enable better relative
13 outcomes from the small farm, as suggested by Figure 5.

14

15 INSERT FIGURE 5 ABOUT HERE

16

17 In order to improve repayment prospects, the repayment rate could be increased to 10 per
18 cent of revenue (Figure 6), however, this could greatly increase the risk of repayment
19 hardship given the relatively crude nature of revenue as a measure of capacity to pay, as
20 noted above.

21

22 INSERT FIGURE 6 ABOUT HERE

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24 The repayment times for different policy settings are summarised in Table 5, including
25 farmer contributions of 0% to 75% of the cost of the fence.

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INSERT TABLE 5 ABOUT HERE

The surcharge reduces the repayment time for large farms on loans for the full cost of the fence, but otherwise there is little difference to applying a 2% interest rate. Recall however that low and median income small farms will be able to repay a loan more quickly with a surcharge than with 2% interest. The larger loans will significantly increase repayment times, especially for the small properties.

Discussion

Implications for policy design

As illustrated above, there are a range of policy parameters that can be adjusted in designing a contingent loan instrument. These include:

- the proportion of the cost of fencing to be borne by the lending body and the farmer;
- the addition of a surcharge which reduces the interest rate subsidy implicit if no interest is charged;
- the inclusion of an interest rate to cover the government’s cost of borrowing; and,
- the repayment rate as a percentage of farm revenue.

Theoretically, if the government’s cost of borrowing is covered in full by either the application of an interest rate or a surcharge, the length of time to repayment is irrelevant in budgetary terms. This would however, need to be weighed against the political desirability of having these loans on the government’s books for the long term and the fact that, for some

farms, the impact of compound interest could see the debt of some properties actually increase over time.

A government could decide to subsidise these loans on the basis of the public benefit associated with fence construction. There could even be a performance contract between borrower and government that included consideration of stocking rate (practice indicator) or post-fence land condition (outcome indicator). The payment for public benefit could then take the form for example, of the government requiring only 80% repayment. Second, if the interest rate on the debt was below the government's cost of the borrowing, there is an interest rate subsidy. For debts in which repayment takes a long time (for example, more than 10 years) interest rate subsidies can be significant and even constitute the main implicit cost to the budget of a loan scheme. Factoring in interest to cover the government's cost of borrowing would however increase the amount owed and therefore the time that would be taken to repay the loans.

Repayments would be set at a standard percentage of gross revenue, with scope to increase the repayment percentage above a given revenue level. This could be desirable in terms of reducing the time frame within which the government/funding agency could expect to receive the repayment of a reasonable proportion of the amount lent.

Administrative considerations

The general assumption underpinning both existing and proposed income/revenue contingent loan schemes is that they be set up and administered by the federal government through the Australian Taxation Office. The ATO has experience with the administration of HECS-

1 HELP which it operates at relatively low cost; the cost to the taxpayer of collecting HECS-
2 HELP is of the order of 2% per annum of annual HECS–HELP revenue receipts (updated
3 figure from Chapman 2014). It also has both the legal backing to require accurate reporting
4 of personal income and established administrative processes for collecting taxes through
5 employer withholding and requiring payment in advance from businesses or individuals
6 where previous income has outstripped the tax liability. Should a State government decide to
7 set up a contingent loan scheme without a national scheme being in place, the administrative
8 arrangements would be more complex and therefore more costly, though just how costly is
9 hard to estimate given that cross-jurisdictional repayment collection would be a new
10 arrangement.

12 In order to reflect the lag time between the construction of the fence and the recovery in
13 sheep and lamb numbers, recipients of a fencing loan might not be required to make any
14 repayments for twelve months. In this case, policy makers could consider a discount for
15 farmers who choose to repay the loan partially or in full during this twelve-month period.
16 This would encourage early repayment by those with the capacity to do so, thereby
17 improving the speed at which government would recover these loans, though such rapid
18 repayment is likely to be rare, given seasonal and market fluctuations and the range of other
19 costs for a grazing enterprise.

21 Many of the issues of potential adverse selection and moral hazard associated with a revenue-
22 contingent loan for wild dog fencing have been addressed in the development of the proposed
23 drought loan (see Botterill and Chapman, 2009). Attaching the repayment obligation to the
24 farm's Australian Business Number, which is a form of identification in the tax system, is the
25 starting point of measures to ensure repayment. The drought loan proposal (Chapman *et al.*,

2004a) also included measures to address the sale of the farm property, the death of the farmer, other changes in ownership arrangements, and in the case of bankruptcy. All of these could be adopted for a wild dog fencing scheme. These measures assume a system run through the Business Activity Statement and the Australian Taxation Office. Any system that moved away from the direct involvement of the ATO would complicate collection in the event of change of farm ownership.

In order to minimise adverse selection, the loan scheme could be available to cover only a portion of the cost of the fence with the borrower required to cover the balance either from their own resources or from the commercial financial sector. As we understand it, most current schemes require 50-60% of private input. A commercial financial institution would be concerned to ensure that their portion of the loan would be repaid and are likely to deny finance to those they deem risky. If the farmer is unable to raise funds to cover even a small portion of the cost of financing, this suggests that their prospects of repaying the larger loan would be poor. Alternatively, financial institutions may yet be unsure about the benefits of fencing.

Individual property vs cluster fencing arrangements

The modelling described above demonstrates the economies of scale that can be achieved through the fencing of larger properties. By extension, this implies that cluster or cell fencing, the fencing of groups of adjoining properties, is a more efficient use of both private and public funds. In addition, cluster fencing minimises the potential 'Swiss cheese' effect which would see predators (and likely kangaroos) relocating and possibly concentrating in unfenced areas thereby exacerbating the problem for unfenced properties. Piecemeal

1 building of individual fences also has the potential to result in the construction of fences that
2 could be superseded if consolidation and infilling of previously unfenced areas were to occur.
3 On the other hand, the costs of removing predators and grazing competitors from larger areas
4 may be relatively higher, though there are no studies of that to date. Additional internal
5 barriers may therefore make predator and competitor management easier.

6

7 Figure 7 shows a simple hypothetical case of a later addition to a cluster of properties. In this
8 case the initial cluster enclosed 270,000 ha, perhaps 10 to 13 properties, but 3-4 others
9 (60,000 ha) stayed out of the arrangement, only to join later. A Queensland Government map
10 of cluster fencing to March 2017, shows both some similar shapes and where different
11 projects have ended up with a shared boundary (Queensland Government, 2017). For the
12 simplified example here, the initial cost would be \$2.03m (290 kms x \$7000/ha) or \$7.5/ha
13 enclosed. Had the other properties participated in that fencing, the total cost would have been
14 \$1.61m (230 kms x \$7000/ha) and \$4.89/ha. This raises questions as to what might be done
15 to encourage or facilitate 'efficient' agglomerations.

16

17 INSERT FIGURE 7 ABOUT HERE

18

19 To date, proposals for contingent loan schemes have not addressed the financing of large
20 scale collective action. These have been focussed on providing finance to individuals or
21 single businesses. Investment in cluster arrangements would maximise the value of
22 investment in wild dog exclusion fencing, however, it would require innovation in the
23 development of a contingent loan scheme. At present, participants in cluster fencing make a
24 contribution to an incorporated entity, either from their own existing resources or with
25 commercial finance. In principle there is no reason why participants in the incorporated

fence entity could not access a contingent loan to meet their obligations as part of that entity. This would require further policy consideration, however using contingent loans to finance participation in cluster arrangements should be possible.

Conclusion

The introduction of revenue contingent loans for wild dog exclusion fencing would be a long-term investment for the funding body. Even with an interest subsidy, the best-case scenario that was modelled would not see any loans repaid in full in under thirteen years at a repayment rate of 5% of revenue per annum. Doubling the rate would substantially decrease the repayment time but increases the risk of hardship for some borrowers. The inclusion of an interest rate approximating the government's cost of borrowing would result in some small farms having very long term loans (greater than 30 years), even under the best case for improved total cash receipts from productivity gains following the construction of the fence. Requiring private contributions generally increases the rate and likelihood of a government getting all of a loan back.

Cluster fence programs to date raise significant equity issues, especially considering our analyses of capacity to repay. 'Disadvantage' factors for a business preferring sheep and wool production would include: smaller scale; isolation from other sheep properties; absentee owners as neighbours; and perhaps even poor local relationships. As shown, larger properties have a greater capacity to repay loans and cluster fencing is likely to reduce the cost per hectare enclosed. Therefore, governments could decide to accept longer repayment times from smaller, individually fenced enterprises as an equity contribution, in which case contingent loans might be particularly appropriate. They may however, also be adapted to support individual contributions to a cluster cell fence. This would need to be examined further to check for legal and management issues. Further to that, there may be an important

1 area of research in considering how the cluster arrangements and policy settings could be
2 used to: maximise participation so as to gain economies of scale; identify any emerging
3 problems within collaborations, such as free-riding on maintenance obligations; and examine
4 existing arrangements to consider the factors that contribute to the workability or otherwise
5 of collaborative area management.

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7 **Conflicts of interest**

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9 The authors declare no conflicts of interest.

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12 **Acknowledgements**

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14 Thanks to South-West NRM for advice and information.

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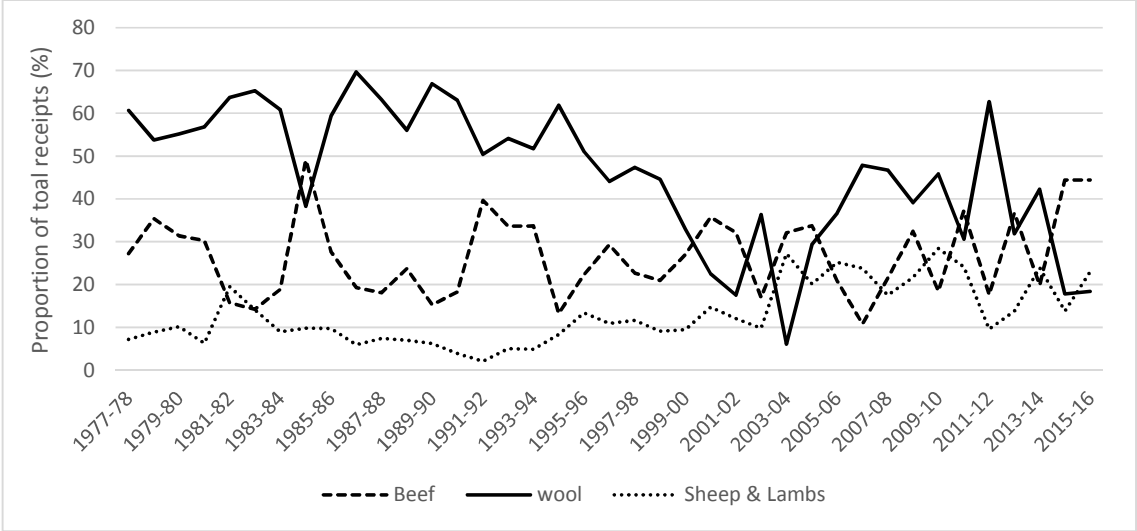
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Fig. 1. Share of farm business receipts by product sales for a sample of farm businesses running some sheep in the Charleville-Longreach region. *Source:* MLA 2017

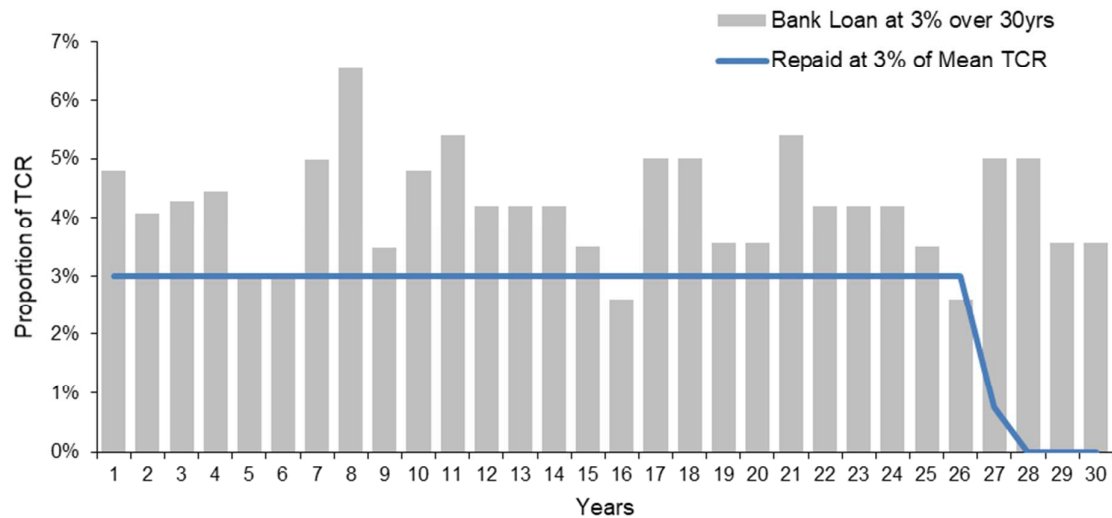


Figure 2: Proportion of Revenue used to repay a contingent loan and a mortgage-type loan by a 13,000HA Farm with Mean Total Cash Receipts. The mortgage-type loan assumes a 30-yr loan of \$175,000 (50% of total cost) and 3% interest.

1

Table 1. Summary of benefits and limitations of financing options

Category	Mortgage-style loans	Contingent loans	Grants
Lender/grantor	Government or commercial entity	Government	Government
Linked to borrower’s capacity to pay	No	Yes	n/a
Income smoothing	No	Yes	n/a
Possibility of default	Yes	No	n/a
Cost to public finance	No	Depends on policy settings	Yes
Administrative costs	Variable	Can be low	Low
Administrative commitment	Life of loan	Life of loan	Short term
Public benefits of investment	Can have	Can have	Should have

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Table 2. Distribution of Revenue for Queensland Sheep Farms, 2000–2015

	Percentiles								
	P10	P20	P30	P40	P50	P60	P70	P80	P90
Average 2000 to 2015 ^A	-66%	-52%	-42%	-33%	-14%	+01%	+21%	+81%	+105%

^AThe percentage values shown are the mean difference between farms in that percentile and the average for each year (2000-2015)

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1 **Table 3. Averages of variables by three scenarios for Charleville-Longreach region**

Variable	Historical	Predation exclusion	Plus kangaroo reduction
Death rate (adult sheep)	9.2	5.5	5.5
Lambing rate (%)	61 ^A	85	85
Marking rate (%)	49	67	67
Increase in adult sheep no. (%)		0	21
Increase in revenue (%) ^B		11	37

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4 slightly higher due to recent prices.
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For Review Only

1 **Table 4. Averages of variables by three scenarios for the West and South West region**

Variable	Historical	Predation exclusion	Plus Kangaroo reduction
Death rate (adult sheep)	10	5.9	5.9
Lambing rate (%)	57	83	83
Marking rate (%)	45	67	67
Increase in adult sheep no. (%)		0	27
Increase in revenue (%)		12	34

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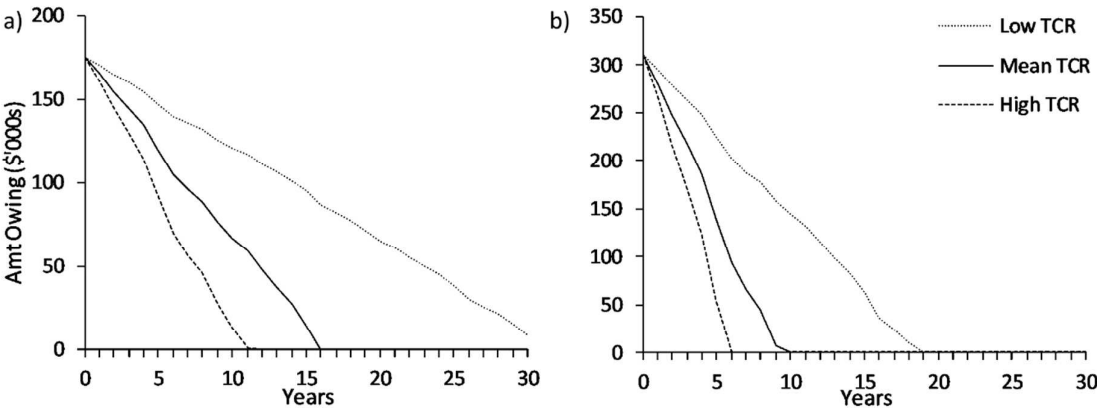


Fig. 3: Payment schedule for loan with 50% subsidy, no interest, 5% (of revenue) repayment rate and 40% improvement in Total Cash Receipts for: a. small and b. large, sheep farms.

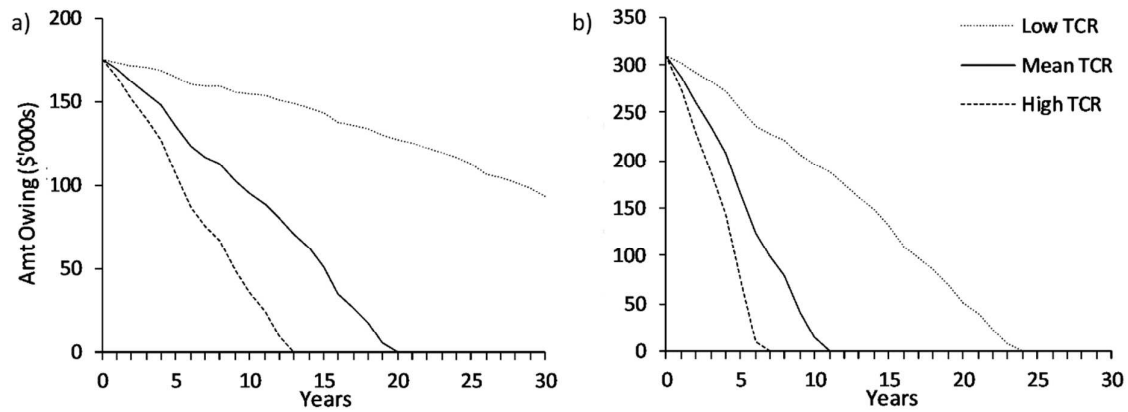
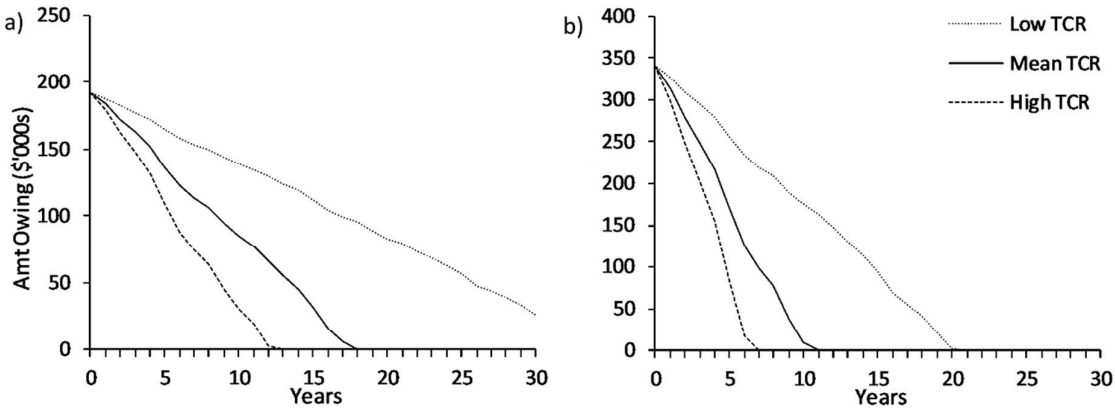


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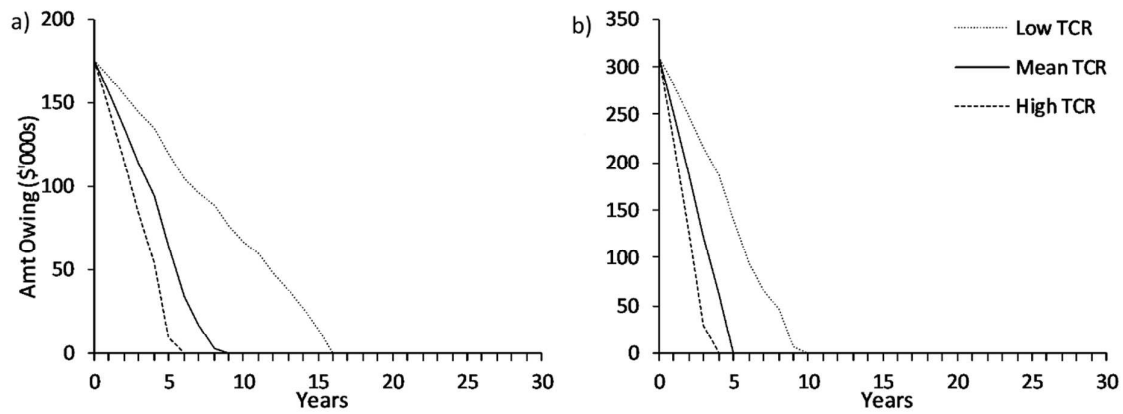


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1 **Table 5. Repayment projections (years) under different policy options**

2

Farmer contribution (% of total cost)	0%			25%			50%			75%		
Farm Size (Small, medium, large)	S	M	L	S	M	L	S	M	L	S	M	L
Interest rate												
0%	30+	24	19	26	18	15	16	12	10	9	6	5
1%	30+	26	21	28	19	16	18	13	10	9	6	5
2%	30+	30+	24	30+	22	17	20	14	11	9	6	5
Surcharge												
5%	30+	26	20	26	19	15	17	13	10	9	6	5
10%	30+	26	21	26	19	16	18	14	11	9	6	5

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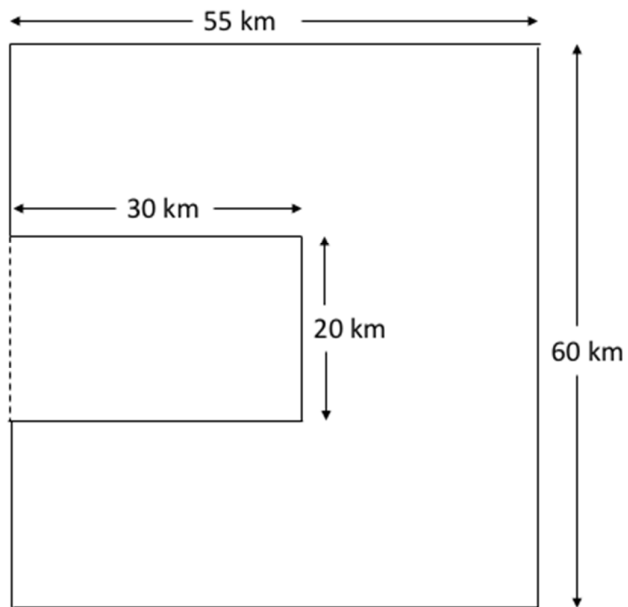


Fig. 7. A hypothetical fenced property with the potential for a later addition.

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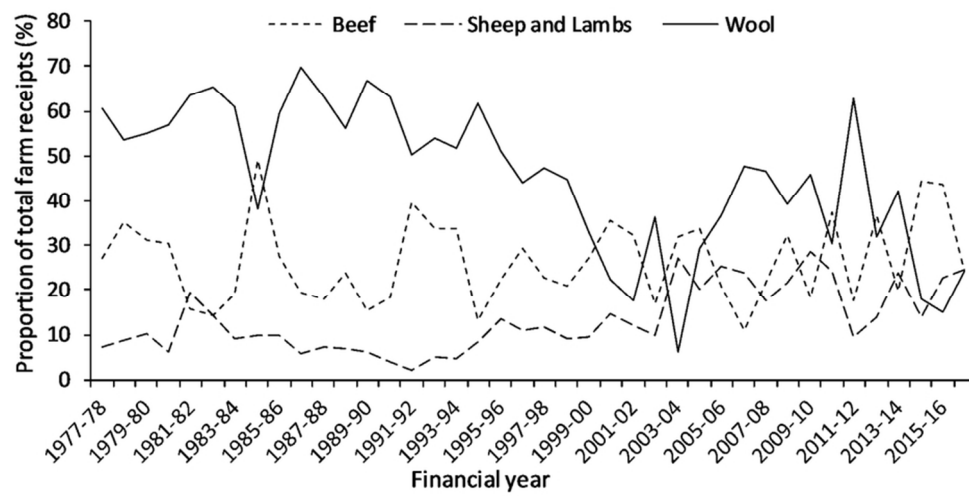


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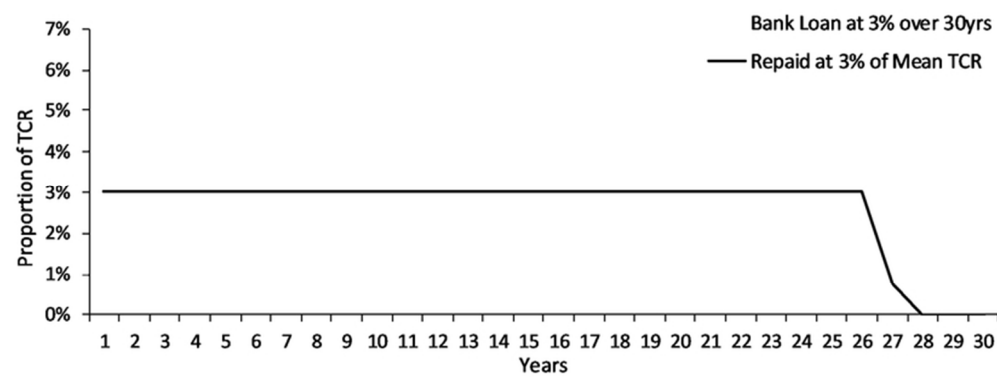


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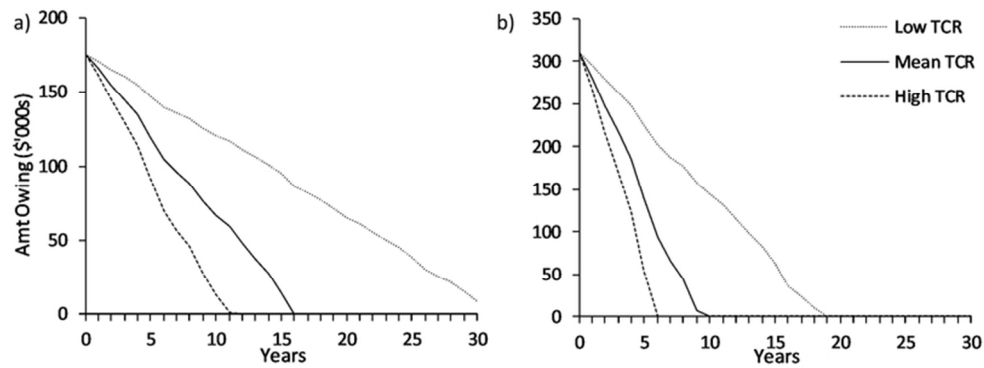


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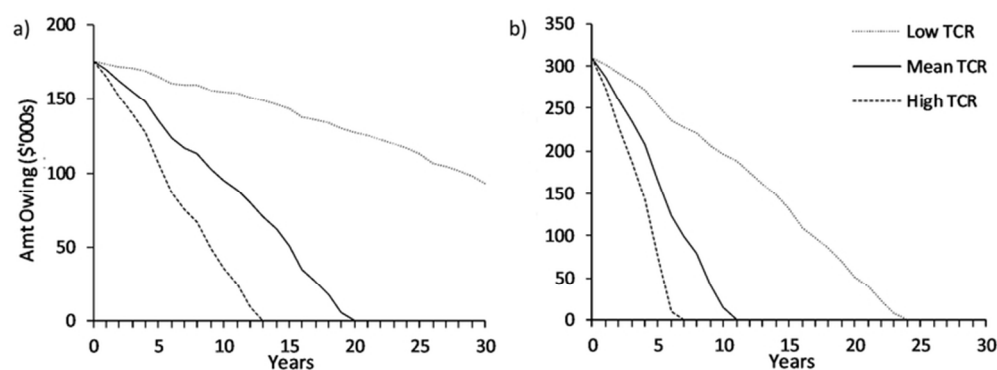


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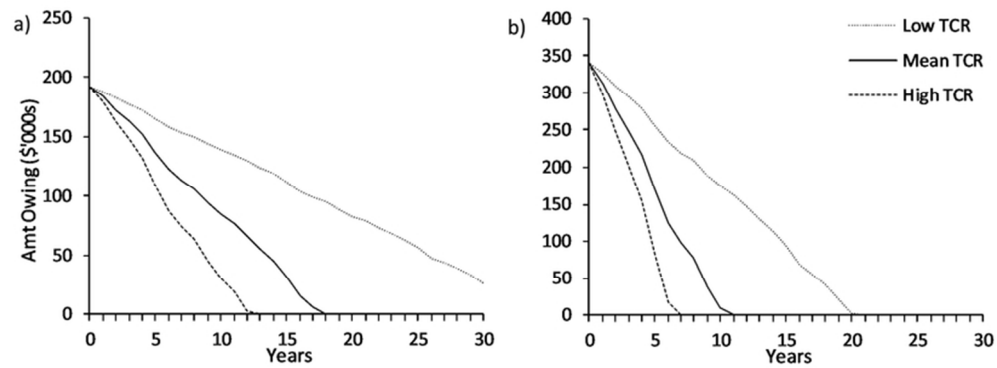


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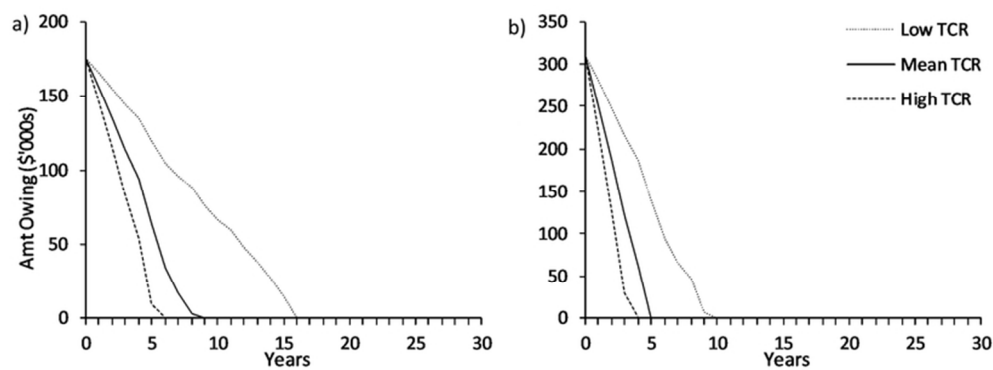


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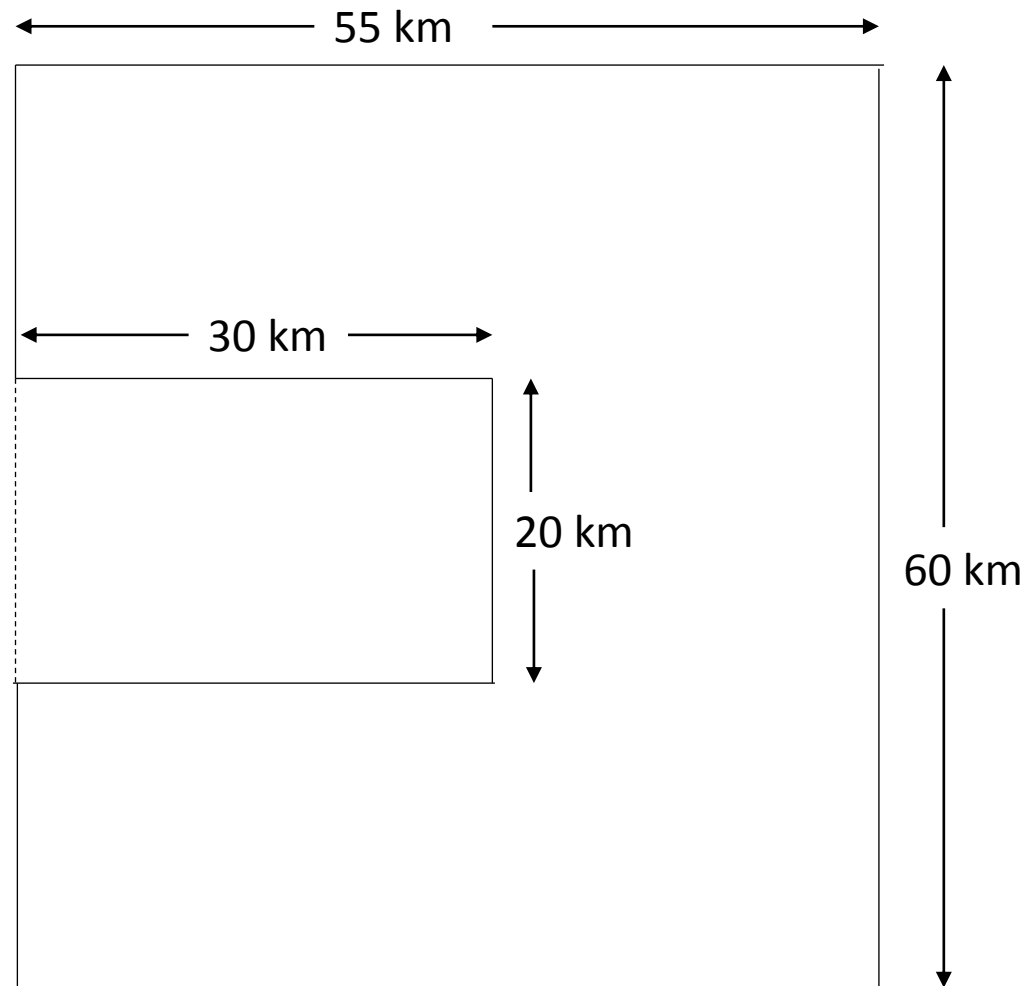


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