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# Estimating the economic impact of feral pigs in the Whitsunday Regional Council

Final report to Whitsunday Regional Council

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# Executive Summary

Feral pigs cause significant damage to agricultural producers in the Whitsunday Regional Council (WRC) area, particularly in the livestock, sugarcane and horticulture sectors. Costs incurred by producers attributable to feral pigs include loss of production value and damage to on-farm infrastructure and equipment.

Synergies Economic Consulting (Synergies) has been engaged by WRC to estimate the economic impact of feral pig damage on the region's agriculture sector. This includes quantifying the direct economic cost imposed by on the sector and the wider regional economic impacts attributable to the loss of production and damage costs incurred as a result of feral pigs.

The estimation of the economic impact of feral pig damage was underpinned by consultation with producers in the region. Sector-specific survey instruments were developed and administered by WRC Land Protection Officers through a combination of telephone and face-to-face discussions with agricultural producers. The survey was administered to ten livestock graziers, eight sugarcane growers and six horticulture growers.

The information obtained from this consultation process was combined with information and data obtained from desktop research to develop scenarios for the damage caused to agricultural enterprises by feral pigs within the region. This information was then used, in combination with Synergies' in-house net margin crop models, to estimate the economic cost of feral pig damage on producers in the three sectors.

The table below sets out the total annual economic cost imposed on livestock producers within the region as a result of feral pig damage. The table shows that the reduced cattle sale weight due to the adverse impacts of feral pigs on cattle herds (e.g. disease) accounts for the majority of the economic cost imposed on producers.

**Total annual cost of feral pig damage on livestock producers in the WRC region**

| Cost impact | Total annual cost for livestock producers | | |
|---|---|---|---|
| | Low scenario | Medium scenario | High scenario |
| Reduction in cattle sale weight | $635,176 | $1,587,940 | $3,175,880 |
| Reduced calving rate | $780,493 | $780,493 | $780,493 |
| Vaccination | $27,799 | $27,799 | $27,799 |
| Feed Supplements | $132,243 | $132,243 | $132,243 |
| On-farm infrastructure | $135,961 | $135,961 | $135,961 |
| TOTAL IMPACT | **$1,711,671** | **$2,664,435** | **$4,252,376** |

Source: Synergies analysis.

Survey responses revealed that feral pigs imposed costs on sugarcane growers through a loss of sugarcane yields and damage costs to on-farm irrigation infrastructure. The table below sets out the estimates for the annual cost attributable to the loss of cane yields for an average cane farm in the WRC region.

**Annual cost of loss of cane yield due to feral pig damage (based on average cane farm)**

| Cane rotation | Total revenue without feral pig damage | Total revenue with feral pig damage | Annual revenue lost per cane farm | Region-wide annual cost |
|---|---|---|---|---|
| Plant Cane | $61,200 | $60,710 | $490 | $109,670 |
| Ratoon 1 | $59,040 | $58,568 | $472 | $105,800 |
| Ratoon 2 | $57,600 | $57,024 | $576 | $129,024 |
| Ratoon 3 | $56,160 | $55,430 | $730 | $163,538 |
| Ratoon 4 | $54,000 | $53,190 | $810 | $181,440 |
| **TOTALS** | **$288,000** | **$284,922** | **$3,078** | **$689,472** |

**Note:** The regional impact is based on a farm population of 224 and a total planted area of 20,160ha. The estimates have been derived based on the characteristics for an 'average' cane farm in the region with a cropped area of 90 hectares and a cane yield of 80 tonnes per hectare.

**Source:** Synergies analysis.

In addition to the above, the total region-wide cost of repairs to on-farm irrigation infrastructure and additional fencing costs attributable to feral pigs was estimated at $147,414 per annum, which results in a total region-wide annual cost estimate of $836,886 for the sugarcane sector.

For the horticulture sector, the economic cost of feral pig damage was estimated by establishing crop-specific estimates for the area of crop area damaged by feral pigs and applying Synergies' in-house crop models to estimate the lost production. These estimates are set out in the table below.

**Annual cost of loss of crop yield for horticulture growers due to feral pig damage**

| Crop | Total revenue without feral pig damage | Total revenue with feral pig damage | Region-wide annual cost |
|---|---|---|---|
| Mangoes | $18,402,712 | $18,356,705 | $46,007 |
| Melons | $18,402,712 | $18,034,657 | $368,055 |
| Capsicum | $110,056,159 | $107,855,036 | $2,201,123 |
| Pumpkins | $6,748,727 | $6,512,521 | $236,206 |
| Corn | $21,803,579 | $21,727,266 | $76,313 |
| Beans | $70,602,064 | $70,249,054 | $353,010 |
| Tomatoes | $191,040,879 | $190,276,716 | $764,163 |
| **TOTAL** | **$437,056,830** | **$433,011,954** | **$4,044,876** |

**Note:** The regional impact is based on a total planted area of 12,800 ha.

**Source:** Synergies analysis.

The table below summarises the estimates for the total annual cost of feral pig damage on agricultural enterprises across the livestock, sugarcane and horticulture sectors.

**Total annual economic cost of feral pig damage on agricultural producers in the WRC region**

| Category | Livestock | Sugarcane | Horticulture | Total |
|---|---|---|---|---|
| Lost productivity | $2,368,433 | $689,472 | $4,044,876 | $7,102,781 |
| Infrastructure damage and fencing costs | $135,961 | $147,414 | - | $283,375 |
| Feed replacement | $132,243 | | | $132,243 |
| Livestock vaccination | $27,799 | | | $27,799 |
| **TOTAL** | **$2,664,435** | **$836,886** | **$4,044,876** | **$7,546,197** |

In addition to this direct economic cost, loss of production and damage caused by feral pigs to agricultural enterprises also has wider economic impacts on the region through reduced production and employment in the agriculture and related sectors. We have applied Synergies' conventional I-O model to estimate these regional economic impacts. The table below sets out the regional economic impacts estimated from the loss of output of $9.13 million per annum from the region's agricultural industry (i.e. the region-wide cost estimate under the 'high' scenario for the reduction in cattle turn-off weights).

**Regional economic impacts of feral pig damage**

| | Indicator | Direct losses | Indirect losses | Total losses |
|---|---|---|---|---|
|  | **Output** | **$9.13 million** | **$3.45 million** | **$12.58 million** |
|  | **Value add (or GRP)** | **$4.51 million** | **$1.45 million** | **$5.96 million** |
|  | Wages paid | $0.78 million | $0.54 million | $1.32 million |
|  | Operating surplus and mixed income | $3.5 million | $0.84 million | $4.34 million |
|  | Taxes less subsidies | $0.23 million | $0.08 million | $0.31 million |
|  | **Employment** | **16 FTEs** | **9 FTEs** | **25 FTEs** |

**Source:** Synergies modelling.

# Contents

# Figures and Tables

# 1 Introduction

Feral pigs represent a significant issue for agricultural producers across many parts of regional Queensland, including in the Whitsunday region. Damage caused by feral pigs imposes significant additional costs on producers, such as repairs to on-farm infrastructure and increased fencing and crop protection requirements and can result in a loss of productive output (e.g. loss of crop yield, reduced cattle weights due to disease).

The Whitsunday Regional Council (WRC) has responded to this problem by coordinating a number of feral animal control activities, including trapping, baiting, and aerial shooting. However, despite these efforts, feral pigs continue to represent a significant constraint on the value of agricultural production in the region. WRC has subsequently engaged Synergies Economic Consulting (Synergies) to estimate the economic impact of feral pigs on the agriculture sector within the region. The scope of this analysis includes quantifying the economic cost and regional economic impact of feral pigs on sugarcane, horticulture and grazing enterprises.

The assessment has involved two key components:

1) Quantification of the direct cost imposed by feral pigs on agricultural producers in the Whitsunday region. This includes loss of output and the increased cost of operations due to the impact of feral pigs; and

2) Estimation of the wider regional economic impacts of this loss of agricultural production value using our in-house input-output (I-O) model for WRC. This model assesses the loss of regional output, gross regional product (GRP) and employment as a result of the damage caused by feral pigs.

The analysis has been informed by consultation with agricultural producers in the region. This consultation has been conducted by WRC Land Protection Officers.

The rest of this report is structured as follows:

- section 2 sets out the approach to undertaking the study;
- section 3 summarises the stakeholder consultation process undertaken;
- section 4 quantifies the direct economic cost of feral pig damage to agricultural production in the WRC; and
- section 5 details the estimation of the regional economic impact of the estimated feral pig damage.

The report also includes three attachments as follows:

- Attachment A sets out all assumptions underpinning the modelling of the direct economic cost to the agriculture sector;
- Attachment B details the I-O table generation process for WRC; and
- Attachment C contains the survey administered to agricultural producers.

# 2 Approach

The project comprised of four key steps, as set out below.

## 2.1 Development of a survey instrument

Quantifying the economic cost of feral pig damage on the agriculture sector within a region requires detailed information on the specifics of firstly the adverse impacts of feral pigs on agricultural producers and secondly how this damage impacts on the economic return derived from agricultural production.

A survey instrument was developed to obtain the information necessary to conduct the economic cost and impact modelling required to quantify the adverse impacts of feral pigs on the region's agriculture sector.

## 2.2 Administering of the survey

The survey was administered by Council Land Protection Officers. The survey was administered through a combination of telephone and face-to-face discussions with agricultural producers. Further information on the information obtained from the survey process is contained in section 3.

## 2.3 Modelling economic cost of feral pig damage

The information obtained from the survey process was used, in combination with other information (obtained through desktop research or acquired by Synergies in past projects) to model the direct economic cost of feral pig damage to agricultural producers in the Whitsunday region. Separate models were developed for sugarcane, horticulture and livestock producers. The economic cost of feral pig damage was quantified as an increase in the cost of production and/or the loss of productive output for agricultural producers. Further information on the modelling of the direct economic cost of feral pig damage

## 2.4 Modelling the regional economic impacts of feral pig damage

Modelling the regional economic impacts of the loss of value in the agriculture sector due to feral pig damage requires a two-step process:

1) Development of an I-O model for the Whitsunday region, using our conventional regional I-O table generation process documented in attachment C; and

2) Tracing the direct as well as additional economic costs associated with feral pig damage to their source using the I-O framework. This produces estimates for the loss of regional output, GRP and employment.

# 3 Summary of stakeholder consultation

This section provides an overview of the consultation undertaken with agricultural producers in the region and summarises the key data and information obtained from the consultation.

## 3.1 Overview of producer surveys

As described in the preceding section, the quantification of the economic cost of feral pig damage on the agriculture sector within the Whitsunday region was informed by data and information collected from agricultural producers. A survey instrument was developed as part of the initial stage of the project and was administered to producers by WRC Land Protection Officers. The survey template is provided in Attachment A.

The survey was administered to the following:

- ten livestock graziers
- eight sugarcane growers
- six horticulture growers.

The survey responses for each producer category are summarised in the following sections.

## 3.2 Livestock producers

Table 1 summarises the responses received from the ten livestock producers surveyed.

**Table 1 Summary of livestock producers' survey responses**

| Producer | Trends in numbers of pigs | Type of damage | Cost of pig damage | Pig control measures |
|---|---|---|---|---|
| Producer #1 | Decreasing. Pig numbers have been low since WRC aerial shooting program started. | Digging to pasture and dams. | Cattle reluctant to drink when dam edges are muddy. This reduces weight gain. Lick blocks and molasses eaten by pigs. | Ground shooting. |
| Producer #2 | Increasing this wet season. Lots of small pigs. No large pigs. WRC aerial shooting program has made a difference since it started. | Digging to pasture, dams and creeks.<br>Four trough floats damaged per year plus labour costs to replace.<br>Sorghum crop eaten and trampled.<br>Dead pigs need to be removed from troughs and dams. | 2019 sorghum crop damaged approx. 3%. 20tx $330/t = $6600. 2020 crop size has increased 3 times. Anticipating 3% damage to this year's crop.<br>Need to vaccinate cattle for leptospirosis @ $1.30/ head. | Allow recreational pig hunters with dogs. |

| Producer | Trends in numbers of pigs | Type of damage | Cost of pig damage | Pig control measures |
|---|---|---|---|---|
| Producer #3 | Decreasing. WRC aerial shooting program has reduced pig numbers. | Digging to pasture, dams and creeks.<br>Digging up infrastructure of Bowen River Rodeo Ground.<br>Disturbance causes weed spread.<br>When pigs were bad pre aerial program, some paddocks were not drivable due to pig digging. | Use machinery to repair damage to roads and pasture. | Ground shooting. Baiting. |
| Producer #4 | Decreasing. | Digging to pasture and waterways. | Digging removes good pasture for 12 months. | Trapping approx. 30-50 pigs per year. |
| Producer #5 | Decreasing dramatically since WRC aerial shooting program began. | Erosion to gullies, pasture digging. | 15yr ago forage sorghum production had to stop due to feral pig damage. Lick blocks and molasses eaten by pigs. | Baiting, ground shooting. |
| Producer #6 | Some recent years increasing. WRC aerial shooting program has kept them down in 2019. | Mainly crop damage. Sorghum, chickpeas. Digging to dams and infrastructure. | When pigs were bad $50,000 damage to crops. Some consumption of lick blocks and molasses. | Ground shooting. |
| Producer #7 | Increasing over the years but the WRC aerial shooting program is making a difference. | Creek erosion, crop damage. Road, Infrastructure damage. | Infrastructure repair. Lick block, molasses consumption.<br>Need to vaccinate for Leptospirosis.<br>Pigs damage crops by eating and trampling.<br>Pigs consume and mess up silage pits. | 1080 baiting, ground shooting. |
| Producer #8 | Decreasing. The WRC aerial shooting program has reduced numbers | Creek erosion, Road, Infrastructure damage.<br>Digging up dams. | Digging up pasture reduces feed available to cattle.<br>The biggest cost is the potential for pigs to spread diseases like foot and mouth. | Ground shooting. |
| Producer #9 | Decreased after the WRC aerial shooting in 2019. Expecting similar numbers for 2020 if no aerial shooting occurs. | Damage to crops like sorghum and chickpeas. Digging around dams and creeks. | If not controlled, they can wipe out large quantities of crop. This can be worth hundreds of thousands. | Ground shooting. |
| Producer #10 | Decreasing since the start of the WRC aerial shooting program. | Water way erosion. Digging around dams. Pasture, lick block, molasses consumption. | Pasture, lick block, molasses consumption. Pigs hunt weaners away from molasses troughs. This limits growth. | Ground shooting. |

**Source:** Based on information collected by WRC Land Protection Officers.

## 3.3 Sugarcane growers

Table 2 summarises the responses received from the eight sugarcane growers surveyed.

**Table 2 Summary of sugarcane growers' survey responses**

| Topic | Grower #1 | Grower #2 | Grower #3 | Grower #4 | Grower #5 | Grower #6 | Grower #7 | Grower #8 |
|---|---|---|---|---|---|---|---|---|
| Location | Bloomsbury | Kelsey Creek | Silver Creek | Andromache River | Bloomsbury | Gregory River | Lethebrook | Andromache River |
| Farm area | 200 ha | 350 ha | 300 ha | 400 ha | 300 ha | 140 ha | 200 ha | 100 ha |
| Est. no. pigs on farm | - | - | >100 | - | - | - | - | >100 |
| Crop damage due to feral pigs | 5 ha | 5-10 ha with 1-5% of crop yield lost (total yield of 70-80t per ha) | 20-30 ha impacted with average loss of yield of 10% | 10 ha damaged with loss of yield of 1-2% | Approx. 1,500 tonnes of cane lost annually | - | - | - |
| Infrastructure damage due to feral pigs | Nil | Nil | Damage caused to furrows – need to reform. Total impact on net profit of 5-10% | Damage to flood irrigation requiring machinery to repair | Nil | Nil | Nil | Damaged furrows |
| Control activities | $15,000 of fencing installed for pig control last year | Pig removal – 10-20 removed per year | Nil | Pig removal | 5km fencing installed last year for pig control<br>Pig removal | Nil | Nil | Nil |

**Source:** Based on information collected by WRC Land Protection Officers.

## 3.4 Horticulture growers

Table 3 summarises the responses received from the six horticulture growers surveyed.

**Table 3 Summary of horticulture growers' survey responses**

| Topic | Grower #1 | Grower #2 | Grower #3 | Grower #4 | Grower #5 | Grower #6 |
|---|---|---|---|---|---|---|
| Location | Gumlu | Gumlu | Gumlu | Bowen | Guthalungra | Bowen |
| Crops produced | Capsicums, pumpkins, mangoes | Capsicums, melons, pumpkins, sorghum, mangoes | Melons, pumpkins | Green beans, sweet corn, baby corn, organic vegetables | Melons, capsicums | Small crops (capsicums, melons, etc.) |
| Areas of crop planted (18/19) | 1,500 ha | 600 ha | 450 ha | 1,100 ha | 250 ha | 1,200 ha |
| Est. no. pigs on farm | >100 | 40 | 110 | 22 | 20-30 | >65 |
| Recent trends in no. of pigs | Decreased by 60-80% last 6 years | Same for the last 3 years | Numbers have been decreasing | Decreased by approx. 60% over the past 3 years | Increasing over the past 3 years | Increased by 10 times in 2018/19 |
| Crop damage due to feral pigs | Significant areas of mangoes | 5-10 ha of melons and capsicums | 10 ha of crops damaged in 2019 (down from 60 ha in 2017 and 30 ha in 2018) | 3 ha of corn and beans in 2019 (down from 20 ha in 2017 and 10 ha in 2018) | 5-10 ha of melons and capsicums | 15% of planted area of pumpkins have been damaged |

| Topic | Grower #1 | Grower #2 | Grower #3 | Grower #4 | Grower #5 | Grower #6 |
|---|---|---|---|---|---|---|
| Infrastructure damage due to feral pigs | Nil | Nil | Trickle tape and plastic has been rooted up – cost of damage in 2019 of $25,000 (down from $60,000 in 2017 and $50,000 in 2018) | Trickle tape damaged by feral pigs | Nil | Approx. $10,000 of damage to fencing in 2019 |
| Other damage | Nil | Nil | Increased biosecurity hazard from spread of disease | Increased biosecurity hazard from spread of disease<br>Streambank erosion from rooting up river banks | Rooting up ground | Exacerbate spread of weeds |
| Control activities | Fences have prevented damage to capsicums and pumpkins<br>Baiting and shooting activities conducted by neighbouring landholder | Nil | 500 ha of fencing – total replacement cost of ~$150,000 | Aerial shooting<br>10km of fencing has been erected – total replacement cost of ~$50,000 | Aerial shooting | Shooting and fencing<br>Replacement cost of fencing attributable to feral pigs estimated at $10,000 |

**Source:** Based on information collected by WRC Land Protection Officers.

# 4 Economic cost of feral pig damage

This section sets out the quantification of the lost economic value of agriculture production in the Whitsunday region due to the impacts of feral pigs.

## 4.1 Approach

Feral pigs impose costs on agricultural producers in two ways:

- increasing the cost of production (i.e. damage to infrastructure, the cost associated with control measures, increased disease treatment requirements, etc.); and
- loss of output (i.e. loss of crop, reduced weight of livestock).

Quantifying the lost economic value of agricultural production in the Whitsunday region attributable to feral pigs requires the data and information obtained from agricultural producers in the region (see section 3) to be extrapolated across all agricultural producers in the region.

This was achieved by taking the information obtained through the consultation process and, combining this with other information (e.g. net margin models for key crops), develop various scenarios in terms of the adverse impacts of feral pigs on producers. The economic cost of each of these scenarios can then be quantified and, based on data provided by the WRC in terms of the breakdown of the regional agriculture sector, extrapolated across the region to derive an overall estimate for the economic cost of feral pig damage.

## 4.2 Modelling scenarios and parameters

Estimating the economic cost of feral pig damage on the agriculture sector in the WRC region required representative enterprises and scenarios to be developed for each key sector. The development of these enterprises and scenarios required several assumptions to be made, as set out in the sections below, and were developed using a combination of information obtained through consultation with producers, particularly in relation to the physical impacts of feral pigs on the farm, and recent analysis undertaken by Synergies as part of other recent projects. For example, Synergies' in-house net margin crop models for key crops (e.g. sugarcane, tomatoes, melons) have been used to estimate the economic cost of crop damage. The representative enterprises have also been informed by information published by the WRC in a 2015 brochure on agricultural production in the region.

### 4.2.1 Livestock industry

*Representative enterprise*

The economic impact of feral pigs on the livestock industry in the WRC has been modelled based on Store Weaner production.[1] While we recognise that other types of beef enterprises are undertaken in the region, the operation of a breeding herd appears to be the most common enterprise. The enterprise was assumed to have an average herd size of 635 head (adult equivalents).[2] The structure of the herd for the representative enterprise is set out in Table 4.

**Table 4 Herd Structure (per property) for the representative enterprise**

| Category | % of Herd[a] | AE's | No. of animals |
|---|---|---|---|
| Weaners | 12% | 75 | 159 |
| Heifers | 22% | 140 | 193 |
| Breeders | 64% | 406 | 462 |
| Bulls and other | 2% | 13 | 9 |
| **TOTAL HERD** | **100%** | **635** | **823** |

**a** *The Economics of beef in Central Queensland*, DAFF

AE's conversion factors based on Table 1 in *The Economics of beef in Central Queensland*, DAFF, 2007.

Table 5 sets out the parameter estimates adopted in terms of sale weights, turn-off percentages and sales prices for each product category for the representative enterprise.

**Table 5 Sale weights, prices and cattle turn-off percentages for the representative enterprise**

| Category | Sale weight (kg LWT/CWT)[a] | Turn-off %[b] | Sale prices ($/kg)[c] |
|---|---|---|---|
| Weaners | 200 (LWT) | 100 | 3.20 |
| Heifers | 186 (CWT) | 30 | 4.50 |
| Breeders | 200 (CWT) | 10 | 5.00 |
| Bulls and other | 350 (CWT) | 0 | 4.50 |

**a** East, M. *Estimating the economic implications for grazing properties in the Mackay Whitsunday catchments of practice changes to more sustainable landscapes.* DAFF. February 2010.

b Based on Table 3 *The Economics of beef in Central Queensland*, DAFF, 2007.

c https://www.mla.com.au/prices-markets/market-reports-prices/

[1] East, M. *Estimating the economic implications for grazing properties in the Mackay Whitsunday catchments of practice changes to more sustainable landscapes*. DAFF. February 2010.

[2] This value has been set to be consistent with the WRC's 2015 Agricultural brochure.

*Impact of feral pigs on cattle weight gain*

The damage caused to cattle by feral pigs can ultimately be characterised either as a reduction in the sale weight[3] of cattle or a delay in cattle turn-off. For simplicity, we have modelled the economic cost of feral pig damage on livestock enterprises in the region based on the former. That is, all adverse impacts of feral pigs on cattle herds are estimated based on a loss of cattle sale weight.

None of the survey responses provided estimates of the average loss of cattle sale weight attributable to feral pigs and a review of the relevant literature failed to produce any direct reference or estimates. Choquenot et al (1996) made reference to a long-term loss of pasture availability of less than 3% in dry arid zones but much greater (up to 98%) on rooted areas in more stable environments such as northern New South Wales.

Noting the above, the following assumptions have been applied to model the economic cost of feral pigs on livestock producers in the WRC area:

- lower weight loss – 1% lower turn-off weights for store weaners and surplus heifers;
- average level of weight loss – 2.5% lower turn-off weights for store weaners and surplus heifers; and
- higher level of weight loss – 5% lower turn-off weights for store weaners and surplus heifers.

These reductions in turn-off weights, i.e. around 5kg for a weaner under the average level of weight loss assumption, are small relative to what can be achieved through improved management practices as shown in East[4] where increases of 14kg in sale weights are achievable with improvements in pasture management. Therefore, the estimates used in this analysis may be conservative estimates of the impact of feral pigs on turn-off weights.

*Impact of feral pigs on calving rates for livestock herds*

Feral pigs adversely affect calving rates in livestock herds by reducing fertility rates as a result of disease and directly predating on calves. Quantifying this cost impact requires an assumption to be applied to the reduction in the average calving rate attributable to

[3] Choquenot, D., McIlroy, J. and Korn, T. (1996) Managing Vertebrate Pests: Feral Pigs. Bureau of Resource Sciences, Australian Government Publishing Service, Canberra.

[4] East, M. *Estimating the economic implications for grazing properties in the Mackay Whitsunday catchments of practice changes to more sustainable landscapes*. DAFF. February 2010. Appendix 2

feral pigs. Based on advice provided by WRC, a percentage reduction of 2 per cent has been applied to estimate this cost impact.[5]

*Cost of replacing feed supplements i.e. lick blocks and molasses*

The loss of cattle sale weight discussed above relates generally to the destruction of crops and pasture used to rear weaners and heifers to turn-off age, i.e. three to six months and one to two years respectively. In addition, several respondents mentioned the loss and destruction of supplementary feed such as molasses. The replacement of these feed supplements imposes a cost on livestock producers. We have estimated this impact based on a 2% loss across all classes of cattle at a cost of $20 per head per year.[6]

*Vaccination for leptospirosis*

While vaccination for leptospirosis is commonly practiced on beef properties in the region, some respondents indicated the potential for increased incidence of leptospirosis in the presence of feral pig infestation and hence an increased need for vaccination. An increased frequency of vaccination of 10% for breeders has been used to estimate this cost impact.

The cost of vaccination was estimated at $1.30 per head based on survey responses. An estimate of $1.20 per head, based on the indexation of DAFF's 2007 report,[7] supported the value provided by survey respondents.

*Repairs to damaged water infrastructure*

Eighty percent of survey respondents stated that feral pigs cause significant damage to on-farm water infrastructure, including farm dams and water courses. This damage requires repair work to be undertaken using a tractor and other earthmoving equipment. The parameters applied to estimate this cost impact are set out in Table 6.

[5] A reduced calving/weaning rate due to the impact of feral pigs also translates to a reduction in cattle feed costs. This cost saving has been estimated at $27 per head. See: NSW DPI Livestock Gross margin Budgets https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/175534/14-Inland-weaners.pdf Inland Weaner Gross Margins

[6] Based on Table 4 The Economics of beef in Central Queensland, DAFF, 2007.

[7] The Economics of beef in Central Queensland, DAFF, 2007, Appendix 2 – Variable cost inputs.

**Table 6 On-farm infrastructure repair costs on livestock properties**

| Parameter | units | Value |
|---|---|---|
| Repair hrs[8] | hrs/annum | 5.0 |
| Labour cost[9] | $/hr | $33.18 |
| Equipment cost[10] | $/month | $1,360 |
| Equipment cost | $/hr | $8.50 |
| F.O.R.M.[11] | $/hr | $35.00 |
| Frequency of Occurrence | % | 90.0% |

### 4.2.2 Sugar industry

*Representative enterprise*

The economic impact of feral pig damage on sugarcane producers has been modelled based on a representative enterprise with the following characteristics:

- total area of cane planted of 90 hectares
- average cane yield of 80 tonnes per hectare.[12]

*Feral pig related crop losses*

Loss of crop yield is the most significant impact of feral pigs on sugarcane farms. Past analysis has estimated that around 0.15% of the region's total sugarcane production was lost to feral pig damage in the early 1980s (noting that the number of feral pigs in the region has increased significantly over the past 40 years).[13] Based on the literature, mature cane plants with a higher sugar content are more prone to feral pig damage. In addition, while damage to roots of plant cane may have a lower immediate impact on cane yields, this permanent damage to the crop can result in greater yield loss throughout the crop's ratoon cycle. These two effects are the basis of the yield loss assumptions detailed in Table 7.

8 Estimate derived based on survey responses.

9 Based on the Pastoral Award 2010 dated 27 June 2019 and http://qeas.com.au/entries/general/the-true-cost-of-employment.

10 Synergies estimate based on $100,000 tractor over 10 years at 10% interest.

11 Fuel oil repairs and maintenance based on https://www.AgMargins.net.au

12 Based on 2015 WRC Agriculture Brochure.

13 Choquenot, D., McIlroy, J. and Korn, T. (1996) Managing Vertebrate Pests: Feral Pigs. Bureau of Resource Sciences, Australian Government Publishing Service, Canberra. Page 37

**Table 7 Cropping losses for sugarcane growers due to feral pig infestation**

| | Area (ha) | Yield (tc/ha) | Area impacted (%)[a] | Yield Loss on damaged area (%)[a] | On-farm return ($/tc)[b] |
|---|---|---|---|---|---|
| Plant Cane | 18.0 | 85.0 | 10.0% | 8.0% | $40 |
| Ratoon 1 | 18.0 | 82.0 | 10.0% | 8.0% | $40 |
| Ratoon 2 | 18.0 | 80.0 | 10.0% | 10.0% | $40 |
| Ratoon 3 | 18.0 | 78.0 | 10.0% | 13.0% | $40 |
| Ratoon 4 | 18.0 | 75.0 | 10.0% | 15.0% | $40 |

**a** Based on survey responses.

**b** Based on a current sugar price of $A480/t, $A/$US exchange rate of 0.67, a CCS of 13% and a constant of .6.

Sensitivity analysis has been performed on both the proportion of the crop area impacted and the yield loss, as follows:

- lower impact case – 5% of area/10% yield loss
- base impact case (as per Table 7) – 10% of area/15% yield loss
- high impact case – 18% of area/30% yield loss.

*Repairs to on-farm irrigation infrastructure*

Approximately one third of the survey respondents indicated that feral pigs cause damage to on-farm irrigation infrastructure, including irrigation headlands and furrows. While the yield impact of this damage is accounted for above, it is also necessary to estimate the cost of repairing the damaged infrastructure. These repairs are undertaken using a tractor and earthmoving attachment. The parameter estimates underpinning our estimation of this cost are detailed in Table 8.

**Table 8 Parameters for estimation of on-farm infrastructure repair costs on cane farms**

| Parameter | units | Value |
|---|---|---|
| Repair hrs[a] | hrs/annum | 3.5 |
| Labour cost[b] | $/hr | $33.18 |
| Equipment cost[c] | $/month | $1,360 |
| Equipment cost | $/hr | $8.50 |
| F.O.R.M[d] | $/hr | $35.00 |
| Frequency of Occurrence | % | 40.0% |

**a** Derived from survey responses.

**b** Based on the Pastoral Award 2010 dated 27 June 2019 and http://qeas.com.au/entries/general/the-true-cost-of-employment

**c** Synergies estimate based on $100,000 tractor over 10 years at 10% interest.

**d** Fuel oil repairs and maintenance based on https://www.AgMargins.net.au.

*Fencing costs*

Damage caused by feral pigs also results in some cane farmers installing additional fencing. These costs have been estimated based on information provided by the WRC, as set out in Table 9.

**Table 9 Parameters for estimating the annual cost of fencing on cane farms**

| Parameter | units | Value |
|---|---|---|
| Proportion of cane land fenced due to feral pigs | % | 2.0% |
| Fencing cost | $/km | $4,700 |
| Life of fencing | years | 10 |
| Cost per annum[a] | $/km | $765 |
| Total Area fenced | ha | 403 |
| Averaged Area fenced | ha/farm | 1.80 |
| Length of fencing per farm | m/farm | 720 |
| Total cost per farm (per annum) | $/farm | $551 |
| Total cost for the region (per annum) | $/farm | $123,364 |

**a** Based on 10 year expected life at 10% interest.
**Source:** Parameter estimates provided by the WRC.

### 4.2.3 Horticulture industry

*Regional cropping mix*

Estimating the economic cost imposed on horticultural producers by feral pig damage requires a representative cropping mix to be established for the region. While tomatoes and capsicums are the two dominant crops and account for around 65% of total horticultural production in the region, a range of other crops are also grown, including green beans, sweet corn, mangoes, melons, and pumpkins.

Table 10 includes those crops identified by survey respondents as being damaged by feral pigs. The table also contains the estimated annual production of each crop in the WRC region based on the 2015 Agricultural Brochure. These crops account for approximately 53% of total horticultural production in the region.

**Table 10 Horticulture crops identified by survey responses**

| Crop | 2015 production[a] ($ million) | Proportion of total crop mix (%) |
|---|---|---|
| Capsicum | 106 | 45% |
| Beans | 68 | 29% |
| Sweet Corn | 21 | 9% |
| Mangoes | 18 | 7% |
| Melons | 18 | 7% |
| Pumpkins | 6.5 | 3% |

| Crop | 2015 production[a] ($ million) | Proportion of total crop mix (%) |
|---|---|---|
| **Total production** | **$237.5[b]** | **100%** |

**a** Based on WRC 2015 Agricultural Brochure.

b Approximately 53% of total horticultural output of the region.

**Source:** WRC 2015 Agricultural Brochure and survey responses.

*Feral pig-related crop losses*

Table 11 sets out the parameter estimates underpinning the estimation of the economic cost associated with crop damage caused by feral pigs. The parameters relating to the crop production metrics (i.e. tonnages produced, average yield and average price) have been taken from Synergies' in-house crop models, developed as part of recent engagements with the Department of Natural Resources, Mines and Energy. The proportion of the crop impacted by feral figs has been taken from survey results.

The parameter estimates for area of crop impacted by feral pigs are based on survey responses received from horticulture growers. The estimates for the loss of crop yield on the impacted area are based on advice provided by WRC. It should be noted that feral pig damage can lead to a loss of crop yield through either:

- damaged fruit and vegetables having to be discarded as a direct result of feral pigs; or
- a reduction in the production of fruits and vegetables by trees and plants as a result of damage caused by feral pigs, either to the trees and plants or to irrigation infrastructure, both of which prevent trees and plants reaching full maturity.[14]

**Table 11 Parameters used to estimate crop losses in the horticultural sector**

| Crop | Est 2020 GVOP ($M) | Ave. Price ($/t) | Quantity Produced (t) | Area planted (ha) | Average Yield (t/ha) | Area Impacted (%) | Yield Loss on Impacted area (%) |
|---|---|---|---|---|---|---|---|
| Capsicum | 110.1 | 1,800 | 61,142 | 2,446 | 25.0 | 4.0% | 50% |
| Beans | 70.6 | 1,500 | 47,068 | 5,884 | 8.0 | 1.0% | 50% |
| Sweet Corn | 21.8 | 3,000 | 7,268 | 808 | 9.0 | 1.0% | 35% |
| Mangoes | 18.4 | 3,000 | 6,134 | 409 | 15.0 | 5.0% | 5% |
| Melons | 18.4 | 660 | 27,883 | 929 | 30.0 | 4.0% | 50% |
| Pumpkins | 6.7 | 500 | 13,497 | 519 | 26.0 | 7.0% | 50% |
| **Total** | **246.0** | **N/A** | **162,993** | **10,994** | **N/A** | **N/A** | **N/A** |

**Source:** Yield and Price information was based on recent research conducted by Synergies. The 2020 GVOP was calculated using the 2015 WRC value and indexed using ABARES Priced Received Indexes for fruit and vegetable crops.

[14] It should be noted that where feral pigs cause damage to irrigation infrastructure, particularly trickle or drip irrigation equipment commonly used by horticultural producers, the repair costs can also be material (in addition to the loss of crop yield). The survey responses received from growers did not contain sufficient information to enable this cost to be estimated and included in the economic cost and impact assessment.

*Scenario analysis*

The crop mix set out in the preceding tables, while based on the survey responses received, did not include the largest horticulture crop produced in the region – tomatoes. The annual value of tomato production in the WRC region is around $184 million, which accounts for around 41 per cent of total production.[15] As such, an additional scenario has been modelled in which the crop mix includes tomatoes. The parameters underpinning the estimation of the loss of economic output attributable to feral pig damage on this crop are detailed in Table 12. The area of tomato crops impacted is based on the weighted average of the other crops in the crop mix.

**Table 12 Parameters used to estimate crop losses for tomatoes**

| Crop | Est 2020 GVOP ($M) | Ave. Price ($/t) | Quantity Produced (t) | Area planted (ha) | Average Yield (t/ha) | Area Impacted (%) | Yield Loss on Impacted area (%) |
|---|---|---|---|---|---|---|---|
| Tomatoes | 191.0 | 1,540 | 124,053 | 1,772 | 70.0 | 2.4% | 40% |

**Source:** Yield and Price information was based on recent research conducted by Synergies. The 2020 GVOP was calculated using the 2015 WRC value and indexed using ABARES Priced Received Indexes for fruit and vegetable crops.

## 4.3 Economic cost estimates

The following cost estimates are based on the scenarios outlined in section 4.2.

### 4.3.1 Livestock industry

*Lower sale weight gains*

Table 13 sets out the estimates for the economic cost imposed on livestock producers as a result of the reduction in cattle sale weight attributable to feral pig damage. These cost estimates are based on the representative enterprise and parameter estimates detailed in section 4.2.1.

**Table 13 Annual cost of lower cattle sale weights due to feral pig infestation**

| Herd | Low impact | | Medium impact | | High impact | |
|---|---|---|---|---|---|---|
| | $ per head | $ per farm | $ per head | $ per farm | $ per head | $ per farm |
| Weaners | $6.40 | $1,016 | $16.00 | $2,540 | $32.00 | $5,080 |
| Heifers | $2.51 | $485 | $6.28 | $1,213 | $12.56 | $2,426 |
| Breeders | $1.00 | $462 | $2.50 | $1,155 | $5.00 | $2,309 |
| Bulls and other | $0.00 | $0 | $0.00 | $0 | $0.00 | $0 |
| **TOTAL HERD** | | **$1,963** | | **$4,908** | | **$9,815** |

**Source:** Synergies analysis.

[15] WRC 2015 Agricultural Brochure.

The estimates in the table above demonstrate that the majority of the cost impact is accounted for, both on a per head and per farm basis, by the reduced sale weight of weaners.

The total cost impact of reduced cattle sale weight on livestock producers across the WRC region has been estimated by applying the above estimates to the representative herd breakdown set out in Table 4 and the estimate of 394 livestock producers in the region. The total cost estimates are set out in Table 14.

**Table 14 Annual regional cost of reduced cattle sale weights due to feral pig infestation**

| Herd | Low Impact | Medium Impact | High impact |
|---|---|---|---|
| Weaners | $248,832 | $622,080 | $1,244,160 |
| Heifers | $178,984 | $447,460 | $894,920 |
| Breeders | $207,360 | $518,400 | $1,036,800 |
| Bulls and other | $0 | $0 | $0 |
| **TOTAL ANNUAL COST** | **$635,176** | **$1,587,940** | **$3,175,880** |

**Source:** Synergies analysis.

*Reduced weaning rates*

Feral pigs also adversely affect calving rates in livestock herds. This impact is a result a reduction in fertility rates due to the infestation of cattle with diseases carried by feral pigs and direct predation on calves by feral pigs. Based on the parameters set out in sections 3.2 and 4.2.1, the annual cost attributable to a reduction of 2 per cent in weaning rates is estimated at $1,981 for a representative enterprise, equating to $780,493 for all livestock producers in the WRC as shown in Table 15.

**Table 15 Annual regional cost of reduced weaning percentage due to Feral pig infestation**

| Herd | Impact |
|---|---|
| Reduction in Weaning % | 2.0% |
| No. of weaners lost | 3.24 |
| Value per Weaner | $640 |
| Feed and Vaccination cost saved | $29 |
| Total value lost/herd | $1,981 |
| **TOTAL ANNUAL COST - REGION** | **$780,493** |

*Other costs*

Table 16, 17 and 18 set out the estimates for the cost impacts of feral pig damage on livestock properties attributable to the replacement of feed supplements, increased vaccination costs, and additional repair costs in relation to on-farm infrastructure.

**Table 16 Regional cost of re-vaccination due to feral pig infestation ($)**

| Herd | Vaccination cost ($/hd/yr) | Herd Composition (hd) | Freq. of re-vaccination[a] (% of yrs) | Regional Impact ($/yr) |
|---|---|---|---|---|
| Weaners | $1.30 | 38,880 | 0 | $0 |
| Heifers | $1.30 | 71,280 | 0 | $0 |
| Breeders | $1.30 | 207,360 | 10% | $26,957 |
| Bulls and other | $1.30 | 6,480 | 10% | $842 |
| **TOTAL IMPACT** | | **324,000** | | **$27,799** |

**a** Synergies' estimate.

**Source:** Synergies analysis.

**Table 17 Regional cost of replacing feed supplements due to feral pig infestation ($)**

| Herd | Feed cost ($/hd/yr) | Herd Composition (hd) | Prop. Of feed supplements destroyed (%) | Regional Impact ($/yr) |
|---|---|---|---|---|
| Weaners | $20.41 | 38,880 | 2% | $15,869 |
| Heifers | $20.41 | 71,280 | 2% | $29,093 |
| Breeders | $20.41 | 207,360 | 2% | $84,635 |
| Bulls and other | $20.41 | 6,480 | 2% | $2,645 |
| **TOTAL IMPACT** | | **324,000** | | **$132,243** |

**a** Synergies' estimate.

**Source:** Synergies analysis.

**Table 18 Cost of repairing infrastructure due to feral pig infestation ($)**

| Parameter | units | Value |
|---|---|---|
| Repair hrs[a] | hrs/annum | 5.0 |
| Labour cost[b] | $/hr | $33.18 |
| Equipment cost[c] | $/month | $1,360 |
| Equipment cost | $/hr | $8.50 |
| F.O.R.M.[d] | $/hr | $35.00 |
| Annual Cost per holding | $/annum | 383.42 |
| No. of holdings | no. | 394 |
| Frequency of Occurrence | % | 90.0% |
| **Total Regional Cost** | **$/annum** | **$135,961** |

**a** Based on survey responses.

**b** Based on the Pastoral Award 2010 dated 27 June 2019 and http://qeas.com.au/entries/general/the-true-cost-of-employment

**c** Synergies estimate based on $100,000 tractor over 10 years at 10% interest.

**d** Fuel oil repairs and maintenance based on https://www.AgMargins.net.au.

## *Summary of costs to livestock producers*

Table 19 summarises the total annual cost impact of feral pig damage on livestock producers in the WRC region. The results demonstrate that the cost of a reduction in cattle sale weight accounts for the majority of the total cost of feral pig damage.

**Table 19 Total annual cost of feral pig damage on livestock producers in the WRC region**

| Cost impact | Total annual cost for livestock producers | | |
|---|---|---|---|
| | Low scenario | Medium scenario | High scenario |
| Reduction in cattle sale weight | $635,176 | $1,587,940 | $3,175,880 |
| Reduced calving rate | $780,493 | $780,493 | $780,493 |
| Vaccination | $27,799 | $27,799 | $27,799 |
| Feed Supplements | $132,243 | $132,243 | $132,243 |
| On-farm infrastructure | $135,961 | $135,961 | $135,961 |
| **TOTAL IMPACT** | $1,711,671 | $2,664,435 | $4,252,376 |

**Source:** Synergies analysis.

These estimates demonstrate the significance of the impact of feral pig damage on cattle sale weights in relation to the total economic cost that feral pigs impose on livestock producers in the WRC region. It is important to note that the assumptions applied in relation to the reduction in cattle sale weight attributable to feral pigs under the 'medium' scenario are conservative and that the annual cost estimate of $4.25 million under the 'high' scenario is considered plausible.

### 4.3.2 Sugarcane

In accordance with the survey responses received, two cost impacts attributable to feral pig damage have been estimated for the sugarcane sector – loss of crop yield and damage costs to on-farm irrigation infrastructure.

*Cost impact of loss of cane yield*

Table 20 sets out the estimated annual cost of the loss of cane yield attributable to feral pigs for all sugarcane farms across the WRC region. The region-wide cost impacts are based on a total farm population of 224 and a total planted area of 20,160 hectares of sugarcane. The parameters and assumptions underpinning these estimates are set out in Table 7.

**Table 20 Annual cost of loss of cane yield due to feral pig damage**

| Cane rotation | Total revenue without feral pig damage | Total revenue with feral pig damage | Annual revenue lost per cane farm | Region-wide annual cost |
|---|---|---|---|---|
| Plant Cane | $61,200 | $60,710 | $490 | $109,670 |
| Ratoon 1 | $59,040 | $58,568 | $472 | $105,800 |
| Ratoon 2 | $57,600 | $57,024 | $576 | $129,024 |
| Ratoon 3 | $56,160 | $55,430 | $730 | $163,538 |
| Ratoon 4 | $54,000 | $53,190 | $810 | $181,440 |
| **TOTALS** | **$288,000** | **$284,922** | **$3,078** | **$689,472** |

**Note:** The regional impact is based on a farm population of 224 and a total planted area of 20,160ha.
**Source:** Synergies analysis.

*Cost of damage to on-farm infrastructure and additional fencing investment*

The total region-wide cost of repairing damage to on-farm irrigation infrastructure was estimated at $24,050 as shown in Table 21.

**Table 21 Regional cost of repairing infrastructure due to feral pig infestation ($)**

| Parameter | units | Value |
|---|---|---|
| Repair hrs[a] | hrs/annum | 3.5 |
| Labour cost[b] | $/hr | 33.18 |
| Equipment cost[c] | $/month | 1,360 |
| Equipment cost | $/hr | 8.50 |
| F.O.R.M.[d] | $/hr | 35.00 |
| Annual cost per farm | $/annum | 268.39 |
| No. of holdings | no. | 224 |
| Frequency of occurrence | % | 40.0 |
| **Total region-wide cost** | **$/annum** | **$24,050** |

**a** Based on survey responses.

**b** Based on the Pastoral Award 2010 dated 27 June 2019 and http://qeas.com.au/entries/general/the-true-cost-of-employment

**c** Synergies estimate based on $100,000 tractor over 10 years at 10% interest.

**d** Fuel oil repairs and maintenance based on https://www.AgMargins.net.au.

In addition to the above, the region-wide cost of additional fencing required as a feral pig control measure for sugarcane farming is estimated at $123,364 per annum. This results in a total region-wide cost for infrastructure and infrastructure repairs attributable to feral pigs of $147,414 per annum.

*Summary of cost to sugarcane growers*

The total annual cost incurred by sugarcane growers in the WRC region attributable to feral pig damage is estimated at $836,886, with around 82 per cent of this total attributable to loss of cane yield.

### 4.3.3 Horticulture

As is the case for sugarcane growers, the main cost impact of feral pig damage on horticulture growers in a loss of crop yield.[16] Table 22 sets out the annual cost estimates derived for each of the horticulture crops included in the analysis based on the parameter estimates detailed in Table 11 and Table 12 in section 4.2.3. As discussed in

[16] While it is acknowledged that horticultural producers incur costs in relation to exclusion fencing to prevent damage to crops and infrastructure as a result of feral animals, it is not possible to conclude, based on the information available, that these costs can be attributed to feral pigs. That is, it cannot be concluded that if feral pigs were eliminated from the region, horticultural producers would be able to reduce their length of animal exclusion fencing. On this basis, fencing costs have not been included in the analysis for horticultural producers.

section 4.2.3, tomatoes have been included in the analysis despite not being identified by survey responses on the basis that it is the most prominent horticulture crop produced in the region.[17]

**Table 22 Annual cost of loss of crop yield for horticulture growers due to feral pig damage**

| Crop | Total revenue without feral pig damage | Total revenue with feral pig damage | Region-wide annual cost |
|---|---|---|---|
| Mangoes | $18,402,712 | $18,356,705 | $46,007 |
| Melons | $18,402,712 | $18,034,657 | $368,055 |
| Capsicum | $110,056,159 | $107,855,036 | $2,201,123 |
| Pumpkins | $6,748,727 | $6,512,521 | $236,206 |
| Corn | $21,803,579 | $21,727,266 | $76,313 |
| Beans | $70,602,064 | $70,249,054 | $353,010 |
| Tomatoes | $191,040,879 | $190,276,716 | $764,163 |
| **TOTAL** | **$437,056,830** | **$433,011,954** | **$4,044,876** |

**Note:** The regional impact is based on a total planted area of 12,800 ha.
**Source:** Synergies analysis.

## 4.4 Region-wide economic cost estimates

Table 23 summarises the region-wide economic cost estimates related to feral pig damage derived for each major sector within the WRC agriculture industry. The table shows that the majority of the annual cost estimate is attributable to loss of productivity due to reduced cattle sale weight and lost crop yield due to feral pig damage.

**Table 23 Total annual economic cost of feral pig damage on agricultural producers in the WRC region**

| Category | Livestock | Sugarcane | Horticulture | Total |
|---|---|---|---|---|
| Lost productivity | $2,368,433 | $689,472 | $4,044,876 | $7,102,781 |
| Infrastructure damage and fencing costs | $135,961 | $147,414 | - | $283,375 |
| Feed replacement | $132,243 | | | $132,243 |
| Livestock vaccination | $27,799 | | | $27,799 |
| **TOTAL** | **$2,664,435** | **$836,886** | **$4,044,876** | **$7,546,197** |

The cost estimates in the above table are based on the 'medium' scenario in relation to the reduction in cattle sale weight attributable to feral pigs. As discussed in section 4.2.1, the parameter estimates underpinning the estimation of this cost under this scenario are conservative.

[17] The cost incurred by tomato growers has been estimated based on estimates for yield loss and impacted areas provided by survey respondents in relation to other horticulture crops.

Based on the parameter estimates applied under the 'high' scenario (i.e. 5% reduction in turn-off weights), the region-wide annual cost for livestock producers increases to $4,252,376. Under this scenario, the total direct economic cost of feral pig damage to agricultural producers across the WRC region increases to $9,134,138 per annum.

# 5 Regional economic impacts of feral pig damage

Section 4 details the direct economic cost that feral pig damage imposes on agricultural producers within the WRC region. This estimate represents the loss of productive value of the agricultural sector as a direct result of the on-farm impacts of feral pigs within the region.

In addition to this direct economic cost, loss of production and damage caused by feral pigs to agricultural enterprises also has wider economic impacts on the region through reduced production and employment in the agriculture and related sectors. We have applied Synergies' conventional I-O model to estimate these regional economic impacts.

I-O tables can be understood as a summary of all supply chains in a region. They are a standard tool for estimating the economic impacts of an increase or decrease in production in a specific industry sector on the economy within a specific region (in this case, reduced agricultural production in the WRC region). Details of the economic impact measures and results are provided below. Attachment B provides a detailed description of the approach to the development of the I-O model used to estimate the regional economic impacts of feral pig damage.

## 5.1 Measures of economic impact

The economic impact assessment examines the cost in total economic activity attributable to the damage caused by feral pigs on WRC's economy, as measured by:

- *Output* – the gross value or cost of additional economic activity attributable to feral pig damage;
- *Value add (or GRP)* – the net value or cost of additional economic activity,[18] consisting of the following components:
  - *Wages paid* – the share/cost of increased production that is directly paid to individuals in the form of wages;
  - *Operating surplus and mixed income* – the share/cost of increased production that is directly paid to businesses in the form of profits;
  - *Taxes less subsidies* – the share/cost of increased production that is directly paid to the local Government in the form of taxes; and

[18] Considers the value added at the final step of the production chain as opposed to the entire transactional value of each step which is the case for output.

*Employment* – the amount of additional labour (in full-time equivalents) as a result of the increase in economic activity.

These economic impacts are reported in the two measures below:[19]

- *direct effects* – relate to the economic costs on agricultural producers directly attributable to feral pig damage; and
- *indirect effects* – relate to the cost of production or loss of productive output in activities downstream that supply and support agricultural production in the WRC.

## 5.2 Modelling results

Table 24 and Table 25 presents the annual regional economic impacts of feral pig damage, broken down by direct and indirect effects. The regional economic impacts have been modelled based on two estimates for the direct economic cost to the agriculture sector - $7.55 million (annual cost based on the 'middle' scenario for reduction in cattle sale weight) and $9.13 million (annual cost based on the 'high' scenario for reduction in cattle sale weight).

The results demonstrate that the direct economic cost of feral pig damage on the agriculture sector in the WRC region results in the following wider economic impacts:

- an additional flow-on annual loss of economic output ranging from $2.8 to $3.45 million (resulting in total losses of output of between $10.35 million and $12.58 million per annum);
- a loss of total 'value-add' (GRP) ranging from $5.09 to $5.96 million per annum, disaggregated as follows:
  - lost wages paid ranging from $1.14 to $1.32 million per annum;
  - reduced operating surplus ranging from $3.7 to $4.34 million per annum; and
  - reduced taxes ranging from $0.26 to $0.31 million per annum.

The model also estimates that the economic cost of feral pig damage on agriculture enterprises results in the loss of between 22 and 25 FTEs from the region (noting the actual amount of employment lost may be higher to the extent that casual and part time positions are impacted).

[19] Induced or "consumption effects" are not reported as they are considered too uncertain.

**Table 24 Regional economic impacts of feral pig damage ('middle' scenario for reduction in cattle sale weights)**

| Indicator | Direct losses | Indirect losses | Total losses |
|---|---|---|---|
| **Output** | **$7.55 million** | **$2.8 million** | **$10.35 million** |
| **Value add (or GRP)** | **$3.92 million** | **$1.18 million** | **$5.09 million** |
| Wages paid | $0.7 million | $0.44 million | $1.14 million |
| Operating surplus and mixed income | $3.02 million | $0.68 million | $3.7 million |
| Taxes less subsidies | $0.19 million | $0.06 million | $0.26 million |
| **Employment** | **14 FTEs** | **8 FTEs** | **22 FTEs** |

**Source:** Synergies modelling.

**Table 25 Regional economic impacts of feral pig damage ('high' scenario for reduction in cattle sale weights)**

| Indicator | Direct losses | Indirect losses | Total losses |
|---|---|---|---|
| **Output** | **$9.13 million** | **$3.45 million** | **$12.58 million** |
| **Value add (or GRP)** | **$4.51 million** | **$1.45 million** | **$5.96 million** |
| Wages paid | $0.78 million | $0.54 million | $1.32 million |
| Operating surplus and mixed income | $3.5 million | $0.84 million | $4.34 million |
| Taxes less subsidies | $0.23 million | $0.08 million | $0.31 million |
| **Employment** | **16 FTEs** | **9 FTEs** | **25 FTEs** |

**Source:** Synergies modelling.

# A. Modelling parameters and assumptions

This attachment summarises the assumptions and parameter estimates applied to estimate the direct economic cost imposed on livestock, sugarcane and horticultural producers that is attributable to feral pigs within the WRC.

## A.1 Cattle producers

An estimate 394 livestock producers operate in the region.

**Herd Structure (per property) for the representative enterprise**

| Category | % of Herd | AE's | No. of animals |
|---|---|---|---|
| Weaners | 12% | 75 | 159 |
| Heifers | 22% | 140 | 193 |
| Breeders | 64% | 406 | 462 |
| Bulls and other | 2% | 13 | 9 |
| **TOTAL HERD** | **100%** | **635** | **823** |

**Sale weights, prices and cattle turn-off percentages for the representative enterprise**

| Category | Sale weight (kg LWT/CWT) | Turn-off % | Sale prices ($/kg) |
|---|---|---|---|
| Weaners | 200 (LWT) | 100 | 3.20 |
| Heifers | 186 (CWT) | 30 | 4.50 |
| Breeders | 200 (CWT) | 10 | 5.00 |
| Bulls and other | 350 (CWT) | 0 | 4.50 |

The following assumptions were used to model the economic cost of feral pigs on livestock producers in the WRC area:

- reduced calving rate – 2% reduction in calving rate for the average enterprise;
- lower weight loss – 1% lower turn-off weights for store weaners and surplus heifers;
- average level of weight loss – 2.5% lower turn-off weights for store weaners and surplus heifers; and
- higher level of weight loss – 5% lower turn-off weights for store weaners and surplus heifers.

**On-farm infrastructure repair costs on livestock properties**

| Parameter | units | Value |
|---|---|---|
| Repair hrs | hrs/annum | 5.0 |
| Labour cost | $/hr | $33.18 |
| Equipment cost | $/month | $1,360 |
| Equipment cost | $/hr | $8.50 |
| F.O.R.M. | $/hr | $35.00 |

| | | |
|---|---|---|
| Frequency of Occurrence | % | 90.0% |

**Annual property level cost of lower cattle sale weights due to feral pig infestation**

| Herd | Low impact | | Medium impact | | High impact | |
|---|---|---|---|---|---|---|
| | $ per head | $ per farm | $ per head | $ per farm | $ per head | $ per farm |
| Weaners | $6.40 | $1,016 | $16.00 | $2,540 | $32.00 | $5,080 |
| Heifers | $2.51 | $485 | $6.28 | $1,213 | $12.56 | $2,426 |
| Breeders | $1.00 | $462 | $2.50 | $1,155 | $5.00 | $2,309 |
| Bulls and other | $0.00 | $0 | $0.00 | $0 | $0.00 | $0 |
| **TOTAL HERD** | | **$1,963** | | **$4,908** | | **$9,815** |

**Annual regional cost of reduced cattle sale weights due to feral pig infestation**

| Herd | Low Impact | Medium Impact | High impact |
|---|---|---|---|
| Weaners | $248,832 | $622,080 | $1,244,160 |
| Heifers | $178,984 | $447,460 | $894,920 |
| Breeders | $207,360 | $518,400 | $1,036,800 |
| Bulls and other | $0 | $0 | $0 |
| **TOTAL ANNUAL COST** | **$635,176** | **$1,587,940** | **$3,175,880** |

**Regional cost of re-vaccination due to feral pig infestation ($)**

| Herd | Vaccination cost ($/hd/yr) | Herd Composition (hd) | Freq. of re-vaccination[a] (% of yrs) | Regional Impact ($/yr) |
|---|---|---|---|---|
| Weaners | $1.30 | 38,880 | 0 | $0 |
| Heifers | $1.30 | 71,280 | 0 | $0 |
| Breeders | $1.30 | 207,360 | 10% | $26,957 |
| Bulls and other | $1.30 | 6,480 | 10% | $842 |
| **TOTAL IMPACT** | | **324,000** | | **$27,799** |

**Regional cost of replacing feed supplements due to feral pig infestation ($)**

| Herd | Feed cost ($/hd/yr) | Herd Composition (hd) | Prop. Of feed supplements destroyed (%) | Regional Impact ($/yr) |
|---|---|---|---|---|
| Weaners | $20.41 | 38,880 | 2% | $15,869 |
| Heifers | $20.41 | 71,280 | 2% | $29,093 |
| Breeders | $20.41 | 207,360 | 2% | $84,635 |
| Bulls and other | $20.41 | 6,480 | 2% | $2,645 |
| **TOTAL IMPACT** | | **324,000** | | **$132,243** |

**Cost of repairing infrastructure due to feral pig infestation ($)**

| Parameter | units | Value |
|---|---|---|
| Repair hrs | hrs/annum | 5.0 |
| Labour cost | $/hr | $33.18 |
| Equipment cost | $/month | $1,360 |
| Equipment cost | $/hr | $8.50 |
| F.O.R.M. | $/hr | $35.00 |
| Annual Cost per holding | $/annum | 383.42 |
| No. of holdings | no. | 394 |
| Frequency of Occurrence | % | 90.0% |
| **Total Regional Cost** | **$/annum** | **$135,961** |

## A.2 Sugarcane growers

The economic impact of feral pig damage on sugarcane producers has been modelled based on a representative enterprise with the following characteristics:

- total area of cane planted of 90 hectares
- average cane yield of 80 tonnes per hectare.

**Cropping losses for sugarcane growers due to feral pig infestation**

| | Area (ha) | Yield (tc/ha) | Area impacted (%) | Yield Loss on damaged area (%) | On-farm return ($/tc) |
|---|---|---|---|---|---|
| Plant Cane | 18.0 | 85.0 | 10.0% | 8.0% | $40 |
| Ratoon 1 | 18.0 | 82.0 | 10.0% | 8.0% | $40 |
| Ratoon 2 | 18.0 | 80.0 | 10.0% | 10.0% | $40 |
| Ratoon 3 | 18.0 | 78.0 | 10.0% | 13.0% | $40 |
| Ratoon 4 | 18.0 | 75.0 | 10.0% | 15.0% | $40 |

Sensitivity analysis was performed on both the proportion of the crop area impacted and the yield loss, as follows:

- lower impact case – 5% of area/10% yield loss
- base impact case (as per Table 7) – 10% of area/15% yield loss
- high impact case – 18% of area/30% yield loss.

**Parameters used to estimate on-farm infrastructure repair costs on cane farms**

| Parameter | units | Value |
|---|---|---|
| Repair hrs | hrs/annum | 3.5 |
| Labour cost | $/hr | $33.18 |
| Equipment cost | $/month | $1,360 |
| Equipment cost | $/hr | $8.50 |
| F.O.R.M | $/hr | $35.00 |
| Frequency of Occurrence | % | 40.0% |

**Parameters for estimating the annual cost of fencing on cane farms**

| Parameter | units | Value |
|---|---|---|
| Proportion of cane land fenced due to feral pigs | % | 2.0% |
| Fencing cost | $/km | $4,700 |
| Life of fencing | years | 10 |
| Cost per annum[a] | $/km | $765 |
| Total Area fenced | ha | 403 |
| Averaged Area fenced | ha/farm | 1.80 |
| Length of fencing per farm | m/farm | 720 |
| Total cost per farm (per annum) | $/farm | $551 |
| Total cost for the region (per annum) | $/farm | $123,364 |

The region-wide cost impacts are based on a total farm population of 224 and a total planted area of 20,160 hectares of sugarcane.

## A.3 Horticultural enterprises

**Horticulture crops identified by survey responses**

| Crop | 2015 production ($ million) | Proportion of total crop mix (%) |
|---|---|---|
| Capsicum | 106 | 45% |
| Beans | 68 | 29% |
| Sweet Corn | 21 | 9% |
| Mangoes | 18 | 7% |
| Melons | 18 | 7% |
| Pumpkins | 6.5 | 3% |
| **Total production** | **$237.5** | **100%** |

**Parameters used to estimate crop losses in the horticultural sector**

| Crop | Est 2020 GVOP ($M) | Ave. Price ($/t) | Quantity Produced (t) | Area planted (ha) | Average Yield (t/ha) | Area Impacted (%) | Yield Loss on Impacted area (%) |
|---|---|---|---|---|---|---|---|
| Capsicum | 110.1 | 1,800 | 61,142 | 2,446 | 25.0 | 4.0% | 50% |
| Beans | 70.6 | 1,500 | 47,068 | 5,884 | 8.0 | 1.0% | 50% |
| Sweet Corn | 21.8 | 3,000 | 7,268 | 808 | 9.0 | 1.0% | 35% |
| Mangoes | 18.4 | 3,000 | 6,134 | 409 | 15.0 | 5.0% | 5% |
| Melons | 18.4 | 660 | 27,883 | 929 | 30.0 | 4.0% | 50% |
| Pumpkins | 6.7 | 500 | 13,497 | 519 | 26.0 | 7.0% | 50% |
| Tomatoes | 191.0 | 1,540 | 124,053 | 1,772 | 70.0 | 2.4% | 40% |

**Annual cost of loss of crop yield for horticulture growers due to feral pig damage**

| Crop | Total revenue without feral pig damage | Total revenue with feral pig damage | Region-wide annual cost |
|---|---|---|---|
| Mangoes | $18,402,712 | $18,356,705 | $46,007 |
| Melons | $18,402,712 | $18,034,657 | $368,055 |
| Capsicum | $110,056,159 | $107,855,036 | $2,201,123 |
| Pumpkins | $6,748,727 | $6,512,521 | $236,206 |
| Corn | $21,803,579 | $21,727,266 | $76,313 |
| Beans | $70,602,064 | $70,249,054 | $353,010 |
| Tomatoes | $191,040,879 | $190,276,716 | $764,163 |
| **TOTAL** | **$437,056,830** | **$433,011,954** | **$4,044,876** |

The regional impact was based on a total planted area of 12,800 ha.

# B. Input-output modelling

I-O tables are constructed following the method of regionalisation. The regionalisation method developed by Synergies to derive state, and thereby sub-state as well as regional level, I-O tables is consistent with other well-accepted and widely used hybrid[20] regional I-O approaches, such as the Distributive Commodity Balance (DCB)[21] and the Generation of Regional Input-Output Tables (GRIT) [22].

Synergies' regionalisation method of I-O tables generally involves the following three main phases, broken-down into seven steps.

## Phase 1 Adjustment to the base (national) I-O table

### Step 1: Selection of base table

The latest (2016-17) national I-O table published by the Australian Bureau of Statistics (ABS) is used as the base table.[23] In this table, there are 114 industries represented with direct allocation of all imports and valuation of transactions at basic prices.

The direct allocation table is selected for the regionalisation process because it excludes imports from national intermediate transactions, expressing the proportion of intermediate inputs in domestic flows only.

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[20] The hybrid approach combines the use of non-survey techniques with superior data (i.e. statistical information obtained through surveys, experts or other reliable sources).

[21] Christie, J. and Varua, E., M. (2010). Application of the Distributive Commodity Balance Method Approach to Regional Disaggregation: the Case of Penrith LGA. University of Western Sydney.

Johnson, P. (2001). An Input-Output Table for the Kimberly Region of Western Australia. Economic Research Centre, University of Western Australia.

[22] Jensen, R., C., Mandeville, T., D. and Karunarante, N., D. (1977). Generation of Regional Input-Output Tables for Queensland. Report to Coordinator General's Department and Department of Commercial and Industrial Development, Department of Economics, University of Queensland.

Jensen, R., C., Mandeville, T., D. and Karunarante, N., D. (1979). Regional Economic Planning: Generation of Regional Input-Output Analysis. Croom Helm, London.

Murphy, T., Brooks, M. and Mazzotti, L. (2003). The Barwon Darling Alliance. The Western Research Institute, Charles Sturt University.

West, G., R. (1980). Generation of Regional Input-Output Tables (GRIT): An Introspection. Economic Analysis and Policy, 10, pp. 71-86.

West, G., R., Morison J., B. and Jensen, R., C. (1984). A Method for the Estimation of Hybrid Interregional Input-Output Tables. Regional Studies, 18(5), pp. 413–422.

[23] Australian Bureau of Statistics (2019). Australian National Accounts: Input-Output Tables, 2016-17. Cat. No. 5209.0.55.001, Commonwealth of Australia, Canberra.

### Step 2: Update the base table

The base table is updated using 'temporal quotients' or industry specific factor levels in terms of weighted average industry earnings data[24] between the compilation year (financial year 2017) and the year to be analysed (financial year 2019). Statistical information from across Australian Bureau of Statistics (ABS) databases were relied upon for estimation of the temporal quotients.[25]

It is important to note that updates to the temporal quotients are based on aggregate input data at the one-digit Australian and New Zealand Standard Industrial Classification (ANZSIC) level. This means that the extent of changes in the economic structure between the compilation year and the year to be analysed is restricted.

### Step 3: Insertion of superior data and balancing

To better capture the latest possible structure of the national economy, and mitigate the problem associated with the application of outdated ratios for intermediate inputs to and outputs from production, we incorporate superior survey-based data into the table. This data is incorporated in the I-O table via the following two rounds of adjustment.

*Round one adjustment*

We initially adjust vectors of primary inputs and column totals using statistical information sourced from the *ABS National Accounts' data-cubes*,[26] while holding flows between industries and vectors of final demand constant.

Industry flows and vectors of final demand are then adjusted following a manual bi-proportional (or RAS)[27] procedure to reflect changes attributable to the transposition of the production vector.

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[24] Average industry earnings data were updated using statistical information classified according to the one-digit or narrow levels of the Australian and New Zealand Standard Industrial Classification structure.

[25] Australian Bureau of Statistics (2018). Census of Population and Housing, 2016. Commonwealth of Australia, Canberra.

Australian Bureau of Statistics (2019). Labour Force, Australia, Detailed, Quarterly, Aug 2019. Cat. No. 6291.0.55.003, Commonwealth of Australia, Canberra.

Australian Bureau of Statistics (2019). Wage Price Index, Australia, Jun 2019. Cat. No. 6345.0, Commonwealth of Australia, Canberra.

[26] Australian Bureau of Statistics (2019). Australian System of National Accounts, 2018-19. Cat. No. 5204.0, Commonwealth of Australia, Canberra.

[27] The bi-proportional (or RAS) procedure is a well-recognised and widely applied technique in re-balancing I-O tables. It is an iterative adjustment procedure for optimisation in which rows and columns, excluding those that have been accurately pre-estimated using superior survey-based data, are harmonised with given margins until consistency is achieved.

*Round two adjustment*

Whilst holding everything else constant, we adjust vectors of final demand and row totals using statistical information sourced from the *ABS National Accounts' data-cubes*, *Household Expenditure Survey* and *International Merchandise Exports*.[28] This is then followed by adjusting industry flow elements following a manual RAS procedure.

The updated and balanced base (or national) I-O table is subsequently checked for accuracy against the ABS derived gross domestic product (GDP).

## Phase 2 Regional I-O table formulation

Note that the remaining steps (Steps 4 to 7) are repeated at the sub-state (or regional) level for which I-O tables are required, though, using the state (or sub-state) I-O table as the base table.

### Step 4: Application of location quotients

Extensive use has been made of methods of location quotients (LQ) in constructing regional I-O tables, since obtaining ad-hoc regional data through a full-scale survey is inevitably expensive and time-consuming.

Synergies conventional method of LQ is capable of assessing how economic, social and fiscal outputs can contribute to regional, state and national economies. The model is essentially based on the Social Accounting Matrices (SAM) framework, which is an extension of the classical input-output framework and includes all flow of resources between economic agents through transactions at a specific period of time.

Under this formulation, we initially verify the existence of a sector at the regional level by collating detailed (at the four-digit ANZSIC level) weighted average earnings data

[28] Australian Bureau of Statistics (2019). Australian System of National Accounts, 2018-19. Cat. No. 5204.0, Commonwealth of Australia, Canberra.

Australian Bureau of Statistics (2017). Household Expenditure Survey, Australia: Summary of Results, 2015–16. Cat. No. 65300DO013_201516, Commonwealth of Australia, Canberra.

Queensland Government Statistician's Office (2020). International Trade – Exports – Overseas exports by industry (4-digit ANZSIC 2006 edition) and country of destination, Queensland and other states and territories, 2008–09 to 2018–19. The State of Queensland (Queensland Treasury), Queensland.

from the 2016 Census.[29] After updating this data to the year to be analysed,[30] we apply conventional LQs to regionalise the base (national) I-O table.

Note that although the relative simplicity of the conventional I-O model lends itself to rapid computation, it disregards constraints on economic activity, such as supply imbalances and lack of interregional trade for the product or nonlinearities in economic production.

### Step 5: Computation of regionalised indices

Regional input and import (competitive) coefficients are derived from base (e.g. national, state or sub-state) technical coefficients through the application of LQs.

## Phase 3 Computation of the complete regional I-O table

### Step 6: Derivation of the prototype regional I-O table

Statistical information derived from previous steps are used to develop the prototype regional I-O table, by:

- transforming the regional direct requirements (industry flows) matrix and import coefficients into monetary flows;
- calculating the sectoral primary inputs' categories; and
- calculating the sectoral final demand categories.

### Step 7: Insertion of superior data and balancing

The approach to inserting superior survey-based data and then re-balancing the regional I-O table is identical to the approach discussed in Step 3, with the only difference being the application of distinct or region-specific data.[31] In the case of smaller regions,

[29] Australian Bureau of Statistics (2018). Census of Population and Housing, 2016. Commonwealth of Australia, Canberra.

[30] Australian Bureau of Statistics (2019). Labour Force, Australia, Detailed, Quarterly, Aug 2019. Cat. No. 6291.0.55.003, Commonwealth of Australia, Canberra.

Australian Bureau of Statistics (2019). Wage Price Index, Australia, Jun 2019. Cat. No. 6345.0, Commonwealth of Australia, Canberra.

[31] Australian Bureau of Statistics (2019). Australian System of National Accounts: State Accounts, 2018-19. Cat. No. 5220.0, Commonwealth of Australia, Canberra.

Australian Bureau of Statistics (2017). Household Expenditure Survey, Australia: Summary of Results, 2015–16. Cat. No. 65300DO013_201516, Commonwealth of Australia, Canberra

however, distinct or region-specific data becomes generally unobtainable or unavailable. In turn, this limits our ability to produce more accurate results through the insertion of superior survey-based data.

Queensland Government Statistician's Office (2020). International Trade – Exports – Overseas exports by industry (4-digit ANZSIC 2006 edition) and country of destination, Queensland and other states and territories, 2008–09 to 2018–19. The State of Queensland (Queensland Treasury), Queensland.

# C. Producer survey

Questionnaire

Whitsunday Regional Council

# Economic impact of feral pig damage

Survey for agricultural producers in WRC
October 2019

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Feral pigs impose significant costs on agricultural producers in the Whitsunday Regional Council. As part of the Queensland Government's Feral Pest Initiative, Council has engaged Synergies Economic Consulting to develop a model to estimate the economic impact of feral pigs on agricultural production and the regional economy. The development of this model is to be informed by information gathered from agricultural producers in the region regarding the on-farm impact of damage caused by feral pigs. The completion of this survey will ensure the economic model is informed by robust, region-specific information and hence provides an accurate estimate of the economic impact of feral pigs on agricultural producers in the Whitsunday Regional Council.

## Respondent' Contact details

Name:

Phone number: ( )

## Enterprise information

**Question 1.** Location of property

**Question 2.** Total farm area by agricultural activity

**Table 1 Farm area by agricultural activity (ha)**

| Land type | 2016/17 | 2017/18 | 2018/19 |
|---|---|---|---|
| Cropped land | | | |
| Livestock grazing | | | |
| Horticulture | | | |
| Other | | | |
| Total Farm Area | | | |

(If NO cropping activity took place over the last 3 years, skip to Q5)

## Cropping Details

**Question 3.** Area under crop production by crop type in the last 3 years.

**Table 2 Cropping activity (ha planted)**

| Crop type | 2016/17 | 2017/18 | 2018/19 |
|---|---|---|---|

**Question 4.** Cropping Costs and returns

**Table 3 Crop Costs and returns (by crop) - 2018/19 cropping year- $/ha planted**

| Crop type | Gross Returns ($/ha) | Total Annual Cash Costs[A] ($/ha) |
|---|---|---|

**A – Cash costs include the direct cost of land preparation, planting, weed and pest control, irrigation, harvesting, storage and handling, transport and marketing costs and levies.**

(If no livestock enterprise was undertaken in the last 3 years, Skip to Q7)

## Livestock Impacts

**Question 5.** Structure of livestock enterprise

**Table 4 Herd structure (no. of cattle by category)**

| Cattle type | 2016/17 | 2017/18 | 2018/19 |
|---|---|---|---|
| Breeders | | | |
| Heifers | | | |
| Stores | | | |
| Other steers | | | |
| Calves | | | |
| Bulls | | | |
| Other | | | |
| Total animals carried | | | |

**Question 6.** Costs and returns from livestock grazing

**Table 5 Livestock Costs and returns (by animal class) - 2018/19**

| Class of cattle | Average sale weight (kg) | Average price ($/kg) | No. sold | Total cash costs [A] ($/annum) |
|---|---|---|---|---|
| Steers | | | | |
| Heifers | | | | |
| Bulls | | | | |
| Calves | | | | |
| Others | | | | |

**A – Cash costs include the direct cost of Herd health and vet supplies, Feed costs (home grown and purchased), transport and cartage, selling and marketing costs and levies. Do not include indirect overhead costs.**

## Impact of feral pigs on your property

**Question 7.** Have feral pigs caused damage on your property over recent years?

☐YES ☐NO

If Yes, proceed to Tables 6 to 10. If no, proceed to Q 9.

**Table 6 Extent of Current and recent Feral Pig infestation by Land use**

| Land Type | Total no. of pigs currently (No) | Estimated Change over last 3 years (%) |
|---|---|---|
| Cropping Land | | |
| Grazing Land | | |
| Other land type | | |
| Total farm | | |

If the property does not grow cash crops, proceed to Table 8

**Table 7 Actual Crop Damage due to Feral pigs – Over last 3 years**

| Crop | Year | Hectares of planted area damaged by feral pigs (ha) | Percent of crop yield lost on DAMAGED hectares (%) |
|---|---|---|---|
| | | | |

If the property does not farm livestock, proceed to Q 8.

**Table 8 Estimated Calving and weaning impacts due to feral pigs – Over last 3 years**

| Year | Target calving rate[A] | Estimated reduction in calving rate (%) [B] | Target weaning Rate[A] | Estimated reduction in Weaning rate (%) [B] | Average target turn-off weight of weaners (kg) |
|---|---|---|---|---|---|
| 2016/17 | | | | | |
| 2017/18 | | | | | |
| 2018/19 | | | | | |

**A In the absence of feral pigs**
**B Due to feral pigs**

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## Table 9 Reduced turn-off weight and/or increase in turn-off age due to morbidity resulting from feral pig related infections –Average over last 3 years

| Cattle Type | Target turn-off weight (kg)[A] | Target age at turn-off (Months)[A] | Specify which impact is included | Estimated reduction in turn-off weight (%)[B] | Estimated increase in Age at turn-off (%)[B] |
|---|---|---|---|---|---|
| | | | ☐ Weight loss<br>☐ Age increase<br>☐ Both | | |
| | | | ☐ Weight loss<br>☐ Age increase<br>☐ Both | | |
| | | | ☐ Weight loss<br>☐ Age increase<br>☐ Both | | |
| | | | ☐ Weight loss<br>☐ Age increase<br>☐ Both | | |

**A In the absence of feral pigs**
**B Due to feral pigs**

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## Table 10 Consequences of Pasture destruction due to feral pigs– Average of last 3 years

| Cattle type | Target turn-off weight (kg) | Target turn-off age (months) | Specify which impact is included | Reduction in weight due to pasture loss (%) | Increase in age at turn-off due to pasture loss (%) | Annual cost of replacement feed ($) |
|---|---|---|---|---|---|---|
| | | | ☐ Weight loss<br>☐ Age increase<br>☐ Both | | | |
| | | | ☐ Weight loss<br>☐ Age increase<br>☐ Both | | | |
| | | | ☐ Weight loss<br>☐ Age increase<br>☐ Both | | | |
| | | | ☐ Weight loss<br>☐ Age increase<br>☐ Both | | | |

## Actual Infrastructure damage incurred on your property

If NO infrastructure damage due to feral pigs has been identified on your property in the past 3 years, proceed to Q 9.

**Question 8.** Incidence of damage to on-farm infrastructure

**Table 11 Actual Damage to on-farm infrastructure in the last 3 years**

| Description of infrastructure | Year of occurrence | Total Cost of repairs/replacement ($) |
|---|---|---|
| Fences | | |
| Land Formation | | |
| Contour banks | | |
| Water and irrigation infrastructure | | |
| Other: | | |
| Other: | | |
| Other: | | |
| Other: | | |

## Cost of control activities

**Question 9.** Do you currently undertake any feral animal control activities to minimise feral pigs impacts on your property?

☐YES ☐NO

## Table 12 Cost of on-farm control measures in the last 3 years

| Control measure | Year measure undertaken | Proportion attributable to Feral pigs (%) | Total Replacement cost of control measure ($)[A] | Annual operating and maintenance cost of measure ($) |
|---|---|---|---|---|

A Where the control measure involved a material capital investment e.g. fencing

## Other impacts

Please describe any other adverse impacts of feral pig infestation on farm activities not covered in previous questions.

Please describe any noticeable off-farm damage caused by feral pigs in the general vicinity of your property.