

AGRICULTURAL IMPACTS OF FERAL PIGS IN AUSTRALIA

June 2026

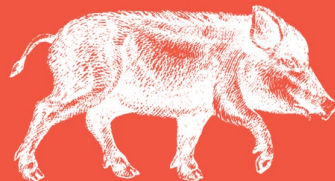
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Executive Summary

The New Zealand Bioeconomy Science Institute (BSI) was commissioned by Australian Pork Limited (APL) to conduct a literature review of the impacts and costs that feral pigs (*Sus scrofa*) have on agriculture (including horticulture) in Australia and to re-analyse pest animal survey data (focusing on feral pigs) collected by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).

The BSI was also tasked with incorporating an additional component of work, undertaken by project partners, into this report. This component focused on evaluating new methods of quantifying the damage and costs that feral pigs cause to agricultural crops.

Methods

- For our qualitative literature review, we followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.
- We analysed quantitative data from the National Pest Animal and Weed Management Survey (PAWS) collected by ABARES for the years 2016, 2019, and 2022. PAWS data were used to estimate costs incurred to manage feral pigs (control expenditure) and losses incurred despite control (residual agricultural losses) for the whole of Australia as well as for selected individual commodities where sample sizes of respondents allowed.
- We conducted pilot trials to estimate the damage caused by feral pigs on wheat and canola (winter) and sorghum (summer) crops in the Moree region, New South Wales (NSW). We collected data using unmanned aerial vehicle (UAV) surveys, harvester equipment, satellite imagery, ground-truthing, and feral pig stomach sampling.
- Unless otherwise stated, all values expressed as (\$) in this report should be read as referring to Australian dollars (AUD), a close-set (M) as referring to millions, and a close-set (B) to billions. All estimates are inflation-adjusted to 2025 AUD.

Results

- We identified 1,096 documents from the systematic literature search and an additional 71 documents were extracted from the authors' bibliographic databases. Upon initial screening, 85% of documents were excluded because the study did not include Australia, concerned non-production landscapes or pest species other than feral pigs, or were not written in English. Upon further screening, we retained 91 studies: 62 contributed to the agricultural impacts review, 31 to the disease transmission risks review, and 2 contributed in both.
- Queensland (QLD), NSW, and the Northern Territory (NT) had the highest proportions of land managers reporting feral pig problems.
- Over 15% of farms in every Natural Resource Management (NRM) region in QLD reported feral pig problems in 2022. In the NT, 34% of farms were impacted by feral pigs. In NSW, the highest proportions of managers reporting problems were along the QLD border. In Western Australia (WA), between 9% and 20% of land managers reported feral pig problems.
- In 2022, we estimated that \$154.6M was spent by land managers on material and labour managing feral pigs, compared to \$136.7M in 2019 and \$131.1M in 2016. Estimated total expenditure was highest in QLD and NSW (\$75.4M and \$67.7M, respectively). Total expenditure increased between 2016 and 2022 in all states except QLD and Victoria (VIC).
- Across Australia, 19% of land managers reported spending time and/or money on feral pig management in 2022, with this percentage increasing slightly relative to previous years (2019: 16.5% and 2016: 16.7%).

- Land managers incurred estimated annual residual agricultural losses of \$55.1M (\$22.4M–\$88.4M, low and high impact scenarios), \$42.7M (\$17.1M–\$68.6M), and \$36.2M (\$15.1M–\$57.1M) in 2016, 2019 and 2022, respectively. NSW and QLD suffered the largest losses.
- Agricultural losses avoided due to feral pig management were estimated to be \$31.6M (\$13.6M–\$50.1M), \$41.2M (\$18.3M–\$64.6M), and \$53.2M (\$24.2M–\$82.7M) in 2016, 2019 and 2022, respectively, with most of the avoided losses achieved for grain crops and sugarcane.
- Feral pig populations harbour a diverse range of endemic and emerging pathogens, including viruses, bacteria, and parasites, which can have important direct and indirect effects on livestock production, plant health and human health. Feral pigs and livestock often come into direct or indirect contact by sharing resources, such as feed, water, and shelter, which can create opportunities for the transfer or spillover of pathogens and associated diseases in both directions. Some of the most economically important pathogens hosted by feral pigs in Australia include *Leptospira* spp., *Brucella suis*, and Japanese encephalitis virus.
- Nine paddocks totalling 1,116 ha were surveyed by UAV to collect RGB and LiDAR imagery for quantifying crop damage. Prints, scats, or chewed and trampled plant material from feral pigs were evident in most damage patches assessed through ground-truthing.
- Crop damage in a 79 ha section of canola was quantified through imagery assessment. Patches containing some feral pig damage totalled 3.9% of the assessed area. However, feral pig damage was often considered secondary to other causes of lost yield (e.g. poor crop seeding or germination, waterlogging). Patches suffering medium-high levels of pig damage represented 2.3% of the assessed area.

Discussion

- We estimated that the costs of feral pigs to agriculture (including horticulture) in Australia was \$190.8M (\$170.1M–\$212.6M) in 2022, \$179.4M (\$153.8M–\$205.2M) in 2019, and \$186.3M (\$153.4M–\$219.5M) in 2016. These estimates include private expenditure on feral pig management as well as residual agricultural losses incurred despite control efforts, but exclude public sector research and management costs, costs related to damage to farm infrastructure, increased soil erosion, introduction of diseases, and spread of weeds.
- There was an increasing trend in feral pig management expenditure from 2016 to 2022. We also found an increasing trend in the estimated agricultural losses avoided by such management, and a decreasing trend in the estimated residual agricultural losses, which is consistent with increased management efforts reducing feral pig impacts.
- The trend since the late-1990s and early-2000s has shown an increase in the estimated costs associated with feral pig damage at a national level (as reported in various studies in the main report). However, an earlier estimate¹ of \$100M (\$213.9M if inflation-adjusted from 1996 to 2025) sits as an outlier in this overall trend. Similar disparities are noted between national annual estimates of the costs of feral pig damage and management versus regional estimates.
- Our analysis of individual commodities highlights the spatial and temporal variation in feral pig impacts and expenditures that are incurred by agricultural land managers across Australia. Across all industries assessed, more than 79% of land managers that reported having major problems with feral pigs in 2022 also reported spending money or labour managing them, although the amount spent varied widely depending on the industry. Likewise, more than 25% of land managers suffered some residual impact, but the average impact per farm varied widely (range: \$3,000–\$110,000) depending on the specific commodity.

¹ See: Choquenot D, McIlroy J, Korn T 1996. Managing vertebrate pests: feral pigs. Canberra, Bureau of Resource Sciences, Australian Government Publishing Service.

- Our estimates help to quantify the magnitude of the feral pig problem for Australian agricultural producers. Across states, the cost as a percentage of the local value of production varied from 0% (Tasmania, where there are no feral pigs on the mainland) to 3% (QLD). QLD and NSW incurred the largest costs, likely due to feral pigs being very abundant in these states and imposing significant damage to crops (grain, cotton and sugarcane), as well as these states having the largest expenditures on control measures.
- Feral pigs pose a significant and ongoing biosecurity risk as reservoirs, amplifying hosts, and potential spreaders of a range of endemic and emerging pathogens affecting livestock, horticulture, and human health. A recent Japanese encephalitis virus outbreak showed that feral pigs can contribute to large, rapid, and costly disease events with substantial production losses and long-term biosecurity costs. At the farm level, disease impacts linked to feral pigs can be severe but sporadic. Overall, disease risks associated with feral pigs are potentially high at local to regional scales, poorly quantified at national scales, and justify continued investment in surveillance, biosecurity, and coordinated feral pig management to reduce the likelihood and harm from future disease outbreaks.
- Assessments using canola as a model crop support the use of imagery collected by UAV to help delineate pig damage to crops. However, ground truthing will be required to validate imagery and correct for yield losses that do not result from feral pigs. Using two-dimensional RGB imagery also requires caution given accurate measurements of lost crop yield may require volumetric measurements of lost plant biomass. While satellite imagery is a potentially suitable source of imagery to quantify pig damage, the level of resolution required to delineate pig damage in canola, wheat and sorghum fields needs to be investigated before recommendations on satellite imagery capture can be made.

Recommendations

- Develop reliable density–damage impact functions for specific high value commodities.
- Quantify feral pig damage to pasture in beef and sheep raising areas based on robust data.
- Update lamb predation rates by feral pigs across NSW and QLD sheep regions.
- Assess whether specific fruit and nut crops incur economically important damage by feral pig (e.g. macadamia nuts in south-east QLD).
- Increase the resolution of PAWS to include more information about the specific commodities produced at each farm.
- Assess the reliability of self-reporting of perceived feral pig damage in PAWS.
- Continue investment in surveillance, biosecurity, and coordinated feral pig management to reduce the likelihood and harm from potential future disease outbreaks.
- Further investigate data from our 2025/2026 field trials to develop refined methodologies.

Future research questions

- Determine the positive economic and social impacts of feral pigs (e.g. commercial, recreational) and include these in future economic valuations.
- Investigate what mix of public and private investment in feral pig research and management is appropriate. What are the real market failures where public investment is appropriate, and under what circumstances are management costs being socialised while profits are privatised?
- Conduct a detailed agroeconomic analysis to determine why national-level cost estimates are much lower than the sum of regional studies. How should national methods be recalibrated to avoid systematic underestimation? How reliable are regional studies?

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I. Background to Research

Feral pigs (*Sus scrofa*) can have a wide range of unwanted impacts in agricultural landscapes, including damage to crops, pasture, soil and infrastructure, lamb predation, weed dispersal, water quality, and disease transmission to domestic livestock, wildlife, humans and plants. Despite these extensive impacts, there has not been a comprehensive review of the agricultural impacts of feral pigs for almost 30 years (Choquenot et al. 1996). Agricultural production systems have evolved significantly since then. Furthermore, sophisticated technologies (e.g. satellites and unmanned aerial vehicles) and data-management systems are being used by many producers to monitor biomass, crop yield and nutritive quality over time. These tools could be applied to measure changes in biomass and vegetative cover consistently and cost-effectively to greatly improve our understanding of feral pig impacts on agricultural systems.

It is therefore timely to review and update our knowledge of the agricultural impacts of feral pigs in Australia. Research also needs to be conducted into how current technologies, including satellite and drone imagery, could be used to quantify the impacts of feral pigs on crops and pastures, and how these impacts translate into reduced productivity and profitability.

2. Objectives of the Research Project

This study aims to address the following objectives:

- Provide a current assessment of the impacts and costs that feral pigs have on agriculture (including horticulture) in Australia. This objective includes a qualitative literature review and a quantitative analysis of Pest Animal and Weed Management Survey (PAWS) data collected by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), Department of Agriculture, Fisheries and Forestry, Australian Government (ABARES-PAWS for short).
- Critically assess exotic and endemic zoonotic disease transmission risks that feral pigs pose to domestic livestock and agricultural crops.
- Pilot methods that land managers could use to capture relevant data from currently used technologies to better quantify agricultural impacts, using broadacre grain cropping as a model system.
- Propose pathways for robust measurement of return on investment from feral pig management activities.
- Identify key questions that could be addressed by further work.

3. Introductory Technical Information

Feral pigs are considered one of the worst invasive species of mammals in the world (Lowe et al. 2000; Courchamp et al. 2007; VerCauteren et al. 2020; Risch et al. 2021). They possess a high reproductive potential relative to most large mammals (Choquenot et al. 1996; McIlroy and Nugent 2021) and have a broad omnivorous diet (Ballari and Barrios-Garcia 2014). These factors have facilitated increases in their geographic ranges and numbers in many parts of the world (Long 2003; Bevins et al. 2014; Bengsen et al. 2017; Aschim and Brook 2019; Hegel et al. 2022).

The unwanted impacts of feral pigs in invaded areas include threatening populations of indigenous fauna and flora (Coblentz and Baber 1987; Hone 2002; Roemer et al. 2002; Barrios-Garcia and Ballari 2012; Murphy et al. 2014; McDonough et al. 2022), facilitating the establishment of invasive alien species (Aplet et al. 1991; Nogueira-Filho et al. 2009; Barrios-Garcia and Simberloff 2013; Latham et al. 2017), transmission of diseases (Wilson and Choquenot 1995; Hampton et al. 2006; Meng et al. 2009; Nugent et al. 2015; Brown et al. 2018; Palencia et al. 2023), and damaging broadscale agricultural, silvicultural, and horticultural assets (Choquenot et al. 1996; Seward et al. 2004; Bengsen et al. 2014; Gentle et al. 2015; Wishart et al. 2015; Latham et al. 2020).

Many unwanted impacts are caused by feral pigs disturbing soil at the surface layer with their rooting behaviour (Hone 1995). Rooting is highly destructive to pasture and crops (McIlroy and Nugent 2021), whereas the impacts of rooting in forests are more nuanced, being potentially negative, neutral, or even positive (Arrington et al. 1999; Cole and Litton 2014; Parkes et al. 2015; Barrios-Garcia et al. 2023). Rooting by feral pigs may also reduce global soil organic carbon stocks (O'Bryan et al. 2022a, b; Rowland and Lovelock 2024), although this has been disputed (Don 2022).

Many of the earliest introductions of pigs into Australia were probably not documented (Choquenot et al. 1996). The first official record of pigs being introduced onto the Australian continent occurred with the arrival of at least 48 animals with the first European settlers in Sydney in 1788 (Bengsen et al. 2017). These pigs rapidly established a feral population, increased in numbers, spread from their release site, and were subsequently controlled to mitigate their unwanted impacts (Pullar 1953). Numerous additional introductions and releases occurred across Australia and feral pigs continue to expand from these populations (Choquenot et al. 1996; West 2008; Cowled et al. 2009; Bengsen et al. 2017; Channon 2021).

There has been much debate about how many feral pigs are in Australia. Most studies that have reported abundance estimates either lack scientific basis or have incorrectly cited published estimates that were made using empirical data and statistical analyses (see references in Hone and Buckmaster 2014). Hone's (1990) estimate of 13.5M feral pigs (95% confidence interval: 3.5M–23.5M) has been widely cited. However, a more recent study suggests that the abundance may be much lower than previously estimated (mean = 3.2M; 95% CI = 2.4–4.0M; Hone 2021). Irrespective of which study one favours, feral pigs are widely distributed across Australia and abundant in many areas.

The states with the most widespread and abundant populations of feral pigs include Queensland (QLD) and New South Wales (NSW), as well as northern parts of Northern Territory (NT; Figure 1; also see West 2008; Bengsen et al. 2017). Within these states they are considered a major vertebrate pest, e.g. they are ranked as the second highest priority introduced vertebrate pest species (after wild dogs, *Canis familiaris*) in QLD (Harriott et al. 2022).

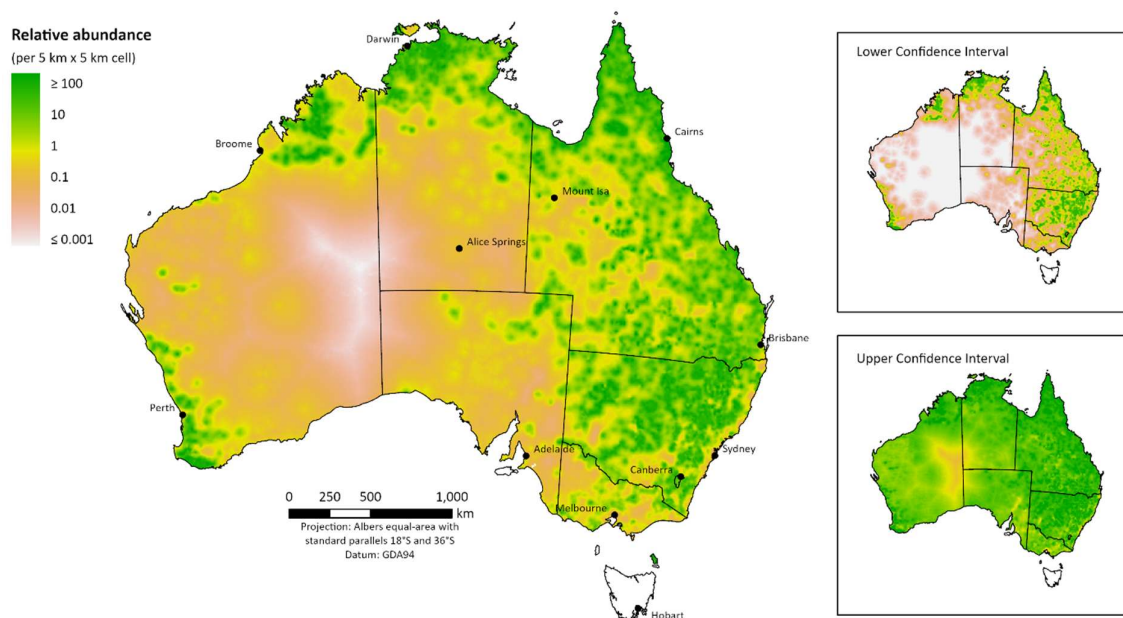


Figure 1. Relative abundance of feral pigs (*Sus scrofa*) in Australia as of 2024. Relative abundance was estimated for each 5 km × 5 km cell in the raster grid, which is proportional to, but not equal to, the absolute abundance of feral pigs in that cell. The relative abundance model does not account for temporal variation in abundance and spatial distribution. Individual data sets that contributed to this model were not all collected at the same time. Last date at which data collection occurred ranges from 2018 to 2024. Source: ABARES & CSIRO (2024).

Feral pigs are also widespread and common in much of the jarrah forest and adjacent farming areas of southwestern Western Australia (WA). They are found in the coastal agricultural areas north of Perth and on the larger Kimberley river systems (Cook 2014). Although absent from or uncommon in north Kimberley Region, pig sightings are becoming more common around Mount Elizabeth Station and in the northern part of the Wunaamin Miliwundi Ranges (formerly the King Leopold Ranges; Corey et al., 2013).

Feral pig distribution is patchy in Victoria (VIC). They are absent from much of the state, but there are some pockets of low to moderate abundances around the centre of the state (West 2008; Figure 1). South Australia (SA) has relatively few feral pigs, with the highest relative abundances occurring in the northeast of that state near the border with QLD (West 2008). Feral pigs are absent from mainland Tasmania (TAS), although several populations of 'roaming' farmed pigs threaten that status (Invasive Species Council 2024). However, feral pigs occur on Flinders Island in the Furneaux Group, where they have been present since the 1800s after being released by sealers and following a shipwreck in 1877 (Statham and Middleton 1987).

Although the bioclimatic conditions in the arid interior of Australia are likely unfavourable for pigs (Bengsen et al. 2017), expansion of their geographic range is expected to continue in some areas (e.g. Cowled and Giannini 2007). For example, the area of suitable habitat for feral pigs in southwest WA is much larger than the current known distribution of feral pigs in that area (Bain and Kinneer 2015). Choquenot and Ruscoe (2003) and Cowled et al. (2009) predicted that in the absence of adequate control measures and where the required movements from essential resources are not too great, feral pigs will continue to expand into suitable surrounding habitat in southwest WA. Conversely, some studies have suggested that suitable feral pig habitat is less widely available than previously thought, e.g. in northern Australia (Froese et al. 2017).

Choquenot et al. (1996) conducted a review of the economic impacts of feral pigs in Australia. These authors state that the financial impact of feral pigs on agriculture includes three components: the value of the direct

losses to agricultural production; the value of the continuing expenditure on pig control; and the value of lost opportunities to take profit from alternative investment of this expenditure.

It is difficult to quantify the costs of the damage that feral pigs cause to agriculture, especially at large spatial and temporal scales because of the high variability in feral pig numbers across space and time (Hone 1995). This can result in a negative exponential frequency distribution, whereby many sites suffer minimal damage and a few incur high levels of damage (Hone 1988; Mitchell and Mayer 1997). Spatiotemporal variability in feral pig activity, abundance and damage, as well as the influence of low empirical sampling intensity and biases in landholder perceptions have likely contributed to the variability in regional and national cost estimates of damage caused by feral pigs. The Australian Bureau of Agricultural and Resource Economics and Sciences Pest Animal and Weed Management Survey (ABARES-PAWS) data and time-series analyses presented in this review should, in part, overcome some of the aforementioned limitations and biases.

4. Research Methodology

4.1 Literature Review

We systematically searched, compiled, and reviewed the literature for relevant descriptive and empirical studies that contributed to our first two objectives: (1) assessing the impacts and costs that feral pigs have on agriculture (including horticulture); (2) assessing disease transmission risks that feral pigs pose to livestock and crops. To avoid any possible biases associated with a non-systematic review, we followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for conducting and reporting of systematic reviews (Page et al. 2020).

We used the following terms in the query combinations in Web of Science and Google Scholar:

(‘Feral pigs’ OR ‘Feral swine’ OR ‘Feral hog’ OR ‘wild hog’ OR ‘Sus scrofa’) AND (impact OR cost* OR damage* OR loss* OR destruction* OR consumption* OR depredation*) AND agriculture AND Australia.*

(‘Feral pigs’ OR ‘Feral swine’ OR ‘Feral hog’ OR ‘wild hog’ OR ‘Sus scrofa’) AND (impact OR cost* OR damage* OR loss* OR destruction* OR consumption* OR depredation*) AND crop* AND Australia.*

(‘Feral pigs’ OR ‘Feral swine’ OR ‘Feral hog’ OR ‘wild hog’ OR ‘Sus scrofa’) AND (impact OR cost* OR damage* OR loss* OR destruction* OR consumption* OR depredation*) AND horticulture AND Australia.*

(‘Feral pigs’ OR ‘Feral swine’ OR ‘Feral hog’ OR ‘wild hog’ OR ‘Sus scrofa’) AND (impact OR cost* OR damage* OR loss* OR destruction* OR consumption* OR depredation*) AND livestock AND Australia.*

(‘Feral pig’ OR ‘Sus scrofa’) AND (disease* OR pathogen* OR infection* OR biosecurity OR ‘disease risk’) AND (cost* OR impact* OR economic* OR burden* OR ‘lost production’ OR loss* OR ‘management cost*’) AND Australia*

(‘Feral pig’ OR ‘Sus scrofa’) AND (reservoir OR vector OR host OR spillover OR transmission OR ‘disease spread’) AND (economic* OR cost* OR impact*) AND Australia*

(‘Feral pig’ OR ‘Sus scrofa’) AND (‘livestock disease*’ OR ‘animal disease*’ OR leptospirosis OR brucellosis) AND (cost* OR impact* OR ‘economic loss*’ OR ‘production loss*’ OR ‘disease management’) AND Australia*

(‘Feral pig’ OR ‘Sus scrofa’) AND (‘plant disease*’ OR phytopathog* OR ‘soilborne pathogen*’) AND (‘Panama disease’ OR ‘Panama TR4’ OR ‘Fusarium wilt’ OR ‘Fusarium oxysporum’ OR Phytophthora OR ‘banana disease*’) AND (cost* OR impact* OR ‘production loss*’ OR ‘management cost*’) AND Australia*

(‘Feral pig’ OR ‘Sus scrofa’) AND (biosecurity OR surveillance OR ‘disease control’ OR ‘disease management’ OR eradication OR monitoring) AND (government OR ‘public cost*’ OR ‘institutional cost*’ OR ‘market failure’ OR ‘public good*’) AND (economic* OR cost* OR burden* OR expenditure) AND Australia*

We only included literature about Australia and studies that conducted research in production landscapes (i.e. land that is used for broadacre agriculture and/or horticulture). Our web searches were conducted during April–May 2025.

We included any relevant peer-reviewed articles, book chapters, government reports, and conference proceedings. Additionally, we searched the authors’ bibliographic databases for any published or unpublished works (including peer-reviewed articles, government reports, conference proceedings, books, theses, and dissertations) that could contribute to our understanding of the current impacts caused by feral pigs in

Australia. While we placed no restriction on publication date, we note that as this review's focus was updating previous reviews of feral pig impacts in Australia (Tisdell 1982; O'Brien 1987; Choquenot et al. 1996; Bengsen et al. 2014, 2017), our use of older literature was not exhaustive.

4.2 Analysis of ABARES data

One key source of data for improving our current understanding of the impacts of feral pigs and how those impacts might be changing over time is from PAWS, which is a series of surveys collected by ABARES (Stenekes et al. 2023). The ABARES-PAWS series (which we may refer to as PAWS for brevity) aimed to determine what changes have occurred in pest and weed management activity on agricultural properties in Australia. The approach consisted of surveys of managers of agricultural properties conducted in 2016, 2019, and 2022. Some of the survey respondents participated in more than one of the surveys, but others only participated once. The sample of agricultural properties were drawn from a population list from the Australian Business Register (ABR) maintained by the Australian Bureau of Statistics (ABS) Agricultural Census frame. The sampling strategy uses a stratified sampling design to represent the population of agricultural properties in Australia by broad industry type (broadacre, dairy, other livestock, and horticulture), their Natural Resource Management (NRM) region (Figure A1.1 in Appendix 1), and the estimated value of their agricultural operation (EVAO). The PAWS data is sampled and reported at the level of NRM regions' 2016 reference year. The regions have not changed significantly between 2016 and 2025, although there have been some minor changes to boundaries and region names.

The PAWS data were analysed in R (version 4.4.3) using the R 'survey' package (Lumley 2024). We mainly used descriptive statistics to describe or summarise the data across the three PAWS years, including measures of frequency, e.g. counts and percentages/proportions; and measures of central tendency, e.g. means and medians.

Management effort is aimed at reducing the negative impact(s) that a pest has on a production system. In some cases, management is highly effective and land managers do not incur any costs other than those related to controlling the pest. In other cases, management is ineffective or only partially effective and therefore there is some residual impact on production, despite management efforts. Some land managers may choose not to manage feral pig populations that occur in their area. These farm businesses would suffer impacts on production if the feral pig population in their area damaged agricultural assets.

To estimate the direct agricultural cost of feral pigs we considered: (1) control expenditure incurred to manage pigs; (2) losses incurred despite control (which we term 'residual agricultural losses'). We assumed residual agricultural losses were suffered by those land managers who indicated in PAWS that pigs were a major problem for them but that their control of pigs was not highly or moderately effective. Residual agricultural losses were estimated based on the dollar value of the residual production lost due to pig impacts. The control expenditure was estimated as the dollar value of labour and other inputs used in undertaking control. We followed the methods detailed in Hafi et al. (2023) to derive estimates of control expenditure and residual agricultural losses at national and state levels, as well as for the three time periods of PAWS. In taking this approach, we considered only the private components of both control expenditure and residual agricultural losses; public components (e.g. expenditure by state or national governments) were not included. We applied a slight modification to Hafi et al.'s (2023) methods by assuming:

- (i) Full residual agricultural impact is suffered by those land managers experiencing a major problem with feral pigs if they do not report that any form of management is moderately or very effective.
- (ii) Half of the residual agricultural impact is suffered by those land managers experiencing a major problem with feral pigs but reporting that at least one form of management is moderately effective.

- (iii) No residual agricultural impact is suffered by land managers experiencing a major problem with feral pigs but reporting that at least one form of management is very effective.

We also estimate total agricultural losses due to feral pigs by assuming full residual impact was suffered for all land managers who indicated pigs were a major problem (including those conducting very or moderately effective management) and derived avoided agricultural losses as the difference between total agricultural losses and residual agricultural losses.

For those land managers suffering residual impacts, the estimated magnitude of the impact was based on studies reporting the yield losses due to feral pigs, and the value of the commodities they produce (extracted from the ABS 'Value of Agricultural Commodities' data series, years 2011/12–2021/22, ABS 2022). We provide estimates for a most-likely scenario of feral pig impact, as well as low and high impact scenarios using the percentage impact values presented in Tables 17 and 18 in Hafi et al. (2023; reproduced in Tables A2.1 and A2.2 of Appendix 2). See Appendix 2 for a detailed description of the analytical methods used and assumptions made.

We estimated the above quantities for the whole of Australia as well as for each state and territory. We also provide a detailed analysis of the impact that feral pigs have on individual agricultural commodities at the NRM level where sample sizes were large enough (i.e. $n > 15$ farms reporting problems with feral pigs in any of the years when the survey was conducted). Agricultural commodities used in PAWS were identified using the Australian and New Zealand Standard Industrial Classification (ANZSIC, see Appendix 3 for ANSIC categories).

Additional assumptions made for each individual commodity are detailed under Section 5.1.

Unless otherwise stated, all values expressed as (\$) in this report should be read as referring to Australian dollars (AUD), a close-set (M) as referring to millions, and a close-set (B) to billions. All estimates are inflation-adjusted to 2025 AUD, using the Reserve Bank of Australia Inflation Calculator, <https://www.rba.gov.au/calculator/annualDecimal.html>, for ease of comparison.

4.3 Pilot methods for better quantifying impacts and costs

The Moree region, in the North West NSW NRM, situated in the northern cropping region was considered an ideal study area to examine potential methods for assessing pig damage given historical reports of feral pig damage to crops (Powell and Revell 2023; Powell 2024), coverage of intensive cropping, and apparent high seasonal (relative) feral pig abundance. The collaboration with local experienced agronomists, including those experienced in assessing pig damage (Lockrey 2025), was also a key reason for selecting this region as the study area.

Wheat and canola (winter) and sorghum (summer) were identified as suitable model crops for pilot trials of damage assessment in the Moree region. This was supported by local agronomist experience, survey of land managers reporting losses to crops (e.g. Powell 2024), anticipated levels of feral pig damage, the relatively high area under production, and the corresponding high value of anticipated economic losses (see Section 5.1.6). Initially, agronomists from AMPS Moree were engaged to identify and shortlist potential paddocks likely to suffer from pig damage in the Namoi region, based on grower advice and historical pig damage. This allowed limited project resources (e.g. drone flights) to be focussed on quantifying areas with known damage, rather than on broader surveys to locate paddocks with damage for study.

After securing grower agreement and completing flight planning and approvals, we conducted aerial surveys of the area using advanced technologies (described below in section 4.3.2) to capture comprehensive data for analysing feral pig damage to crops.

4.3.1 Study area, crop and paddock selection

We completed field inspections to examine each site and crop paddock for signs of feral pig activity. Crop paddocks were initially investigated through a crop perimeter and walk-in visual survey, observing for signs of feral pig use (e.g. pads, tracks, scats) and signs of damage (knocked down, fully or partially consumed plants). Paddocks were selected for further field assessments based on initial aerial scans of the area, using an unmanned aerial vehicle (UAV), for pig activity and potential damage.

4.3.2 Damage assessment methods

Unmanned aerial vehicle surveys

Crops selected for assessment were surveyed using a UAV. Surveys were conducted before harvest for wheat and canola (2–5 October 2025) and for sorghum (19–22 January 2026). UAV crop surveys were completed as close as practicable to pre-harvest, with the aim of capturing the total accumulated crop damage pre-harvest, within the constraints in drone contractor availability. These periods provide a survey of crop damage at advanced growth stages following varying periods of attractiveness and palatability to foraging animals.

UAV flights were conducted piloting a DJI Enterprise Matrice 300 (Da-Jiang Innovations, Shenzhen, China) using either a Zenmuse P1 sensor utilising the visible spectrum (Red, Green, Blue; RGB) or a Zenmuse L1 LiDAR sensor (Light Detection And Ranging). We used DJI Pilot (Da-Jiang Innovations, Shenzhen, China) to delineate paddock survey boundaries and design efficient flight transects. We employed DroneDeploy for initial photogrammetric processing, enabling rapid map generation and streamlined management of spatial imagery.

The P1's RGB sensor (45 MP) captured a series of high-resolution colour images. Image overlap was 40–70%, and 70–80% frontal to enable stitching to produce a high quality orthomosaic map. The resulting high-resolution orthomosaic map provides a two-dimensional overview of the surveyed area. In addition, a photogrammetrically derived three-dimensional point cloud was generated to produce a Digital Elevation Model (DEM), representing surface variation across the field and serving as a proxy for crop canopy height. Flights utilising the P1 sensor were primarily conducted at an altitude of 50 m above ground level (AGL) to maximise resolution and gain the lowest ground sampling distance (GSD) of 0.6 cm. To complement the high-resolution surveys, additional flights were conducted at 120 m AGL to provide broader spatial context, enabling assessment of overall crop health and the identification of additional areas of damage.

LiDAR flights (using the L1 sensor) were conducted at 50–80 m AGL. Topology mapping with LIDAR can be used to generate Digital Surface Models (DSM) and Digital Terrain Models (DTM), which can be used to derive accurate volume estimation of vegetation density (biomass). Changes in plant volume can be used to identify and map pig damage. These measures can be compared to yield maps from the harvester which may also give indications of crop density.

A previous study suggested that 0.9 cm GSD would likely be sufficient to differentiate feral pig damage patches of c. 1 m² or greater (Fischer et al. 2019). For vegetation mapping (RGB/LIDAR), flight height of c. 80 m AGL or less is required to provide imagery at resolution of at least 0.9–1.0 cm GSD. Flights were planned to provide 0.6 cm GSD wherever possible.

All flight operations were conducted by QLD Department of Primary Industries Civil Aviation Safety Authority (CASA)-licensed pilots following departmental UAV operational policy and risk assessment protocols.

Yield mapping

Modern harvester equipment often has yield mapping capability that provides a spatial layer of harvested crop yield across a paddock. Resolution is coarse given it is collected at the scale of harvester comb width (often 9–12 m), so yield mapping is unlikely to accurately delineate smaller patches of damage commonly expected from feral pigs (Gentle et al. 2011; Lockrey 2025). Without ground truth data, yield reductions from maps may also be inaccurately attributed to pig damage rather than other causes such as excessive moisture, disease or planting machinery issues (Lockrey 2025). However, yield mapping could help validate crop yield variation that could inform or correct estimations of yield losses in each damaged patch. As a result, for the paddocks surveyed via UAV, we downloaded yield maps from harvesters (when collected) for comparison to data collected through our damage mapping.

Satellite imagery

There is a range of satellite imagery available through commercial providers. For example, Nearmap Australia Pty Ltd provides, under subscription, visible spectrum images captured at multiple times per year, typically at a coarser GSD. Representative layers of Normalised Difference Vegetation Index (NDVI) are available at no cost at 10 m resolution (e.g. www.datafarming.com.au) – but higher resolution requires purchase. Satellite imagery has several advantages for imagery capture, particularly in scalability (ability to capture imagery at large-scale) and forward-scheduling at regular time intervals (e.g. 7 days) for repeat imagery capture across time (i.e. a crop cycle). For efficiency, we considered the optimal approach to examining resolution requirements was through collecting high resolution UAV imagery (i.e. 0.6 cm GSD) and then post-capture resampling at reduced resolution (e.g. 2 cm, 7 cm, 30 cm, 1 m, and 10 m GSD). This provides the ability to examine the effects of resolution on pig damage delineation and compare high resolution UAV to available satellite resolutions to inform future approaches. Hence efforts in the pilot trials logically focused on UAV imagery data collection.

Ground truthing

A sample of the damage patches detected from the UAV imagery or by direct observation during initial field inspections was checked by an observer from the ground. Each patch was examined primarily to determine the taxa (or other agent/s) responsible for the crop damage to aid with accurate classification of aerial imagery. Damage was classified by the type of damage (e.g. trampled, consumed, ground rooting, other) and by the taxa or agent/s responsible (pig, macropod, emu, other). The taxa or agent/s responsible were identified primarily by the presence of animal signs (e.g. pads, prints or scats) or other non-animal sign (e.g. poor crop germination, machinery tracks). There was no ground truthing of undamaged areas.

Stomach sampling

Confirmation of crop consumption by feral pigs could potentially support assessments of crop damage and density–damage relationships through helping to quantify the per-capita consumptive impacts of pigs. If there was aerial shooting in the region where damage assessments took place, the stomachs of culled pigs were sampled opportunistically. Entire pig stomachs were removed, individually bagged and a matching GPS location was recorded. Stomachs were sent to a commercial provider (Scats About, Majors Creek, New South Wales) to quantify dietary composition.

4.3.3 Damage assessments

The following methods have been trialled to delineate crop damage from UAV imagery, initially utilising canola as the model crop.

Following data conversion, Zenmuse PI data were used to generate a DEM resulting in the generation of contours of crop surface of the canola. The resultant contour map was overlaid with the high resolution RGB orthomosaic in GIS software (QGIS) to provide an initial layer of potential damage patches (i.e. contours representing possible damage patches). This layer was viewed by subject matter experts (SME) for manual selection, re-delineation (where required), and classification as damage patches. Ground-truthed data assisted the SME to classify the damage type (pig, other, or a combination of both) for each damage patch. These were then grouped into four categories of damage based on the relative contribution from feral pigs (low: <50%; medium: 50–80%; high: >80%) or from other causes (other). The resulting polygons were then used to determine the total extent of damage. The percentage of crop damaged by pigs was calculated based on the extent of damage (polygon area) compared to the total crop area. With corresponding crop yield (tonnes/ha) and net crop value at harvest (\$/tonne), the value of economic losses due to pigs can be calculated.

The second approach used LiDAR imagery to derive a structural model of canola crop damage (following its application in wheat; see Kuželka and Surový [2018]). LiDAR data was used to generate a DSM which provided a spatial layer of the height of the crop canopy structure. A DTM was then used to generate a model of the ground (soil) surface. To obtain a crop height model (CHM), the DTM was subtracted from the ground surface model (GSM) to estimate true (i.e. net) crop height. The CHM could then be examined for reduced height values to identify areas of the crop that were absent or trampled, and measure lost plant volume (i.e. lost yield).

5. Results

We identified 1,096 documents from the systematic literature search and 71 additional documents from grey literature extracted from the authors' bibliographic databases. Figure 2 shows the search process, and the number of documents considered at each step and ultimately included or excluded. Eighty-five percent of the studies found through Web of Science and Google Scholar were discarded after inspection of the title and/or abstract. Articles were excluded from the review because the study did not include Australia, or it concerned non-production landscapes or pest species not including feral pigs. Some of the discarded articles were not written in English. All documents identified from the authors' databases were retained for further screening. Of the 171 studies from which we screened their full-text, 47% were focused on control tools and methods, discussed impacts in non-agricultural environments, or were not specifically focused on Australia. These studies were also excluded. The final literature review was based on 91 studies, 62 of which contributed to the agricultural impacts review, 31 were included in the disease transmission risks review, and two were included in both. The information extracted from studies contributing to the agricultural impacts review was split and presented by commodity type and is included alongside the analysis of the PAWS data in Sections 5.1.1-5.1.6.

5.1 Impacts and costs of feral pigs on agriculture, including analysis of ABARES-PAWS data

Feral pigs are a widespread problem in Australia and are a declared pest in all states and territories. QLD, NSW, and NT have the highest proportion of land managers reporting feral pig problems (Figure 3), and this has been consistent across the three periods of PAWS. Although the problems caused by feral pigs in WA are lower overall compared to QLD, NSW, and NT, feral pigs are perceived as a problematic destructive pest in all NRMs within that state (Figure 4). The lowest perceived problems with feral pigs occur in SA, TAS, and VIC.

The NRMs with highest perceived problems with feral pigs in 2022 were Cape York (93%, SE = 6%), Northern Gulf (81%, SE = 8%), Southern Gulf (81%, SE = 7%), Burdekin (85%, SE = 6%), South West QLD (86%, SE = 6%; all in QLD), and North West NSW (87%, SE = 5%; Figure 4). More than 15% of farms in every NRM in QLD reported problems with feral pigs. In the NT, 34% (SE = 8%) of farms were affected by feral pigs. The proportion of farms reporting feral pig problems in NSW was variable, but the highest proportions were reported in the NRMs closest to the border with QLD: North West NSW (87%, SE = 5%), Western (66%, SE = 6%), Central West (57%, SE = 7%), and Northern Tablelands (51%, SE = 10%). In WA, between 9% and 20% of land managers reported having problems with pigs, with the highest problems reported in Northern Agricultural (18%, SE = 6%) and South West (19%, SE = 5%).

In 2022, agricultural land managers spent an estimated \$154.6M a year on material and labour managing feral pigs, compared to \$136.7M in 2019 and \$131.1M in 2016. Estimated total expenditure was highest in QLD and NSW (Figure 5), with total expenditure on feral pig management of \$75.4M and \$67.7M, respectively, in 2022. Total expenditure increased between 2016 and 2022 in all states except for QLD and VIC (Figure 5). Expenditure changes were due to both changes in the level of the problem with feral pigs as well as changes in the cost of the inputs (see Stenekes et al. 2023).

Across Australia, 19% of land managers reported spending time and/or money on feral pig management in 2022, with this percentage increasing slightly relative to the two previous years of the survey (2019: 16.5% and 2016: 16.7%). Of those that conducted pig management, 50% spent less than \$3,336.90 in 2022, while 5% spent more than \$20,000 (Figure A4.1 of Appendix 4).

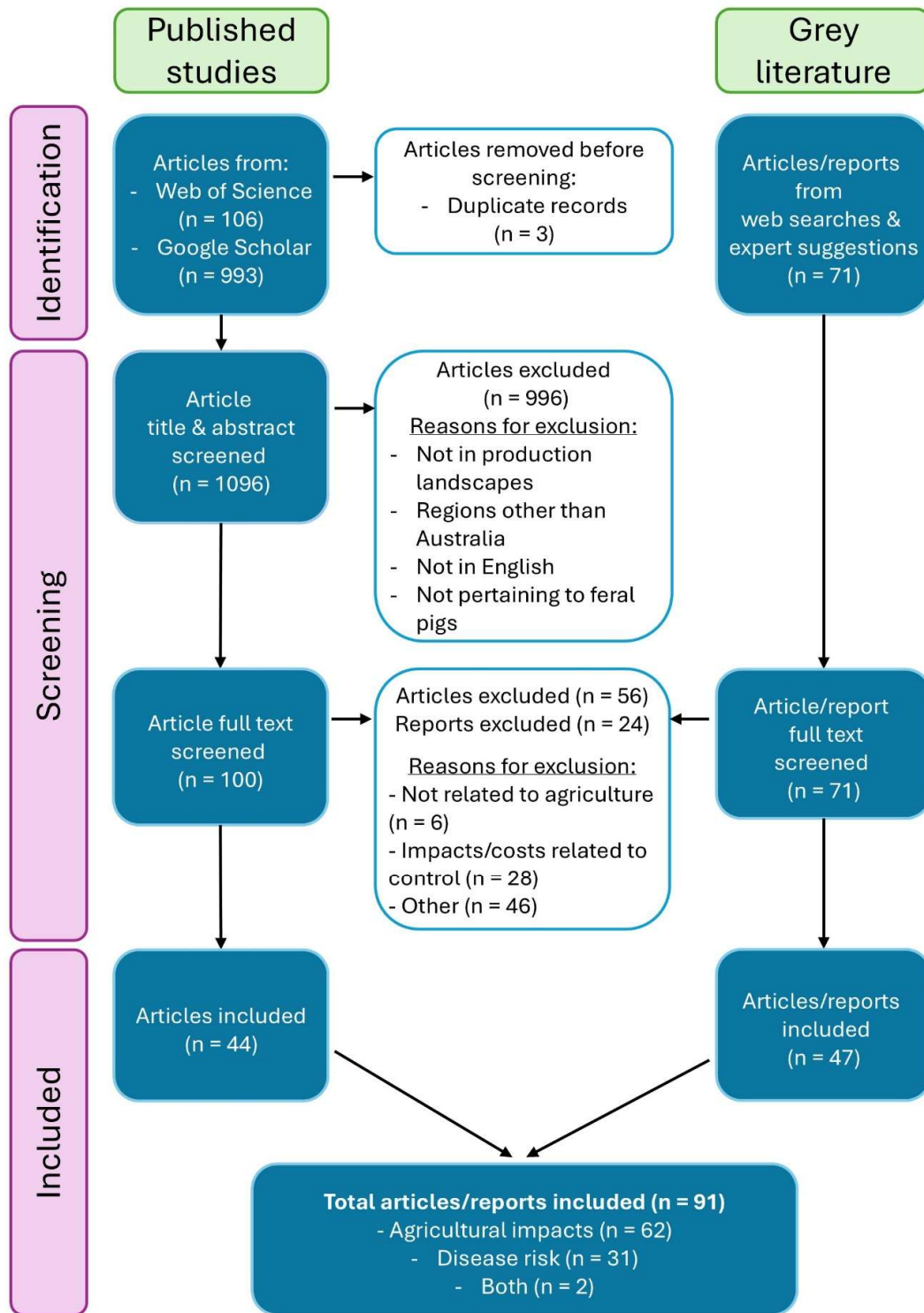


Figure 2. Modified PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram showing the decision process for including or excluding identified documents related to the agricultural impacts and disease transmission risks of feral pigs in Australia. The results include documents from a systematic literature search and grey literature extracted from the authors' bibliographic databases. Note: Articles used solely in Section 3 have not been considered in these tallies.

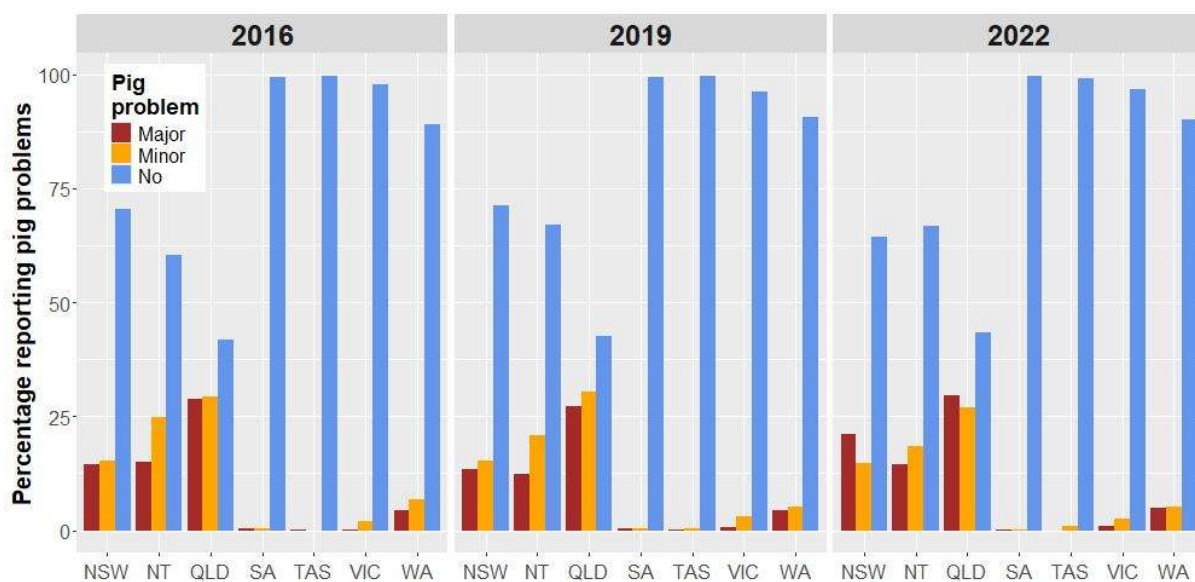


Figure 3. Percentage of land managers reporting major, minor and no problems with feral pigs by state/territory, for the three years when the ABARES-PAWS was conducted.

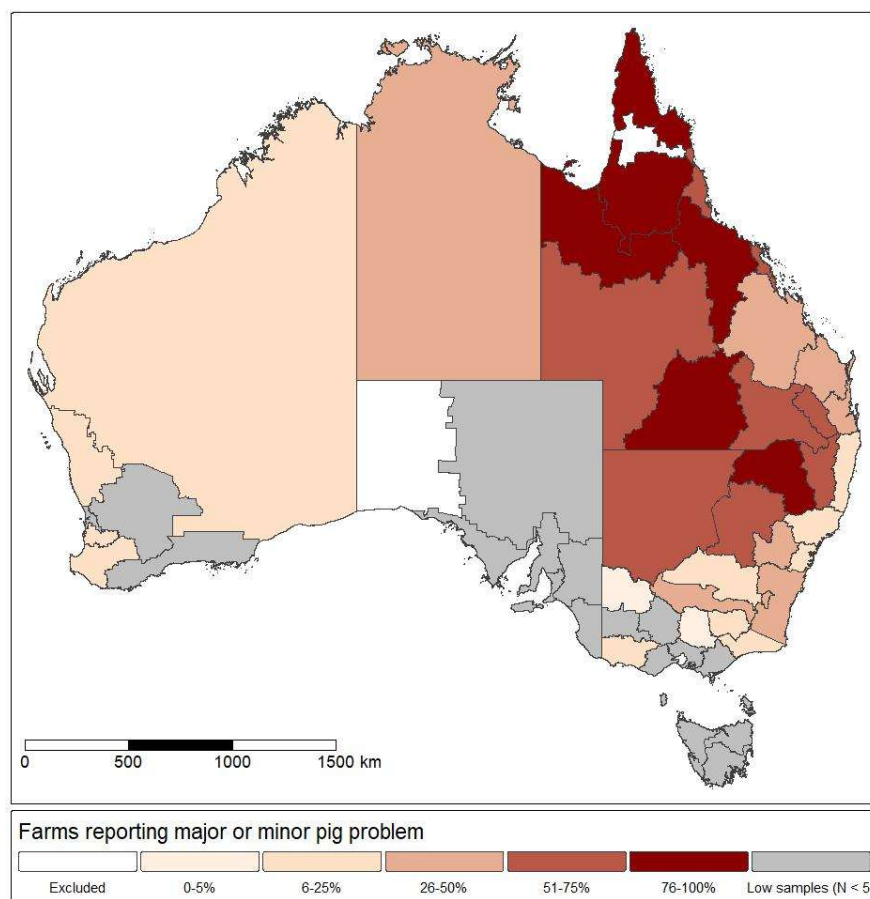


Figure 4. Percentage of land managers reporting problems with feral pigs in 2022 in each of 54 NRM regions covered by the ABARES-PAWS. Alinytjara Wilurara NRM (SA) and Cooperative Management Area NRM (QLD) were excluded from the ABARES-PAWS due to insufficient sample of farms. Note: the grey category 'Low samples (N < 5)' are regions where there was an adequate number of survey samples, but a very low number of land managers who reported a feral pig problem.

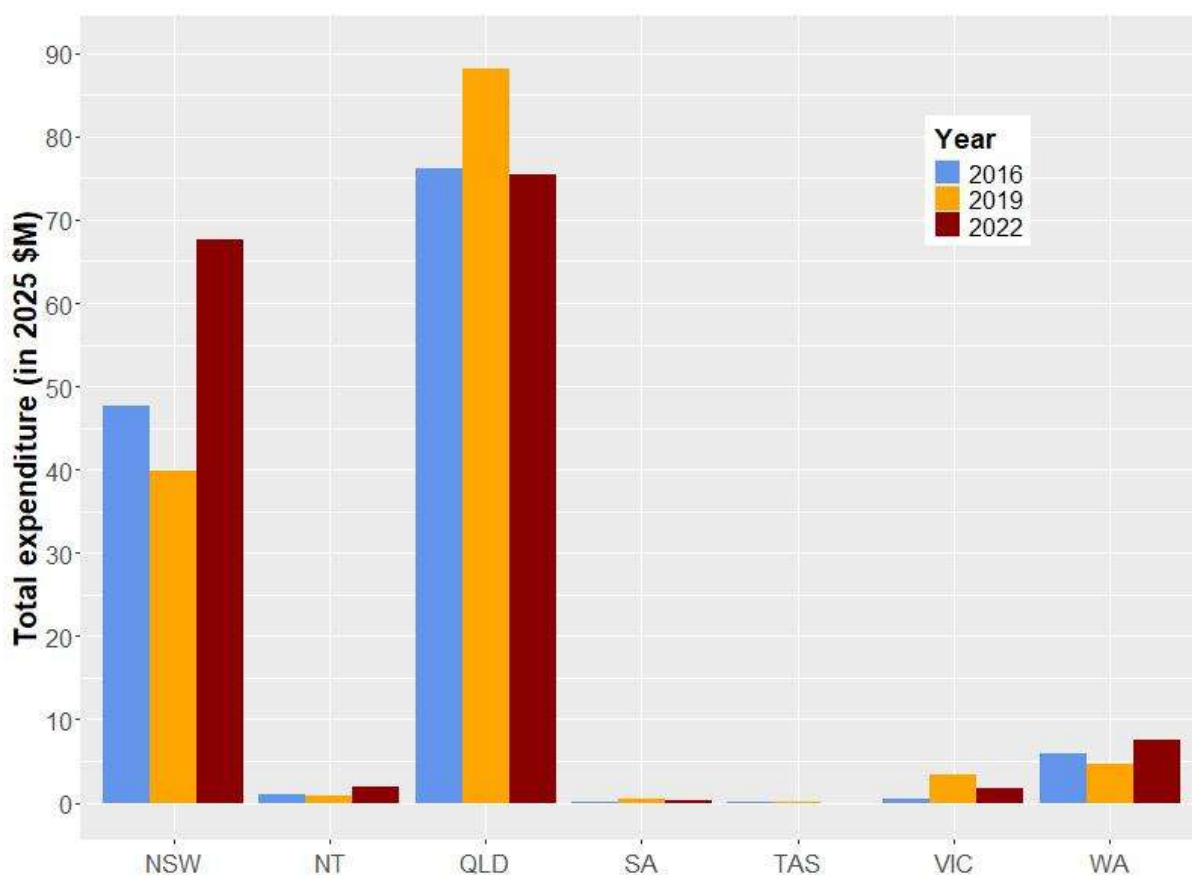


Figure 5. Total expenditure (in 2025 \$M) per year spent by land managers managing feral pigs by state/territory, for the three periods of the ABARES-PAWS.

In addition to expenditure on management, land managers incurred estimated annual residual agricultural losses of \$55.1M (\$22.4M–\$88.4M, low and high impact scenarios), \$42.7M (\$17.1M–\$68.6M), and \$36.2M (\$15.1M–\$57.1M) in 2016, 2019, and 2022, respectively. Estimated residual losses were mainly from damage to grain crops and sugarcane, and to a lesser extent livestock production (Figure 6). Additional losses due to other impacts such as competition for pasture on grazing land, damage to infrastructure, or losses to horticultural businesses were not estimated because of inadequate data. Agricultural losses avoided due to the implementation of feral pig management were estimated to be \$31.6M (\$13.6M–\$50.1M), \$41.2M (\$18.3M–\$64.6M), and \$53.2M (\$24.2M–\$82.7M) in 2016, 2019 and 2022, respectively, with most of the avoided losses achieved for grain crops and sugarcane (Figure 6). Interestingly, the estimated avoided damage showed an increase (from 2016 to 2022) in most industries, suggesting that more land managers are implementing management and that this management is perceived as being more effective at reducing the impacts of feral pigs. This was particularly evident for grain crops and was a result of a decreasing temporal trend in the proportion of land managers suffering residual impact (Table A2.3 in Appendix 2), coupled with an increase in the local value of grain crops over time (2016: \$10.5M, 2019: \$9.7M; 2022: \$11.5M).

By adding the residual agricultural losses and the avoided agricultural losses, we estimate the total potential losses to feral pigs if no management was undertaken of \$86.8M (\$36.0M–\$138.5M), \$84.2M (\$35.5M–\$133.8M), and \$89.6M (\$39.7M–\$139.8M) in 2016, 2019 and 2022, respectively.

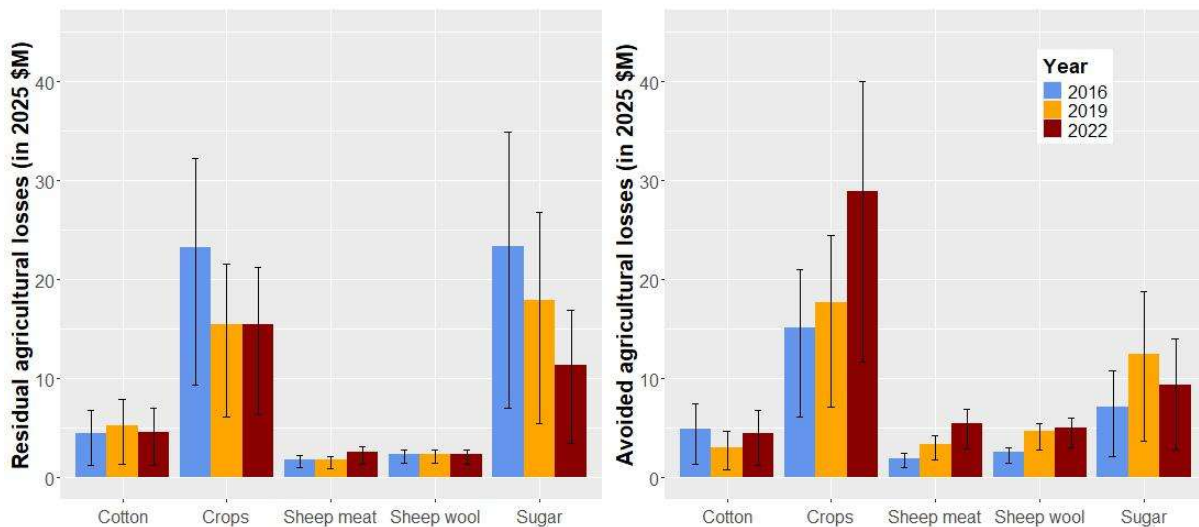


Figure 6. Estimated costs of residual agricultural losses due to feral pig impacts and losses avoided due to feral pig management across five commodity classes in Australia, for three periods of the ABARES-PAWS. Beef has not been included because it was assumed that feral pigs do not have a direct impact to the production of that commodity. The error bars show the range in estimates from assuming low and high feral pig impact scenarios, whereas the columns show the estimates from a most likely impact scenario (see Tables A2.1 and A2.2 in Appendix 2 - reproduced from Tables 17 and 18 in Hafi et al. 2023 - for yield reductions assumed for each commodity under each scenario).

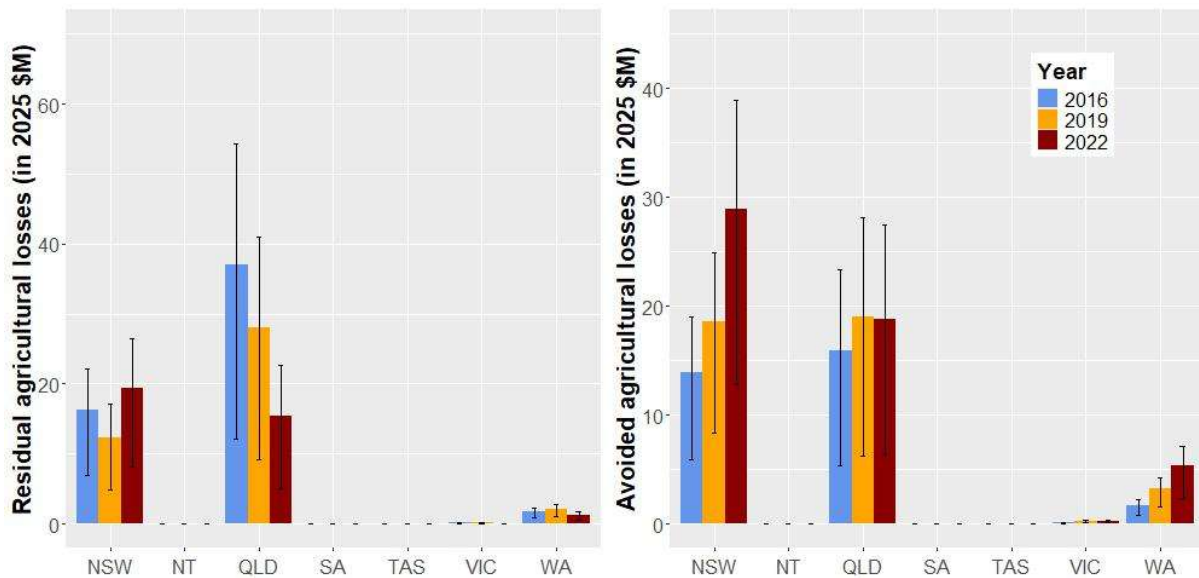


Figure 7. Estimated residual losses due to feral pig impacts and losses avoided due to feral pig management in each state, for the three waves of the ABARES-PAWS. The error bars show the range in estimates from assuming low and high feral pig impact scenarios, whereas the columns show the estimates from a most likely impact scenario (see Tables A2.1 and A2.2 in Appendix 2 - reproduced from Tables 17 and 18 in Hafi et al. 2023 - for yield reductions assumed for each commodity under each scenario).

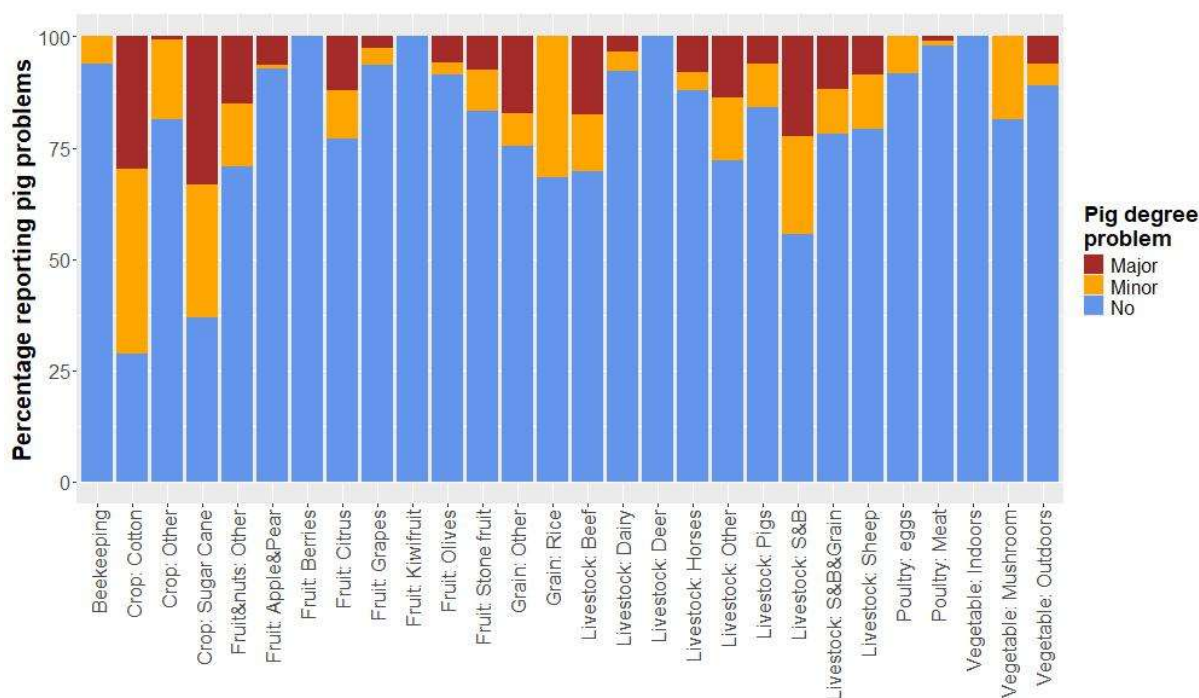


Figure 8. Percentage of land managers reporting major, minor and no problems with feral pigs in 2022, for each of the 28 ANSIC industry types included in the ABARES-PAWS (Appendix 3).

Dissecting the residual agricultural losses by state (Figure 7) shows that NSW and QLD suffered the largest losses. This was primarily caused by feral pigs damaging a range of crops (barley, chickpeas, cotton, maize, oats, sorghum, sugarcane, and wheat) that are commonly grown in these two states, which also corresponds with the areas where the reported problems with feral pigs are highest (Figures A1.2 and A1.7 in Appendix I). In 2022, NSW and QLD accounted for 96% of the total residual agricultural losses caused by feral pigs, with WA accounting for the remaining 4%. In terms of losses avoided due to management, 54% were accrued in NSW, 35% in QLD, and 10% in WA. Residual and avoided agricultural losses in NT, SA, TAS and VIC were <1%. Agricultural losses avoided by implementing effective feral pig management showed an increasing temporal trend in NSW, QLD and WA, whereas there was no clear temporal trend in residual losses.

For land managers that reported feral pigs as a major problem, >86% reported that feral animals damaged their commodities (crop and/or livestock), 63% reported impacts on infrastructure, 52% reported that feral animals posed a risk of disease transmission, 47% reported that feral animals caused erosion and posed a risk of weed seeds introduction, 44% reported damage to water sources, and 32% reported impacts on native flora or fauna.

Many agricultural industries are affected by feral pigs, with the PAWS data indicating that in 2022 the most widespread problems occurred for cotton growers, sugarcane growers, orchardists and nut growers, grain growers, and beef cattle and sheep producers (Figure 8). We look at each of these commodities in more detail in Sections 5.1.1–5.1.6. It is important to note that in addition to the agricultural industries detailed in the following sections, citrus, stone fruit, and rice, are also negatively impacted by feral pigs. However, they are not analysed in further detail due to small sample sizes (i.e. $n \leq 15$ farms reporting problems with feral pigs in any of the years when the survey was conducted).

5.1.1 Sugarcane growing

Introduction

The sugarcane industry in Australia is predominantly located along the north-eastern coastline, with six sugar producing regions in QLD (Wet Tropics, Burdekin, Northern Gulf, Mackay-Whitsundays, Burnett Mary, and

South East QLD) and one in NSW (North Coast NSW). Previous research has shown that feral pigs can cause substantial damage to sugarcane crops (including to infrastructure on plantations) within these regions.

Mitchell and Dorney (2002) conducted surveys to estimate the damage caused by feral pigs to sugarcane farms in QLD's Wet Tropics. These authors estimated that the average direct economic cost of feral pigs to sugarcane farms was \$5,352 (c. \$9,931 inflation-adjusted from 2002 to 2025). This represents 3.5% of the cane production value of the sampled farms (Mitchell and Dorney 2002). Mitchell and Dorney (2002) also obtained damage estimates from harvest data for sugarcane. Based on harvest data, feral pigs caused damage to 16,147 tonnes (valued at \$700,552 in 2025 Australian dollars), or 5.65% of the sugarcane crop.

In the sugarcane industry in Hinchinbrook Shire, Herbert region (spanning northern Burdekin (now North QLD Dry Tropics) and southern Wet Tropics (now Terrain) NRMs), QLD, the economic losses caused by feral pig damage to the cane crop and decreases in the current cost of supplies due to deteriorated cane has been estimated to exceed \$1M (\$1.34M if inflation-adjusted from 2014 to 2025) in some years (DiBella et al. 2014). In terms of tonnes of sugarcane lost to what was determined to be damage caused by feral pigs, the highest recorded losses were in 2009 (28,725 tonnes) and 2012 (33,324 tonnes), with only three measured years being below 10,000 tonnes of sugarcane lost to feral pigs (DiBella et al. 2023).

In response to increasing levels of damage to sugarcane crops, sustained control initiatives to mitigate damage by feral pigs have previously been initiated. For example, landowners in Wet Tropics spent an average of \$4,010 (c. \$7,441 inflation-adjusted from 2002 to 2025) per farm per annum on the control of feral pigs, at an average cost of \$250 (c. \$464 inflation-adjusted from 2002 to 2025) for every pig killed (Mitchell and Dorney 2002). The authors noted that the abundance of feral pigs and the damage they caused was spatially and temporally variable. Given that Mitchell and Dorney (2002) report high variability of feral pig numbers and damage from 30 surveyed farms, it is tenuous to extrapolate their results beyond the area surveyed.

Similarly, the Hinchinbrook Community Feral Pig Management Program has coordinated feral pig management activities across the Hinchinbrook Shire for about 15 years (DiBella et al. 2023). DiBella et al. (2023) claim that the program has been very successful, killing many pigs over the period of the program (mean = 715 per year, 2009–2019) and increasing income for the sugarcane industry (i.e. the reduction in sugarcane damage across the Hinchinbrook Shire was reported to be more than \$1M per annum (DiBella et al 2014). However, it is unclear whether this estimated reduction also included other causes of crop loss apart from feral pigs).

Results from ABARES' data

A high percentage of agricultural land managers reported major feral pig problems in four of the seven sugarcane producing NRM regions in the 2022 survey period (sample sizes were too small to assess the remaining three regions). These four regions were all in QLD and included the Wet Tropics (63% of land managers reported major problems with feral pigs), Mackay-Whitsunday (20%), Burnett Mary (13%) and Burdekin (48%; Figure 9, Figure A1.2 in Appendix 1).

Interestingly, the problem with feral pigs impacting sugarcane increased in the Burdekin NRM between 2016 and 2022 but decreased in the Burnett Mary and Mackay Whitsunday NRMs over that period. The feral pig problem appears to have remained approximately constant in the Wet Tropics NRM, where more than 96% of land managers reported having some level of problem with feral pigs in 2022. Of those sugar producing farms that reported having a major problem with pigs in 2022, 99% reported suffering crop damage and about 63% suffered damage to infrastructure (both could be confounded by the impacts from other pests such as rats).

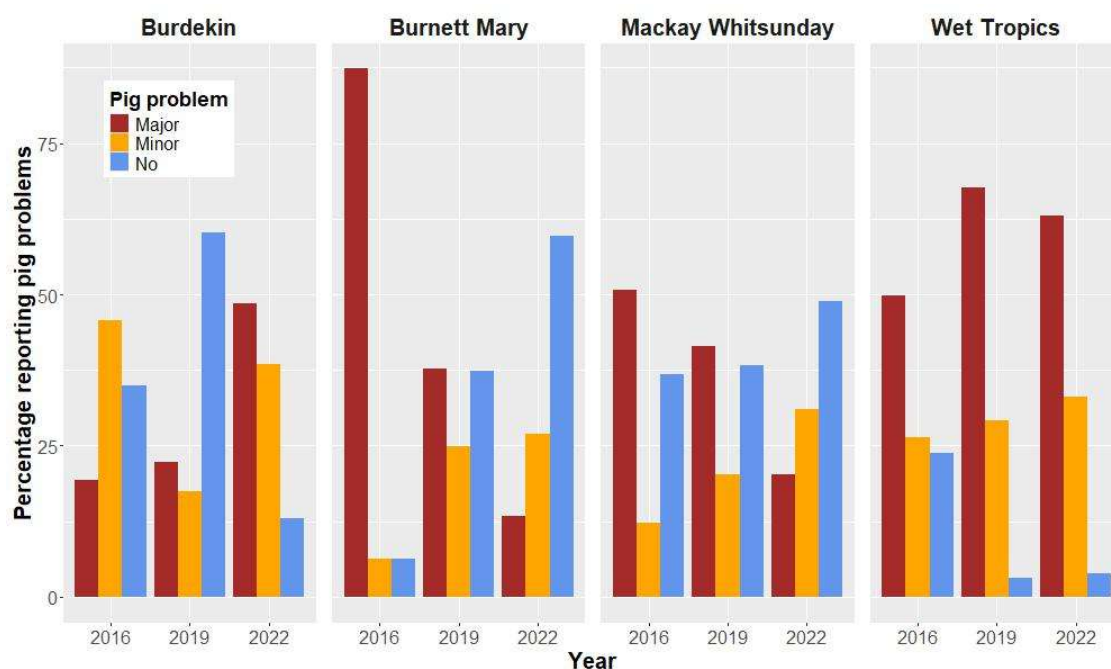


Figure 9. Percentage of sugarcane farms reporting major, minor and no problems with feral pigs in each of the four-sugarcane growing NRM regions, for the three periods of the ABARES-PAWS. For the location of these four regions, see Figure A1.1 in Appendix 1.

Eighty-eight percent of sugarcane growers reported spending time and/or money on feral pig management in 2022, with this percentage increasing to 93% on sugarcane farms where pigs were considered a major problem. Management activities by sugarcane growers included ground shooting (84%), ground baiting (68%), trapping (38%), aerial shooting (13%), and fencing (7%). The perceived effectiveness of different control tools varied substantially, e.g. 31% of respondents perceived trapping as very effective, whereas only 16% thought ground shooting was very effective. Nevertheless, all control tools were considered moderately or very effective by at least half of the land managers using them. Ground baiting was considered either moderately or very effective by the highest percentage (76%) of those using it.

While on-farm management of feral pigs was considered reasonably effective by sugarcane growers, management in the local area was considered less so. This refers to the stakeholders' perception about the effectiveness of overall pest animal and weed management actions undertaken by all stakeholders in the local area. Only 6% of sugarcane growers considered management in their local area to be very effective, while 32% considered it to be moderately effective. For those land managers that had reported major problems with feral pigs, only 1.5% considered that management in the local area was highly effective.

We derived an estimate of expenditure per hectare in 2022 by dividing total expenditure on feral pig management on a farm by the reported area of the farm. For the Wet Tropics NRM, the estimated median expenditure for those land managers that spent money or labour on feral pig management and reported major problems with pigs (94%) was \$130/ha, which is about 4.3% of the estimated total cash costs of sugarcane farms in the Wet Tropics NRM (estimated at \$3027/ha by Topp et al. 2021; these include materials and services, interest and finance payments, and payments for permanent and casual hired labour). In the Burdekin NRM, the median expenditure for the 87% of sugarcane farms that spent on pig management was \$79.50/ha, which is about 2.7% of the estimated total cash costs of sugarcane farms in the Burdekin region (using the average of the value for the Herbert and Burdekin regions from Topp et al. 2021, as the Burdekin NRM encapsulates both). For the Mackay Whitsundays NRM, the median expenditure for the 53% of sugarcane farms that spent on feral pig management was \$10.40/ha (average \$59.40/ha). For the Burnett Mary NRM, the median expenditure for the 40% of sugarcane farms that spent on feral pig management was \$4.90/ha (average \$236.4/ha).

Across those four sugarcane-growing NRMs, median expenditure on feral pig management by land managers was \$47.10/ha, and total expenditure was estimated to be \$15.9M in 2022. This compares to an estimated

median expenditure of \$44.80/ha in 2019 and \$17.90/ha in 2016, and an estimated total expenditure of \$19.7M in 2019 and \$12.7M in 2016. The higher value of total expenditure in 2019 was due to two properties having very large expenditures (>\$74,335 in the 12 months to 2019).

Residual impact was based on the work by Mitchell and Dorney (2002). These authors estimated that feral pigs caused an average 5.6% (range: 1.4–6.2%) reduction in harvested returns for sugarcane production in the Wet Tropics NRM. The value of cash returns per ha of sugarcane harvested in 2022 was obtained from Topp et al. (2021). We used the estimates published in this study as these matched the spatial resolution of the PAWS data (i.e. were NRM-level), whereas data from the ABS for the year 2021/22 was only published at the state level.

Based on these assumptions, we estimated that 23% of sugarcane farms in the Wet Tropics NRM suffered the full residual impact (estimated to be \$208.40/ha) in 2022 and 10% suffered half the residual impact (\$104.20/ha) in 2022. The total average cost per farm for the 33% of sugarcane farms that suffered residual impacts due to feral pigs was about \$39,770. The estimated avoided impact for those that considered feral pigs a major problem but applied moderately or very effective management averaged about \$37,754 per farm. The average expenditure on feral pig management for the land managers that avoided impacts was about \$18,000 per farm. Estimated returns on expenditure (impact avoided divided by expenditure) for these farms ranged widely, with 50% achieving at least 1.2:1.

Applying this approach to the three NRM regions that had more similar sized–sugarcane farms (Wet Tropics, Burdekin, and Mackay Whitsundays), we estimate that 20% of sugarcane farms suffered the full residual impact and 6% suffered half the residual impact in 2022. The average impact for a sugarcane farm suffering the full residual impact was estimated to be about \$80,700 per farm. The avoided impact for land managers that considered feral pigs a major problem but applied moderately or very effective management averaged about \$104,200 per farm. These land managers reported an average expenditure on feral pig management activities of about \$18,300 per farm. Estimated returns on expenditure (impact avoided divided by expenditure) for these farms ranged widely, with 50% achieving at least 3.2:1.

5.1.2 Cotton growing

Introduction

The Australian cotton industry is a significant contributor to the nation's agricultural financial value, with exports generating \$3.1B in 2025 (ABARES 2025a). The cotton growing industry is predominantly located in the Murray-Darling Basin (northern NSW and southern QLD), with three cotton-producing NRM regions in QLD (Border Rivers Maranoa-Balonne, Condamine, Fitzroy) and three in NSW (Central West, North West NSW, Riverina).

Feral pigs eat cotton bolls, and Lockrey and Marshall (2019) argue this is becoming more prevalent as dryland cotton growing displaces summer grain crops in some areas. Nevertheless, data quantifying the impacts of feral pigs on cotton production are lacking and therefore the costs of the damage to cotton by feral pigs are poorly understood.

Results from ABARES' data

A high percentage of cotton land managers reported major feral pig problems in three of the cotton-growing regions in the 2022 survey period (sample sizes or the degree of the feral pig problem were too small to assess the remaining three regions). Of those regions we could assess, 37%, 50%, and 59% of land managers from Border Rivers Maranoa-Balonne (QLD), Central West (NSW), and North West NSW (NSW), respectively, reported major problems with feral pigs in 2022 (Figure 10, Figure A1.3 of Appendix 1). Interestingly, the proportion of land managers with some level of problem with feral pigs increased in the Border Rivers NRM between 2019 and 2022 but decreased in the Central West NRM. The percentage of land managers reporting problems with feral pigs appears to have remained reasonably constant in the North West NSW. Of those land managers with cotton producing farms that reported having a major problem with feral pigs in 2022, 97% reported suffering crop damage and between 58–70% reported damage to infrastructure, erosion, contamination of water sources, disease risk, and seeds of invasive weeds being spread. These percentages may also incorporate impacts from other pest species, as the impacts of feral pigs alone could not be determined from the data.

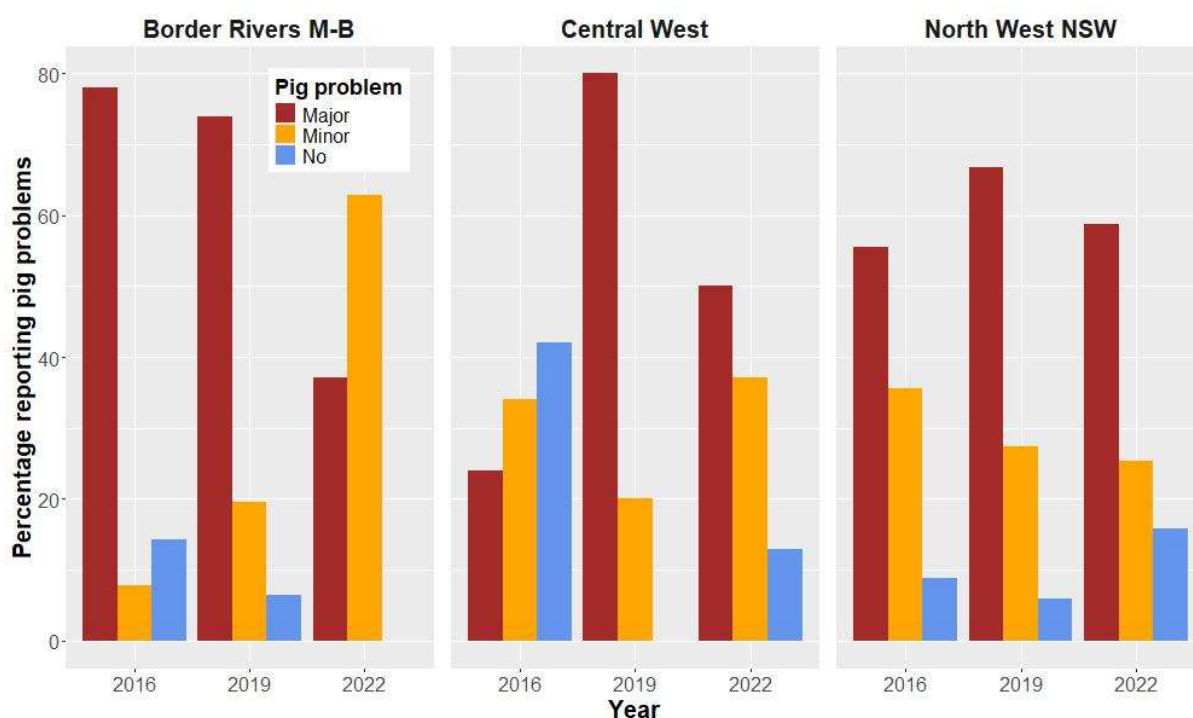


Figure 10. Percentage of cotton farms reporting major, minor and no problems with feral pigs in each of the cotton growing NRM regions, for the three years of the ABARES-PAWS. For the location of these regions, see Figure A1.1 in Appendix 1.

Ninety-five percent of cotton growers reported spending time and/or money on feral pig management in 2022, with this percentage increasing to 100% on farms where feral pigs were considered a major problem. Management activities by cotton growers reporting expenditure on feral pig management included ground shooting (87%), trapping (78%), ground baiting (75%), aerial shooting (46%), and fencing (21%). The perceived effectiveness of these control activities varied, e.g. 63% of respondents perceived aerial shooting as very effective, whereas only 20% thought the same for ground shooting even though this was the most-used control method. Nevertheless, all management approaches were considered moderately or very effective by at least 60% of the land managers using them. Ground baiting was considered either moderately or very effective by all of those using it.

While on-farm management was considered reasonably effective in 2022, feral pig management in the local area was considered less so. Only 6% of cotton growers considered management in their local area to be very effective, with 21% considering it to be moderately effective. For those land managers reporting major feral pig problems, only 7% considered that management in the local area was very effective. Interestingly, results from the 2019 survey showed that 8% of farm managers considered local area management to be very effective, but 52% considered it to be moderately effective. This is a major change in the perception of local area management effectiveness which could be related to a decrease in the number and extent of local programs.

Most cotton farmers surveyed (97%) reported damage to their cotton crops, suggesting that this impact was more significant than damage to other assets on their properties. Feral pigs appear to be the most important vertebrate pest impacting cotton farmers (Figure 11), with only 13% of growers reporting no problems with pigs in 2022, a pattern that has been relatively consistent across the three ABARES-PAWS periods (2016: 15%, 2019: 6%).

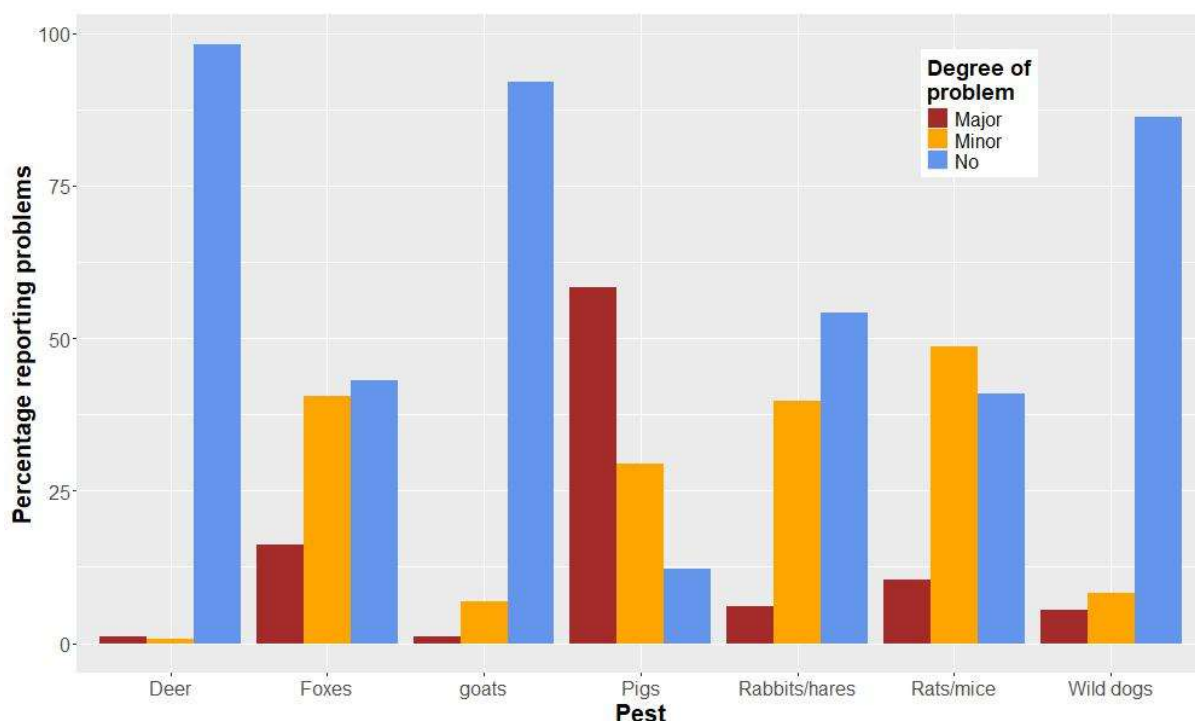


Figure 11. Percentage of cotton farms reporting major, minor and no problems with different pests, combined over the three years of the ABARES-PAWS.

Across the three cotton-growing NRMs with major pig problems in 2022, 83% of cotton farmers spent on average \$4.30/ha (median spend \$2.80/ha) or \$13,530 per farm on feral pig management. The total expenditure on feral pig management was estimated to be \$3.4M in 2022. This compares to an estimated median expenditure of \$1.70/ha in 2019 and \$2.20/ha in 2016, and an estimated total expenditure of \$1.6M in 2019 and \$4.4M in 2016.

Full residual impact for 2022 was based on work by AgEcon (Powell 2024), who estimated feral pigs caused an average of 0.63% reduction in cotton yields (range: 0.2–1.2%), and production receipt data from ABS ‘Agricultural Commodities 2020/21’ and ‘Value of Agricultural Commodities 2020/21’ (ABS 2020/21a, 2020/21b), apportioned to account for irrigated and non-irrigated production. Unfortunately, ABS data from 2021/22 onwards stopped being published at the NRM level and is now published at the state level, so we used data from the previous financial year (2020/21) to obtain production data for each NRM.

We estimate that in 2022, 14% of cotton farmers in the three NRM regions with sufficient sample sizes suffered the full residual impact of feral pigs and 27% suffered half the residual impact. We estimate the full impact of feral pig damage to be around \$47/ha, and the average impact per farm that suffers the residual impact to be about \$109,800. The estimated avoided impact for those that considered feral pigs a major problem, but applied moderately or very effective management, averaged about \$140,000 per farm in 2022, and those farms reported an average expenditure on feral pig management of about \$16,400 per farm. Estimated returns on expenditure (impact avoided divided by expenditure) for these farms ranged widely, with 50% achieving at least 8:1. The relative difference in the estimated average residual impact per farm compared with the avoided impact per farm is driven by differences in farm sizes, with those that have residual impacts tending to be smaller than those whose impacts have been avoided by effective management. This result suggests that land managers on larger farms perceive their management as being more effective than those from smaller farms, possibly because they can apply a different suite of management techniques than those available to or affordable for smaller farms.

5.1.3 Beef cattle production

Introduction

The beef cattle industry is one of the largest agricultural industries in Australia. Around 39% of Australian farm businesses are classified as broadacre livestock farms (34,000 farms), of which 22,100 are beef specialists (Ashton et al. 2024). The gross value of Australian cattle and calf production (including live cattle exports) in 2025 was estimated at \$18.7 billion (ABARES 2025a), and the total national number of cattle as of 2025 was 29.2M head of cattle (ABARES 2025b). As of June 2023, QLD had the highest number of cattle at 13.3M head, followed by NSW at 6.2M head, and VIC at 4.1M head (Meat and Livestock Australia 2024). The analysis of the ABARES' data below has been restricted to farms with an ANZSIC classification of 'Beef Cattle Farming (Specialised)'.

Feral pigs are not known to kill cattle (including calves). The primary mechanisms by which feral pigs affect the beef cattle industry are pasture loss and disease transmission (Bengsen et al. 2017). We discuss damage to pasture by feral pigs in Section 5.1.4 and disease transmission in Section 5.2.

Results from ABARES' data

The Cape York (in 2016 and 2022, QLD), Central West (NSW), and Southern Gulf (QLD) NRMs had the highest percentage of specialised beef producers reporting major feral pig problems, with over 50% reporting a major problem at some point (Figure 12; Figure A1.4 in Appendix 1). The major agricultural industry in Cape York and Southern Gulf NRMs is beef cattle. Fitzroy Basin (QLD), with just under 40% of land managers claiming major problems with pigs, is the largest cattle NRM region in Australia with over 2.5M head of cattle in 2021 (Meat and Livestock Australia 2024).

Although not necessarily attributable only to feral pigs (because the impacts of rats, mice, wild dogs, and foxes are not individually addressed in PAWS), about 60% of cattle land managers with major feral pig problems reported impacts to livestock, infrastructure and water sources, while 66% reported that the risk of spreading diseases was also a perceived impact. The impacts of feral pigs to beef farmers have not been widely quantified. However, in the Whitsunday region it was estimated that between \$1.7M and \$4.2M (\$2.09M and \$5.16M inflation-adjusted to 2025) is lost annually from lost productivity, infrastructure damage, feed replacement, and the need for vaccination against diseases that feral pigs could spread (Synergies Economic Consulting 2020).

In 2022, 79% of beef farms that reported a major feral pig problem and 45% that reported a minor feral pig problem spent money on feral pig management. More than 85% of beef farms reported spending money or time on feral pig management in the Cape York, Burnett Mary, Central West, Fitzroy, and Southern Gulf NRMs. However, the amount spent by beef farmers in 2022 differed greatly, with the mean expenditure per farm ranging between \$0.45/ha and \$9/ha depending on the NRM and the perceived impact of feral pigs in those NRMs. Across the 13 beef-raising NRM regions with major pig problems, 39% of beef farmers spent an estimated \$10.90/ha on average (median spend \$1.80/ha), and total expenditure was estimated to be \$33.6M in 2022. This compares to an estimated median expenditure of \$2.00/ha in 2019 and \$5.50/ha in 2016, and an estimated total expenditure of \$39.2M in 2019 and \$48.2M in 2016. It should be noted that average farm size differs between these NRM regions, with average farm sizes ranging between 200 ha and 160,000 ha.

Ground shooting was the most used management method for controlling feral pigs on beef farms where feral pigs were considered a major problem (91% of land managers reported using this method). However, ground shooting was not considered highly effective, with only 47% finding it very or moderately effective. Trapping (70%) and ground baiting (65%) were also used frequently and were considered more effective than ground shooting: 75% of land managers using ground baiting and 60% using trapping reported these methods were very or moderately effective. Aerial shooting was used by 34% of land managers, and 80% of those using it considered it very or moderately effective.

Land managers in the beef-growing NRMs with most pig problems considered that using a variety of control methods was effective on their own properties, but local area management was considered less effective: only 3% considered management to be very effective in their local area, while 37% considered it moderately effective.

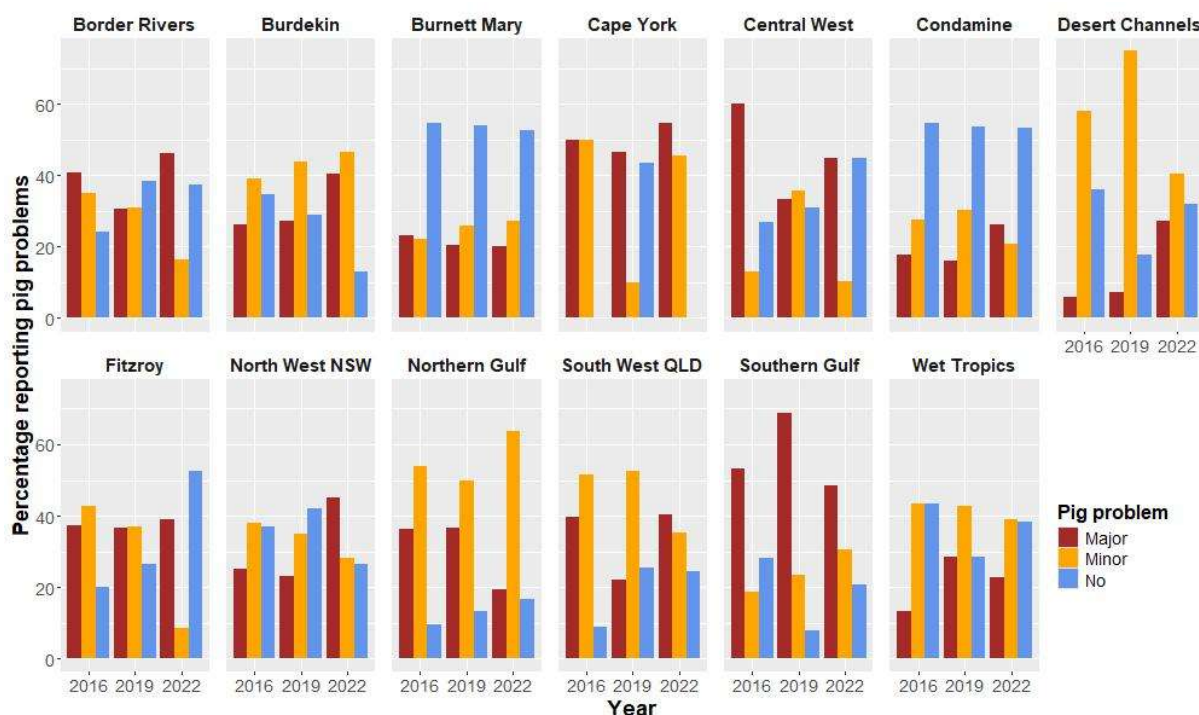


Figure 12. Percentage of beef farms reporting major, minor and no problems with feral pigs in each of the beef growing NRM regions, for the three years when the ABARES-PAWS was conducted. For the location of these regions, see Figure A1.1 in Appendix 1.

The absence of estimates for the economic impact of feral pigs on beef production, and some evidence in the literature that feral pigs are not regarded as having a significant impact on the beef industry (Gong et al. 2009, McLeod 2016, Hafi et al. 2023) means we have not estimated or incorporated these effects in this study. The impact on the cattle industry arises mainly from competition for pasture and potential risks of disease transmission. Choquenot et al (1996) referred 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 wetter zones such as northern NSW. However, how this loss of pasture translates into reduced yields in terms of sale weight of cattle or delays in cattle being ready to be sold has not been quantified.

5.1.4 Sheep production

Introduction

Australia is one of the world's largest producers of wool, producing around 25% of greasy wool sold on the world market (DAFF 2022). In 2025, the value of Australian wool exports was \$2.5B (ABARES 2025a). Wool is produced in all Australian states except the NT. NSW produces the greatest volume of wool, followed by VIC, WA, and SA.

The gross value of Australian lamb and mutton production was \$5.7B in 2025 (ABARES 2025a). As at June 2025, the national flock is estimated to be 74.2M head (Meat and Livestock Australia 2025). In 2023, most of Australia's sheep population was in NSW (36.6%), followed by WA (18.8%), VIC (14.9%), and SA (14.9%). TAS and QLD accounted for 3% and 4%, respectively. In 2025, 25M lambs were slaughtered and processed for meat, and 10M adult sheep were slaughtered (Meat and Livestock Australia 2025).

As noted in Section 3, feral pigs have a broad omnivorous diet (Ballari and Barrios-Garcia 2014). In the context of livestock production, diet is important because pigs can directly impact (i.e. grazing and rooting) pasture and forage crops grown as food for livestock and kill livestock (especially newborn lambs). We review both of these impacts in this subsection on sheep production, but note that pasture offtake by feral pigs will also affect livestock other than sheep.

A loss of pasture, either due to grazing or rooting damage, can affect livestock production through competition for pasture resulting in a reduction in the number of stock units that a farm can maintain and/or lower weight gain yields for livestock, unless alternative feed can be affordably sourced (Latham et al. 2020). Competition can occur when food (pasture) is limiting, but the additional grazing pressure and rooting from feral pigs can potentially increase the length and frequency of future periods when food is limiting. An increased and unmanaged stocking rate can also result in land degradation from overgrazing, where there are longer term reductions in pasture composition and biomass (Freudenberger et al. 1997).

There are sparse empirical data from Australia or elsewhere demonstrating how pasture loss caused by feral pigs affects stocking rates or weight gain yields. An observational study in NSW showed that plots rooted by feral pigs had a lower biomass of edible pasture than unrooted plots (Hone 1980); however, the resultant livestock production impacts were not examined. Conversely, a manipulative experimental study in a semi-arid floodplain system showed that feral pigs had no detectable impact on pasture biomass at densities ranging from about <1–7 pigs km² (Choquenot 1998). Choquenot et al. (1996) reported that rainfall is a more important determinant of pasture availability than grazing pressure from feral pigs in highly climatically variable, semi-arid floodplain environments. Conversely, competition for pasture among grazing herbivores is likely to be greatest in the semi-arid zone during drought periods, when food is obviously limiting. Moreover, the numerical response of feral pig populations in regions that suffer from highly variable amounts of rainfall are in large part driven by rainfall, which is a proxy for food availability for large herbivores (Gentle et al. 2019). In areas with comparatively high and stable rainfall, feral pigs may have a greater impact on pasture consumption and livestock (Choquenot et al. 1996), but this will occur mainly when food (pasture) is limiting and feral pig density is high enough to affect pasture biomass.

Despite feral pigs occurring at medium to high densities (c. 3.0 pigs per km²) on Flinders Island, minimal damage to pasture was recorded in most agricultural areas (Statham and Middleton 1987). Strzelecki National Park (TAS) was an exception, with localised damage occurring on some farms, especially in damp gullies. Most damage to pasture occurred immediately adjacent to the national park, with feral pigs digging for dock (*Rumex* spp.) and thistle (*Cirsium* spp.) roots and grass grubs (Statham and Middleton 1987). In the 1980s, the annual total pasture area damaged was estimated to be <50 ha and, despite visiting paddocks with lambing ewes, there were no reports of feral pigs killing lambs (Statham and Middleton 1987).

Latham et al. (2020) used an indirect method to estimate how many feral pigs are required to consume the same amount of annual dry matter (550 kg) that is eaten by one New Zealand stock unit (i.e. one ewe). This analysis is complicated by the proportion of pasture versus other food sources in the diet of feral pigs and the average weight of individuals in the pig population. These caveats noted, if feral pigs obtain 100% of their diet from pasture, as few as 1.2 adult pigs are equivalent to one stock unit. Conversely, if they receive about a quarter of their diet from pasture, five adult pigs are equivalent to one stock unit (Latham et al. 2020). This suggests that food still needs to be limiting for feral pigs to have an impact on sheep via competition. A separate problem is overstocking, which can lead to longer term pasture damage and resultant reductions in future carrying capacity or stocking rate.

The impact of predation by feral pigs on lambs, lambing ewes, and drought-affected livestock in Australia has been widely studied (Tisdell 1977; Pavlov 1980; Pavlov et al. 1981; Pavlov and Hone 1982; Choquenot et al. 1997). For example, lamb losses due to feral pig depredation were estimated at 18.7% in central NSW (Pavlov et al. 1981) and 32% in northwest NSW (Plant et al. 1978). Similarly, Benson (1980) estimated that depredation by feral pigs caused a net decline in lambing percentage of approximately 7% in western NSW. This equated to an estimated >10,000 lambs lost to feral pigs.

Additional lamb losses of approximately 1% of the annual gross value of wool and sheep production have been attributed to feral pigs reducing the carrying capacity of properties through rooting and pasture consumption (Tisdell 1982). In the 1980s, these combined estimates pro-rated to the semi-arid rangelands of NSW and QLD resulted in a loss of approximately \$6.0M per annum (\$14.9M inflation-adjusted from 1990–2025) (Johnston et al. 1990).

It is possible that some lamb losses from feral pigs may go unnoticed as many Australian sheep producers have no knowledge of expected lambing percentage. For example, three surveys of sheep producers have documented that approximately 40–50% of respondents scan their flocks, and approximately 30% of these

farmers scan for foetal numbers (Howard and Beattie 2018; Sheep Sustainability Framework 2022, 2024; Young et al. 2025). Consequently, about 70% of farmers may be unaware of how many lambs were born in a given year and, in areas impacted by predatory feral pigs, how many were killed and eaten.

Depredation of lambs by feral pigs is spatiotemporally variable. For example, feral pigs lowered the number of lambs per 100 ewes by 37.9 and 31.9 in autumn and spring 1978, respectively, but were an insignificant cause of lamb loss in 1979 (Pavlov et al. 1981). Although individual variability in propensity to kill newborn lambs occurs, Choquenot et al. (1996, 1997) attribute much of the variability in lamb depredation to the density of feral pigs.

Research suggests that at low densities of feral pigs, there are probably sufficient young lambs that cannot evade capture to satiate the intake of the pigs which are present and the relationship between reduction in yield and pig density will be approximately linear (Caley 1993; Choquenot et al. 1996). Conversely, there are probably too few accessible lambs to satiate the intake of all pigs present at higher feral pig densities and the relationship between reduction in yield and feral pig density will reach a maximum level. Choquenot et al. (1997) found that the rate of lamb depredation increased with feral pig density, reaching a maximum proportional rate of 0.29 on the site where pig density was highest (5.8 pigs/km²). Moreover, they suggest that the availability of alternative foods did not influence the propensity of pigs to prey upon lambs and depredation rates indicated that twin lambs were on average 5–6 times more likely to be preyed upon by pigs than were single lambs.

Gong et al. (2009) estimated the annual losses (measured in terms of changes in economic surplus) caused by feral pigs to lamb and wool industries in Australia at \$1.0M and \$2.32M, respectively (c. \$1.53M and \$3.54M, respectively, inflation-adjusted from 2009 to 2025). The impacts to these two industries caused by feral pigs were largely confined to NSW (lamb industry = 94.0%, wool industry = 98.3%). The QLD lamb and wool industries were minimally impacted, whereas the remaining states were unaffected by feral pigs (Gong et al. 2009).

Lethal control of feral pigs to mitigate depredation of lambs can be financially worthwhile for landowners. For example, bioeconomic modelling has shown that helicopter shooting can be profitable when pasture biomass is above 220 kg/ha, especially when feral pig densities are reduced to ≤ 1.5 pigs/km² (Choquenot and Hone 2002). Conversely, below a pasture biomass of 220 kg/ha, 1080 poisoning was predicted to be more profitable than helicopter shooting. Including logistic population growth for pigs in the models allowed control to be simulated through time and resulted in a greater return on investment from both lethal control methods (Choquenot and Hone 2002).

Pasture availability can negatively affect the uptake of lethal baits by feral pigs. For example, Choquenot and Lukins (1996) found that as pasture biomass increased, fewer pigs consumed baits and/or the number of baits each pig consumed declined. Assuming fewer pigs consume baits, the effect of increasing pasture biomass on the relationship between percentage uptake of baits and pig density indicated that, for every increase in pasture biomass of 100 kg/ha, the percentage of pigs consuming bait declined by about 10% (Choquenot and Lukins 1996).

Results from ABARES' data

In the analyses described below, we combine three ANZSIC categories (Sheep Farming (Specialised), Grain-Sheep or Grain-Beef Cattle Farming, and Sheep-Beef Cattle Farming) and focus on regions where both sheep meat and wool production occur.

Across the north-central-west NSW (including the Central Tablelands, Central West, North West NSW, Northern Tablelands, and Western NRMs, hereafter referred to as C&W-NSW), 40% of sheep farms considered feral pigs a major problem and a further 24% considered them a minor problem in 2022 (Figure 13; Figure A1.5 in Appendix 1). Further south in the Riverina NRM (NSW), 7% of sheep farmers considered feral pigs a major problem, while 28% of sheep farmers in the South East NSW NRM (NSW) considered feral pigs a major problem. Across the sheep growing regions of WA (including Northern Agricultural, Peel-Harvey, and South West NRMs), 9% of sheep farmers considered feral pigs a major problem. In QLD (including Border Rivers Maranoa-Balonne, Burdekin, Burnett Mary, Condamine, Desert Channels, Fitzroy,

South East QLD, and South West QLD NRMs), 35% of sheep farmers considered feral pigs a major problem. The degree of problems with feral pigs grew between 2016 and 2022 in the C&W-NSW group and, if major and minor problems are combined, in the Riverina NRM. Conversely, it remained reasonably constant in the QLD and WA groups and was variable across years in South East NSW.

Many of the sheep farms that reported feral pigs as a major problem also reported foxes as a major problem, so it is difficult to quantify the exclusive impacts feral pigs have on sheep-producing farms. Foxes (*Vulpes vulpes*) are a significant predator of lambs in Australia, with losses due to fox predation reported to be between 3% and 10% (McLeod et al. 2010). Over 64% of those reporting feral pigs as a major problem indicated that vertebrate pests (more generally) were affecting crops and infrastructure. Other significant impacts for those claiming feral pigs as a major problem included risk of disease spread (55%), livestock loss/depredation (51%), introduction and spread of seeds from weedy species (44%), and impacts to water sources (44%).

In 2022, 84% of sheep farms that had a major feral pig problem and 50% that had a minor feral pig problem spent money or labour managing them. More than 80% of sheep farms with major pig problems reported spending money and/or time on feral pig management in the C&W-NSW, Riverina, and QLD, with this percentage slightly lower (66%) in WA and South East NSW. However, the amount spent in 2022 differed greatly across farms and regions, with the mean expenditure per farm suffering major pig problems ranging from \$0.45/ha to \$9.37/ha depending on the region. Across the five sheep-raising regions with major pig problems, 38% of sheep farmers spent an estimated \$7.39/ha on average (median spend \$1.28/ha), and total expenditure was estimated to be \$47.1M in 2022. This compares to an estimated median expenditure of \$1.37/ha in 2019 and \$1.32/ha in 2016, and an estimated total expenditure of \$25.8M in 2019 and \$19.0M in 2016. It should be noted that median farm size differed between the regions, ranging between 1,200 ha and 6,300 ha.

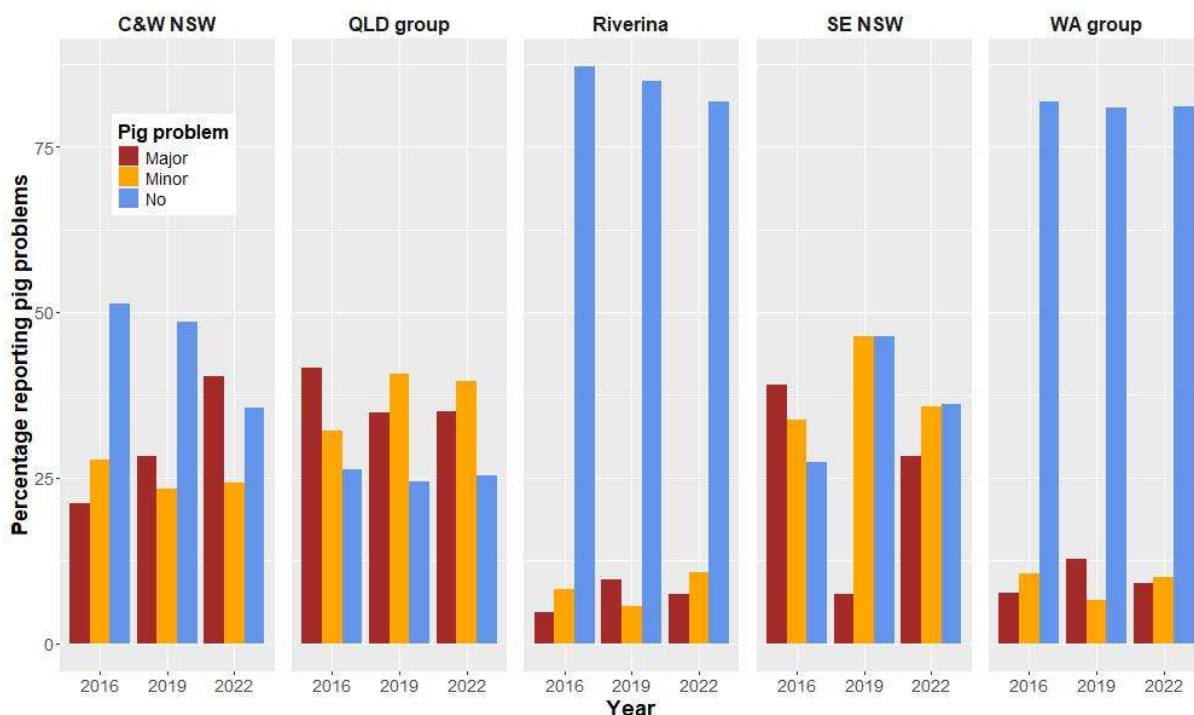


Figure 13. Percentage of sheep farms reporting major, minor and no problems with feral pigs in each of the sheep raising regions, for the three years of the ABARES-PAWS. For the location of these regions, see Figure A1.1 in Appendix 1.

In the C&W-NSW group, 48% of all sheep farmers spent an average of about \$7,282 per farm on feral pig management in 2022. Of the subset with a major feral pig problem, 80% spent an average of \$10,083 on feral pig management, and the maximum reported spend for a single property was \$132,194. In the Riverina NRM, 10% of all sheep farmers spent an average of \$4,294 per farm on feral pig management, whereas 100% of

those with major pig problems spent an average of \$5,726 per farm. In the South East NSW NRM, 34% of all sheep farmers spent an average of about \$5,153 per farm on feral pig management, whereas 66% of those with major pig problems spent an average of \$7,618 per farm. In QLD, 60% of all sheep farmers spent an average of about \$8,223 per farm on feral pig management, whereas 97% of those with major feral pig problems spent an average of \$8,156 per farm. In WVA, 13% of all sheep farmers spent an average of about \$3,835 per farm on feral pig management, whereas 66% of those with major feral pig problems spent on average \$15,326 per farm.

Almost all (93%) sheep producers that managed feral pigs used ground shooting as a management tool, with 74% finding it moderately or very effective. Ground baiting was also commonly used (83%), with 92% of land managers reporting it as effective. Aerial shooting and aerial baiting (confined to specific council areas in QLD) were less frequently used (40 and 34%, respectively) but both were considered effective by more than 72% of land managers using them. Only 12% of sheep land managers considered management in their local area to be very effective, with 32% considering it to be moderately effective. Results from the 2019 survey showed that 25% sheep land managers considered management in their local area to be very effective and 48% moderately effective. Similar to cotton growers, the perception of the effectiveness of local area management has decreased between years among sheep farmers. For those land managers reporting major pig problems, 18% considered that management in the local area was very effective.

Sample sizes were considered reasonable in the C&W-NSW and QLD groups, and responses were reasonably consistent across these groups, so we focus on these groups in subsequent analyses. The analysis of full residual impact was estimated based on work by AgEcon (Powell 2024), who estimated feral pigs caused an average of 12% reduction in sheep farm yields (range = 6–19%), and state-level production receipt data (\$/ha) from Ashton et al. (2024) and the Farm Data Portal (ABARES 2025b) for each of the years in the PAWS data.

We estimated that 7% of sheep farms in the C&W-NSW region suffered the full residual impact and 18% suffered half the residual impact in 2022 (see section 4.2 for detail on residual impact calculations). We estimated full impact to be around \$10.12/ha, and an average impact per farm that is suffering residual impact of around \$24,646. The estimated avoided impact for those that considered feral pigs a major problem, but applied moderately or very effective management, averaged about \$33,609 per farm in 2022, and those farms reported an average expenditure on management of about \$4,257 per farm. Estimated returns on expenditure (impact avoided divided by expenditure) for these farms ranged widely, with 50% achieving at least 2.5:1.

We estimated that 3% of sheep farms in the QLD region suffered the full residual impact and 13% suffered half the residual impact in 2022. We estimated full impact to be around \$5.38/ha, and an average impact per farm that is suffering residual impact of around \$41,787. The estimated avoided impact for those that considered feral pigs a major problem, but applied moderately or very effective management, averaged about \$45,036 per farm in 2022, and those farms reported an average expenditure on management of about \$8,626 per farm. Estimated returns on expenditure (impact avoided divided by expenditure) for these farms ranged widely, with 50% achieving at least 2.5:1.

Extrapolating to the whole population of sheep farms in the C&W-NSW region, Riverina NRM and South East NSW NRM, we estimated a residual impact of feral pigs of \$42.46M in 2022, \$46.04M in 2019 and \$50.75M in 2016. The decreasing trend in the estimated residual impact across the three periods suggests that management has been increasingly effective at partially mitigating the feral pig problem for sheep farmers. Alternatively, it could reflect a temporal reduction in the number of sheep farms operating, a trend that was reported by Forsyth et al. (2014).

5.1.5 Horticulture

Introduction

Horticulture is Australia's third largest agricultural industry. It includes fruit, vegetables, nuts, flowers, turf, and nursery products. The local value of production of horticulture was \$19.0B in 2025 (ABARES 2025a). One of the most valuable horticultural crops in Australia is bananas, with a production value of almost \$700M

in 2023/24 (ABS 2024). Ninety-five percent of banana production occurs in the Wet Tropics NRM (State of Queensland 2016).

Mitchell and Dorney (2002) conducted farm surveys to estimate the damage caused by feral pigs to banana farms in Wet Tropics NRM (QLD). These authors estimated that the average direct economic cost of feral pigs to banana farms was \$1,824 (c. \$3,385 inflation-adjusted from 2002 to 2025). This represents 0.08% of the value of banana production of the sampled farms (Mitchell and Dorney 2002).

There are sparse or no data on the damage that feral pigs cause to most horticultural crops in Australia. One exception is a study in NSW in a macadamia orchard (Bright and Kaddatz 2020), where the authors reported that a moderate size pig consumed up to six kilograms of nuts in shell per hour, and ten pigs feeding in an orchard for ten days could destroy nearly 300 kilograms of nuts in shell. Over a whole season (March to September), it was estimated that feral pigs could cause a loss of up to \$40,500 (\$45,365 inflation-adjusted to 2025) in a single orchard, compared to a one-off cost of \$23,400 (\$26,211 inflation-adjusted to 2025) for effective fencing.

Results from ABARES' data

Our analysis of horticulture focuses on the 'Other Fruit and Tree Nut Growing' ANZSIC category, which consists of tree nuts, tropical fruit, subtropical fruit, and other fruit not classified elsewhere. This category does not easily allow analysis of specific horticultural commodities to the crop level as these are not explicitly recorded.

Feral pigs are considered a major problem for horticulture, particularly in QLD but also in localised regions in other states. Problems were reported for many different ANZSIC horticulture categories (e.g. citrus and stone fruit; Figure 8), but we only had sufficiently large sample sizes to explore issues for the 'Other Fruit and Tree Nut Growing' category in three NRM regions in QLD where the largest problems with feral pigs occur: Wet Tropics, Burnett Mary, and South East QLD. Around 38%, 32%, and 27% of fruit and tree nut growing land managers in the Wet Tropics, Burnett Mary, and South East QLD NRMs, respectively, report that they have major feral pig problems (Figure 14; Figure A1.6 of Appendix 1). The degree of reported problems with feral pigs appears to have been reasonably stable in the Wet Tropics over the three periods, but it seems to have increased in South East QLD and Burnett Mary NRMs.

Of those land managers with farms producing fruit and tree nuts that reported major problems with feral pigs in 2022, 80% reported damage to crops and 51–60% reported damage to infrastructure, erosion, and the introduction and spread of seeds of weedy species. Contamination of water sources (23%) and risk of disease spread (37%) were also reported by land managers (although these percentages probably incorporate the impacts of other pests, such as rodents, which we could not separate from those of feral pigs). Feral pigs, rats, and mice were the most important vertebrate pests affecting fruit and nut growers, with 33% of growers reporting problems with these vertebrate pests in 2022.

In 2022, 43% of fruit and tree nut growers reported spending time and/or money on feral pig management, with this percentage increasing to 79% on farms where feral pigs were considered a major problem. Management activities by fruit and tree nut growers reporting expenditure on feral pig management included trapping (70%), ground shooting (67%), ground baiting (62%), and fencing (50%). The perceived effectiveness of these control activities varied, e.g. 37% of respondents perceived ground baiting as very effective, whereas only 7% thought the same for ground shooting or trapping, even though these methods were commonly used. Ground baiting was considered either moderately or very effective by all land managers that used it.

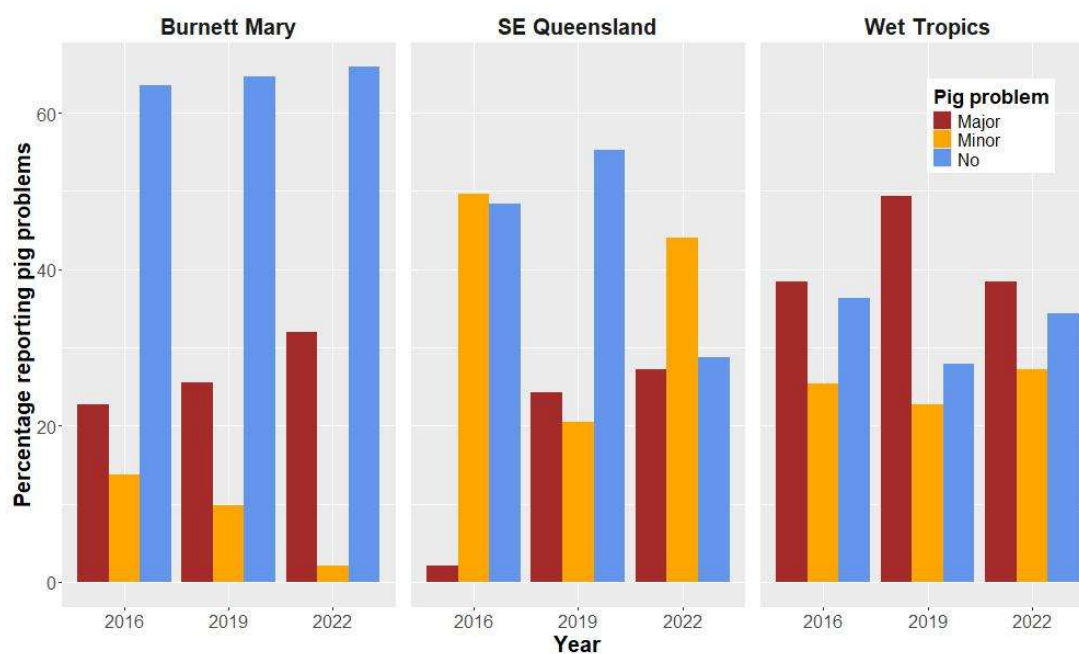


Figure 14. Percentage of fruit and tree nut growing farms reporting major, minor and no problems with feral pigs in each of the NRM regions, for the three years of the ABARES-PAWS. For the location of these regions, see Figure A1.1 in Appendix 1.

While on-farm management was considered reasonably effective, management in the local area was considered less effective. Nearly 60% of fruit and nut land managers reported that feral pig management in the local area was not effective, 12% considered it somewhat effective, and 26% considered it to be moderately effective. Only 4% of fruit and nut growers considered management in their local area to be very effective. This suggests that most of the fruit and nut land managers do not consider management of feral pigs in their local areas to be effective. These results are comparable to the perceived effectiveness of management of feral pigs for sugarcane growers, which may be partly because of the substantial spatial overlap across the two industries.

In the Wet Tropics NRM, 41% of fruit and tree nut farms spent an average of \$268/ha (median \$201/ha) on feral pig management (equating to an average of about \$8,626 per farm). In the Burnett Mary NRM, 36% of fruit and tree nut farms spent an average of \$261/ha (median spend \$36/ha and an average of about \$14,564 per farm). In South East QLD NRM, 54% of fruit and tree nut farms spent an average of \$108/ha (median spend \$78/ha, equating to about \$2,953 per farm). Across these three NRM regions with major pig problems, 43% of fruit and tree nut land managers spent an estimated \$137/ha (median spend \$78/ha), and total expenditure on feral pig management was estimated to be \$2.9M in 2022. This compares to an estimated median expenditure of \$39/ha in 2019 and \$58/ha in 2016, and an estimated total expenditure of \$4.4M in 2019 and \$2.1M in 2016. The larger expenditure in 2019 is likely inflated by three of the 95 farms in the sample reporting expenditures of >\$74,335 in the 12 months to 2019. Large expenditures may reflect some form of capital investment in feral pig management like fencing which would have benefits over longer timeframes (if well maintained).

From the large number of different fruit and tree nut types included in the 'Other Fruit and Tree Nut Growing' ANZSIC category, we only estimated residual impact to banana growers in the Wet Tropics NRM. We limited the analysis to bananas because this commodity represents 81% of the total value of fruit and tree nuts revenue in that NRM (so we assume that feral pig problems reported for fruit/tree nut farms in the Wet Tropics apply mainly to bananas) and there are published estimates available for the impact of feral pigs on banana growers. For the other two NRMs for which we have a sufficiently large sample of horticultural growers (Burnett Mary and South East QLD), production data from ABS indicates that there are several fruit and tree nut types that are of importance in these NRMs. For example, mandarins, pineapples, macadamias, and avocados are all important fruit/tree nut types grown in Burnett Mary NRM, whereas pineapples, strawberries, bananas and macadamias are all important in South East QLD NRM. Because the PAWS data

do not provide details of the specific type of fruit or nut grown in each farm, we cannot determine the level of damage or the costs of the damage to the fruit/tree nut category for these two NRMs.

Full residual impact to banana growers in the Wet Tropics NRM in 2022 was estimated based on work by Mitchell and Dorney (2002), who estimated that feral pigs caused an average of 0.08% reduction in banana yields (range: 0.04–0.22%), area cultivated in banana trees from the ABS 'Agricultural Commodities 2021/22' (ABS 2021/22a), and production data for bananas derived from the ABS 'Value of Agricultural Commodities 2021/22' (ABS 2021/22b). Unfortunately, ABS data from 2021/22 onwards stopped being published at the NRM level and is now published at the state level, so we had to use banana production data for QLD for our Wet Tropics NRM calculations, which is supported by the fact that 91–94% of banana production in QLD comes from the Wet Tropics NRM.

We estimated that 6% of banana growers in the Wet Tropics NRM suffered the full residual impact and 18% suffered half the residual impact in 2022. We estimated full impact to be around \$53.60/ha, and an average impact per farm that is suffering residual impact of around \$2,689. The estimated avoided impact for those that considered feral pigs a major problem, but have applied moderately or very effective management, averages about \$3,249 per farm in 2022, and those farms reported an average expenditure of about \$2,465 per farm. Estimated returns on expenditure (impact avoided divided by expenditure) for these farms ranged widely, with 50% achieving at least 1:1.

5.1.6 Grains and pulses

Introduction

Grains and pulses represent one of Australia's largest agricultural industries, valued at \$22.5B in 2024/25 (ABS 2025). In 2024/25, wheat, barley, and canola were the three largest crops in terms of value with a combined local value of production of \$18.7B (\$10.1B + \$3.7B + \$4.9B, respectively), representing 83% of the national winter crop total. Wheat comprised 70% of total winter crop production sold with 34.8M tonnes, the highest of all winter crops.

Lockrey (2025) noted that although it is widely recognised that feral pigs damage grain crops, quantifying the costs of the damage is difficult. Given landowners are usually responsible for controlling feral pigs on their land, a greater understanding of the costs of the damage caused by pigs to grain crops is needed, especially as this is a key driver for initiating lethal control (Lockrey 2025).

Gentle et al. (2015) assessed the diet composition of 196 feral pigs from agricultural properties in southern QLD. They found that food consumed was almost entirely plant matter (>99%). Crops were consumed more frequently than non-crop plant species. The dietary biomass of feral pigs comprised >60% crops, indicating a clear potential for direct economic losses (Gentle et al. 2015). About 24% of the biomass of pig diet comprised wheat, barley and oats, whereas chickpeas, cotton, and sorghum each constituted 10–11%. The authors also note that consumption of pasture and forage species has the potential to create competition for pasture with domestic stock (see 'Beef cattle production' and 'Sheep production' above). Seasonal differences in consumption of crop, pasture or animal food groups probably reflect the changing availability of food items (Gentle et al. 2015).

Based on landowner surveys, about 60% of grain growers in the Murray-Darling area of southern QLD reported that feral pigs damage their crops (Gentle et al. 2011). Damage (mean percentage loss) was notably high (>10%) for pasture, lucerne and forage crops, barley, millet, and vegetables. The reported damage equated to mean annual losses of, for example, >20 tonnes of wheat and barley, >30 tonnes of sorghum and peanuts, and >200 tonnes of pasture, lucerne, and forage crops (Gentle et al. 2011). For some landowners the losses were substantially higher, e.g. 180 tonnes of sorghum and peanuts and 1,500 tonnes of pasture, lucerne, and forage crops. These differences may have been affected by spatial and temporal variability in pig population densities. Feral pig densities in the Murray-Darling area are usually c. 2.0 pigs/km², but can reach comparatively high densities (4.4–6.3 pigs/km²) in some places when environmental conditions are favourable (Gentle et al. 2011). The total estimated cost of damage to four agricultural commodities (sorghum, wheat, barley, and lambs) in the QLD Murray-Darling area in 2011 was about \$9.1M (\$13.1M inflation-adjusted from 2011 to 2025; Gentle et al. 2011).

In addition to landowner surveys, Gentle et al. (2011) attempted to directly quantify damage to agricultural commodities (sorghum and wheat) in southern QLD and determine the relative contributions to damage of multiple vertebrate species. The mean damage levels caused by feral pigs in surveyed paddocks were 1.3% for sorghum and <0.4% for wheat. Most paddocks assessed had low levels of damage. The data from the quantitative surveys of damage in southern QLD showed much lower levels of damage than suggested by the landowner surveys.

While estimates of damage based on land managers' perceptions typically overestimate unwanted impacts (Benson 1980), the quantitative estimates from Gentle et al. (2011) were substantially lower than those previously estimated for sorghum (40%) by Caley (1993) and wheat (4–7%) by Pavlov (1980). We think the estimates of damage and their associated costs based on landowner surveys in southern QLD should be interpreted cautiously because of potential limitations associated with the representativeness of the survey data, sample size of respondents, and subjective or qualitative nature of the data assessing the damage caused by pigs (Gentle et al. 2011). Furthermore, feral pig abundance fluctuates considerably over time (Gentle et al. 2019), so damage estimates also need to be considered over multiple years.

Most landowners (>95%) in QLD conducted lethal control to mitigate damage to their crops. Shooting by recreational and commercial hunters, trapping, and toxic baiting were the most frequently used tools for controlling pig populations. Most control tools were considered ineffective to moderately effective, with the exception of toxic baiting, which many landowners ranked as being an effective method for pig control. Commercial harvesting is generally an ineffective tool for reducing the abundance of feral pigs (Gentle and Pople 2013; Bengsen et al. 2020). To maintain any gains associated with meaningful reductions in the numbers of feral pigs, the higher rates of population growth generated following control (e.g. Giles 1980; Caley 1993; Choquenot 1998; Hone 2002) must be stopped.

Benson (1980) estimated that the average decline in wheat production over two surveyed Pasture Protection Boards in western NSW was 5.6% (or 906 tonnes). He contended that although some growers were losing negligible amounts of wheat, other growers in areas with high feral pig numbers and preferred wheat varieties were losing very large amounts of wheat. Benson (1980) also considered non-bearded wheat varieties to be more susceptible to damage by feral pigs (13.2–100% consumed) than bearded ones (2.0–11.6% consumed). Most of the wheat grown in this part of NSW was bearded.

Caley (1993) estimated that feral pigs reduced the yield of *Sorghum* spp. and maize (*Zea mays*) crops at properties in the NT by 7–50%, depending on the number of pigs present and the size of the crop. Cook (2014) stated that when food is scarce in southern parts of the feral pig range in WA, the feeding activity of pigs extends onto agricultural land where they damage crops and fences. Feral pigs can damage cereal, pulse and oilseed crops in the south west of WA. If left unmanaged, production losses in these parts of WA could average \$8.1M per annum (inflation-adjusted from 2014 to 2025) (Cook 2014). Recent evidence collected across 7 years of aerial shooting operations of feral pigs in WA shows that cereal crops, primarily wheat, were the most frequently consumed food items (S. Dawson, Western Australia Department of Primary Industries and Regional Development, unpublished data).

Gong et al. (2009) estimated the annual losses (measured in terms of changes in economic surplus) caused by feral pigs to all grain crops combined in Australia at \$5.86M (c. \$8.95M inflation-adjusted from 2009 to 2025). The impacts to grain crops by feral pigs were greatest in NSW, \$5.10M, followed by QLD, \$0.77M (c. \$7.79M and \$1.18M, respectively, inflation-adjusted from 2009 to 2025). When the research was done in the early-2000s by Gong et al. (2009), the costs of the damage to grain crops in Australia's other states was nil or negligible. However, since that time, feral pigs have expanded their geographic ranges and their unwanted impacts in agricultural areas in previously unaffected areas has likely increased. For example, feral pigs have become common to abundant in the north and west of WA and northeast SA, and they are present in the east and south of VIC, with pockets having high reported abundance amidst areas of uncertainty in abundance status (see Figure 30.1 in Bengsen et al. 2017).

A recurring pattern from studies attempting to quantify damage to crops caused by feral pigs is that the spatial and temporal distribution of crop damage is highly uneven (Bengsen et al. 2014). The results from our analysis of the ABARES' data below show similar patterns of highly uneven crop damage.

Results from ABARES' data

Feral pigs are considered a major problem for grain growers, particularly in central NSW, southern QLD, and some areas of WA. For our analyses on grain growers, we concentrated on the following NRMs for which we had a sufficiently large sample of grain growers: Central West (NSW), North West NSW (NSW), Riverina (NSW), Border Rivers Maranoa-Balonne (QLD), Condamine (QLD), Fitzroy (QLD), and Northern Agricultural (WA). More than 50% of grain growers in Border Rivers, Central West, Condamine, Fitzroy and North West NSW reported having problems with feral pigs in 2022, while less than 25% did so in Northern Agricultural and Riverina (Figure 15; Figure A1.7 in Appendix 1). The percentage of grain growers with different degrees of problems with feral pigs (major, minor or none) was variable over the three years, which may be related to the type of grain grown from year to year (i.e. grain crops are rotationally grown), spatial and temporal variability in the abundance of feral pigs, variability in the availability of alternative foods, climatic variability affecting grain growth (especially rainfall), and/or the level of management of feral pigs. We also note that NSW experienced a severe drought in 2019, but not in 2016 or 2022, which could potentially explain the lower percentage of land managers reporting problems with feral pigs in Central West and North West NSW, the two main grain growing regions in that state.

Of those land managers with farms producing grain or pulses that reported having a major problem with feral pigs in 2022, 100% reported suffering crop damage, 73% reported damage to infrastructure, 62% erosion, and 44% risk of weed seed introduction. Disease risk (37%) and contamination of water sources (29%) were also reported (these numbers could also include impacts from other pest species, such as rats). Feral pigs, foxes, rats, and mice were the most important vertebrate pests impacting grain growers, with 45% of growers reporting major problems with feral pigs, 22% with foxes, and 15% with rats and mice in 2022.

Fifty percent of grain growers in the NRMs we included reported spending time and/or money on feral pig management in 2022, with this percentage increasing to 82% on farms where feral pigs were considered a major problem. Management activities by grain growers reporting expenditure on feral pig management included ground shooting (100%), ground baiting (90%), trapping (79%), aerial shooting (55%), aerial baiting (32%), and fencing (30%). The perceived effectiveness of these control activities varied, e.g. 58% of respondents perceived aerial shooting as very effective, whereas <5% thought the same for ground shooting or trapping, even though these methods were extensively used. Ground baiting was considered either moderately or very effective by 75% of those using it. While on-farm management was considered reasonably effective, management in the local area was considered less so. Only 7% of grain growers considered local area management to be very effective, while 33% considered it to be moderately effective and 32% somewhat effective.

In 2022, 86% of grain growing farms in the North West NSW NRM spent an average of \$4.03/ha (median \$2.09/ha) on feral pig management (equating to an average of about \$8,693 per farm), 70% spent an average of \$5.38/ha in the Central West NRM (median spend \$0.90/ha and an average of about \$9,719 per farm), and 16% spent an average of \$1.12/ha in the Riverina NRM (median spend \$1.10/ha; equating to about \$2,331 per farm). In the Condamine NRM, 40% of grain farms spent an average of \$4.48/ha (median \$2.24/ha) on feral pig management (equating to an average of about \$3,457 per farm), while 10% spent an average of \$1.34/ha in the Northern Agricultural NRM (median spend \$0.47/ha, equating to about \$8,178 per farm). Sample sizes were too small in the Border Rivers and Fitzroy NRMs in 2022 to assess expenditure on feral pig management.

Across these seven NRM regions with major feral pig problems, 50% of grain growers spent an estimated average of \$3.51/ha (median spend \$2.08/ha), and total expenditure on feral pig management was estimated to be \$14.5M in 2022. This compares to an estimated median expenditure of \$1.85/ha in 2019 and \$2.40/ha in 2016, and an estimated total expenditure of \$15.2M in 2019 and \$10.1M in 2016. The larger expenditure in 2019 is probably inflated, with three of the farms in the sample reporting expenditure of >\$61,946 in the 12 months to 2019, while no farm reported such large expenditures in 2022 and only one did in 2016. Large expenditure may reflect some form of capital investment in feral pig management like fencing, which would have benefits over longer timeframes.

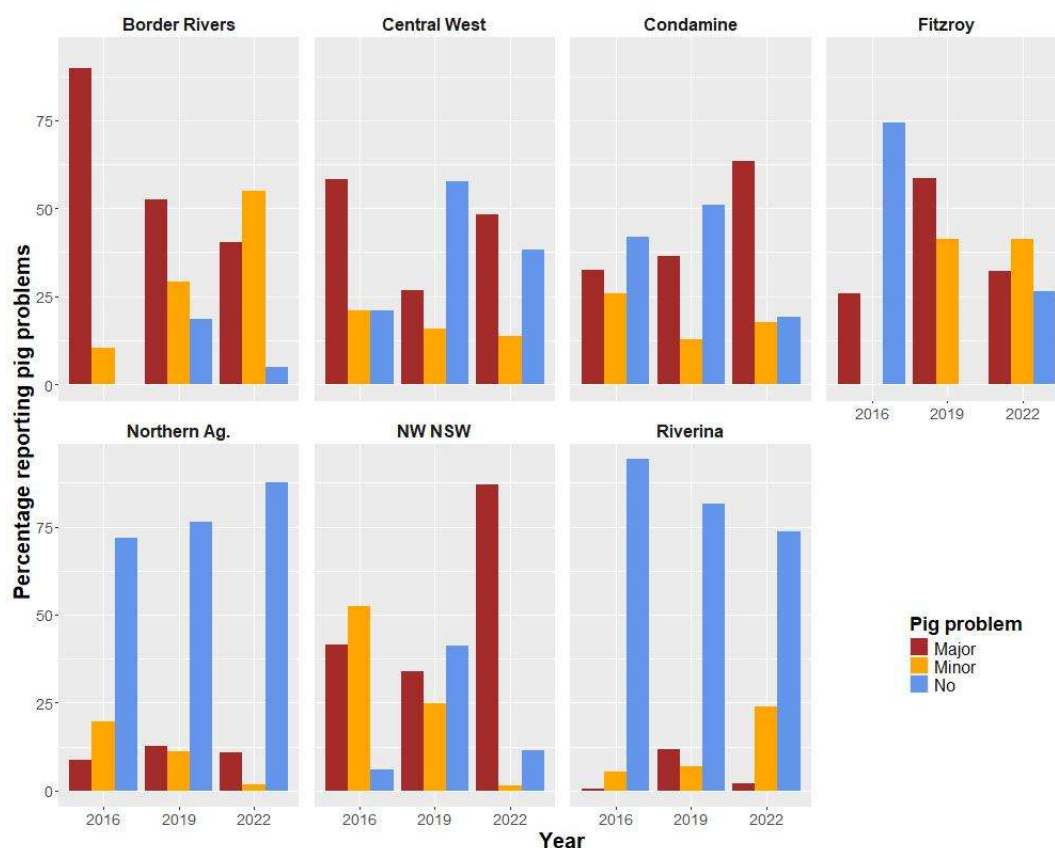


Figure 15. Percentage of grain growers reporting major, minor and no problems with feral pigs in each of the NRM regions, for the three years when the ABARES-PAWS were conducted. For the location of these regions, see Figure A1.1 in Appendix 1.

We estimated residual impact to grain growers in three NRMs (one from each of the states that have major feral pig problems) for which we had a sufficiently large sample of farms: North West NSW (NSW), Condamine (QLD) and Northern Agricultural (WA). Within North West NSW, wheat is the largest grain crop produced (>50% of the area that grows crops), followed by barley (16–20%, depending on the year). In Condamine, sorghum is the largest grain crop produced (34–61% of area of crops, depending on the year), followed by barley and wheat (14–25% each, depending on the year). In Northern Agricultural, wheat is the largest grain crop produced (>67% of the area that grows crops), followed by canola (11–20%, depending on the year).

Residual impact was estimated based on work by AgEcon (Powell 2024), who estimated feral pigs caused an average reduction of 1.3% in wheat yields (range = 0.07–3.56%) and of 3.44% in sorghum yields (range = 1.3–6.5%), area planted in each crop from the ABS ‘Agricultural Commodities’ (2020/21a), and production data for wheat and sorghum derived from the ABS ‘Value of Agricultural Commodities’ (2020/21b). Unfortunately, ABS data from 2021/22 onwards stopped being published at the NRM level and is now published at the state level, so we had to use data from the previous financial year (2020/21) to obtain production data for each NRM. For North West NSW and Northern Agricultural NRMs, we assumed receipt data (\$/ha) and yield impact values derived for wheat, whereas for Condamine we assumed values derived for sorghum.

We estimated that 15% of grain growers in the North West NSW NRM suffered the full residual impact (\$16.20/ha) and 28% suffered half the residual impact in 2022, and an average impact per farm that is suffering residual impact of around \$44,812. The estimated avoided impact for those that considered feral pigs a major problem, but have applied moderately or very effective management, averaged about \$90,743 per farm in 2022, and those farms reported an average expenditure of about \$10,419 per farm. Estimated returns on expenditure (impact avoided divided by expenditure) for these farms ranged widely, with 50% achieving at least 5:1.

We estimated that 25% of grain growers in the Condamine NRM suffered the full residual impact (\$50.40/ha) and 12% suffered half the residual impact in 2022, and an average impact per farm that suffered residual impact of around \$34,729. The estimated avoided impact for those that considered feral pigs a major problem, but have applied moderately or very effective management, averaged about \$47,052 per farm in 2022, and those farms reported an average expenditure of about \$3,921 per farm. Estimated returns on expenditure for these farms ranged widely, with 50% achieving at least 11:1.

We estimated that 2.5% of grain growers in the Northern Agricultural NRM suffered the full residual impact (\$11.20/ha) and 2.5% suffered half the residual impact in 2022, and an average impact per farm that is suffering residual impact of around \$61,392. The estimated avoided impact for those that considered feral pigs a major problem, but have applied moderately or very effective management, averaged about \$119,871 per farm in 2022, and those farms reported an average expenditure of about \$15,684 per farm. Estimated returns on expenditure (impact avoided divided by expenditure) for these farms ranged widely, with 50% achieving at least 10:1.

5.2 Risks from disease transmission

Australian feral pig populations harbour a diverse range of endemic and emerging pathogens, including viruses, bacteria, and parasites, which can have important direct and indirect effects on livestock production and human health (Pavlov 1988; Henderson 2009; Pearson et al. 2014). Feral pigs are sympatric with different livestock production systems throughout much of their range, including beef and dairy cattle production, sheep wool and meat production, and intensive and free-range piggeries. Feral pigs and livestock often come into direct or indirect contact by sharing resources, such as feed, water, and shelter (e.g. Figure 16). This creates opportunities for the transfer or spillover of pathogens and associated diseases in both directions. Some of the most economically important pathogens hosted by feral pigs in Australia include *Leptospira* spp., *Brucella suis*, and Japanese encephalitis virus (JEV) (Table 1). However, the role of feral pigs as a source of infection for many other important pathogens, such as bovine diarrhoea virus and *Clostridium* spp., remains unclear in Australia. Some pathogens hosted by feral pigs are zoonotic and have important costs associated with human health; however, human health impacts are only noted here in the context that they can result in lost farm labour.



Figure 16. A feral pig running through a feed bunk at a cattle feedlot in northern NSW (Image credit: Andrew Bengsen, NSW Department of Primary Industries & Regional Development).

Table 1. A selective overview of some diseases and disease agents likely to occur in Australian feral pigs, summarising transmission routes, economic impacts, and evidence for their distribution in feral pigs.

Disease	Disease agent and transmission route	Economic impacts	Evidence for pathogen presence in feral pigs?
Japanese encephalitis	Bites from mosquitoes carrying Japanese encephalitis virus. Feral pigs are likely to act as amplifying hosts.	Reproductive losses and encephalitis in domestic pigs; increased biosecurity costs; debilitating illness and death in horses and humans	Confirmed recent outbreaks in northern and south-eastern Australia with major production and human health impacts (Moore et al. 2024; Richards et al. 2025).
Leptospirosis	Ingestion of environmental material contaminated with pathogenic leptospires by feral pigs	Reproductive losses in cattle and domestic pigs; vaccination costs; zoonotic risk to farm workers	Confirmed widespread in feral pigs in eastern Australia (Mason et al. 1998; Pavlov and Edwards 1995; Pearson et al. 2014; Ridoutt et al. 2014).
Porcine brucellosis	Direct contact with pigs infected with <i>Brucella suis</i>	Infertility and abortions in pigs; zoonotic risk to humans from direct contact with infected pigs	Confirmed endemic in parts of QLD and NSW (Ridoutt et al. 2014; Kneipp et al. 2025).
Q fever	Contact with tissues or fluids of in pigs infected with <i>Coxiella burnetii</i> ; inhalation of contaminated aerosols	Reproductive losses in cattle, sheep, and goats; debilitating illness in humans, especially farm workers	Exposure detected in feral pigs in parts of QLD and NSW (Keast and Littlejohns 1963; Cooper et al. 2012;)
Gastrointestinal diseases	Ingestion of water or feed contaminated with pathogens such as <i>Giardia</i> , <i>Cryptosporidium</i> , and <i>Salmonella</i> by feral pigs	Ill thrift in cattle, sheep, pigs and goats; reproductive losses; debilitating illness in human	Exposure detected in feral pigs at multiple sites in WA (Hampton et al. 2006; Ward et al. 2013)
Mycoplasmal pneumonia	Contact with pigs infected with <i>Mycoplasma hyopneumoniae</i>	Increased susceptibility of domestic pigs to secondary respiratory infections, causing high mortality	Exposure detected in feral pigs at one site in QLD (Pearson et al. 2014)
Porcine proliferative enteropathy	Contact with environmental material contaminated with <i>Lawsonia intracellularis</i> by feral pigs	Reduced weight gain and feed conversion efficiency in domestic pigs	Exposure detected in feral pigs at one site in QLD (Pearson et al. 2014)
Sarcocystis	Consumption of feed contaminated with <i>Sarcocystis</i> spp. by a carnivorous definitive host (pigs can be intermediate hosts)	Trimming and condemnation of pig, sheep and goat carcasses	<i>Sarcocystis miescheriana</i> detected in feral pigs at one site (Shamsi et al. 2024)
Panama disease Tropical race 4, fusarium wilt	Exozoochory: transport of soil contaminated with <i>Fusarium oxysporum</i> f. sp. <i>cubense</i> by feral pigs	Severe banana crop losses; increased biosecurity costs	Present in NT and north QLD soils. Pigs spread similar soil-borne pathogens; their role in spreading TR4 is assumed rather than evidence-based (Pegg et al. 2021)

5.2.1 Disease costs at the farm level

At the farm level, the economic costs of livestock diseases can be viewed as the difference in production efficiency between an ideal disease-free system and a system burdened by the disease (Hogeveen and Van Der Voort 2017). These costs can be disaggregated in several ways. Using a loss-expenditure framework, the costs (C) of disease represent the sum of production losses (L) and expenditures (E) arising from the presence of the disease ($C = L + E$; McInerney et al. 1992). Losses are incurred from reduced outputs due to animal morbidity or death, whereas expenditures arise from increased inputs such as vaccines, biosecurity measures, or veterinary services that aim to prevent or alleviate disease. Rational producers are expected to adopt

management strategies that balance losses and expenditures, thereby minimising the total cost of the disease to their enterprises. However, achieving this balance is challenging in practice and since diseases rarely respect property boundaries there are wider risks and costs that also need to be considered (see Section 5.2.2).

The loss-expenditure framework is conceptually simple: farm-level costs can be estimated by monitoring production losses from disease and expenditures to prevent or manage disease (McInerney et al. 1992). However, most of the economically important pathogens hosted by feral pigs either circulate within domestic populations or can be maintained and transmitted by other wild species that commonly interact with livestock (Emanuel et al. 1964; Pearson et al. 2014). This makes it difficult to isolate the likely contribution of feral pigs to the overall disease burden and cost. For example, an assessment of the risks of different wild animals transmitting several pathogens to domestic pigs concluded that rats (*Rattus rattus*, *R. norvegicus*) posed the greatest risk of disease transmission to domestic pigs, followed by European starlings (*Sturnus vulgaris*) and feral pigs (Pearson et al. 2016). That study concluded that feral pigs posed the greatest risk of *Mycoplasma hyopneumoniae* transmission to domestic pigs; however, another study (Pearson et al. 2014) found greater seroprevalence in domestic pigs (100%) than in feral pigs close to a piggery (42%), suggesting that the domestic population may have been a source of infection rather than a recipient. We also note that the costs associated with disease prevention or management are often shared across multiple pathogens, which might be associated with different hosts. To accurately determine the impact of feral pigs on disease-related losses and expenditures, it would be necessary to separate their specific contribution from those of other potential sources of infection.

We were unable to find robust analyses of the economic impact of diseases associated with feral pigs at the farm level. Most farm-level examinations of diseases associated with feral pigs have been ad hoc disease investigations. For example, mass reproductive failures in unvaccinated cattle have been attributed to infection with *Leptospira interrogans* (serovar Pomona), ultimately acquired from feral pigs (e.g. Anonymous 2000, 2011, 2012). It is difficult to retrospectively estimate the economic losses associated with these specific cases, but similar failures could be expected to incur losses of between \$1,796 and \$53,866 at the time of writing (Table 2).

Regional investigations into the costs associated with feral pigs provide another source of farm-level information. One such assessment in northern NSW specifically excluded disease costs due to high uncertainty and variability (Powell 2024). Another assessment that extrapolated across approximately 400 livestock producers in the Whitsunday Regional Council local government area estimated a total annual expenditure of \$27,799 for vaccination against leptospirosis (\$34,383 adjusted for inflation in 2025) based on self-reports from 10 producers (Synergies Economic Consulting 2020). However, leptospiral vaccines are commonly packaged in combination with vaccines against clostridial diseases (e.g. Ultravac 7 in 1, Zoetis) so the proportion of expenditure that should be attributed to protection against leptospirosis acquired from feral pigs is unclear. The same study assumed a 2% reduction in potential weaning rates due to combined disease (presumably leptospirosis) and predation, resulting in an average expected total annual loss of \$1,981 per herd or \$780,493 across the region (\$2,433 and \$958,704, adjusted for inflation). Again, it is difficult to isolate the proportion of estimated losses that should be attributed to disease acquired from feral pigs, but the large difference between vaccine expenditure and potential losses implies that routine vaccination of cattle exposed to leptospirosis is justified.

Table 2. Potential losses derived from five mass reproductive failures attributed to infection of cattle with *Leptospira interrogans* via feral pigs in NSW.

Year	Region	Reproductive failures	Herd size	Estimated loss (2025\$) ^a
2000	North West NSW	60	150	53,866
2011	Central West NSW	28	80	25,138
2012	North West NSW	11	42	9,875
2012	North West NSW	2	31	1,796
2012	North West NSW	10	12	8,978

^a Losses were estimated using an average young cattle sale price of 388 cents per kg liveweight (Meat and Livestock Australia 2025) for 225 kg weaners.

The 2022 JEV outbreak had significant impacts on pork production in Australia, including losses incurred due to the outbreak itself and expenditure to reduce the risk of further major impacts in future outbreaks. Feral pigs are effective maintenance hosts of JEV and might play an important role in its persistence in the environment, although mosquitoes are the primary vector for transmission from wild hosts, such as waterbirds and feral pigs, to domestic animals (Moore et al. 2024). Preliminary information provided by the Australian pork industry indicates that businesses representing approximately 60% of the industry were affected by the 2022 outbreak. The types and extent of impacts varied greatly, but disease-induced reproductive failure and juvenile mortality were estimated to have reduced annual production by between 3% and 6% on affected farms. The cost of these losses was estimated to be \$35,000 to \$40,000 per 100 sows (Richards et al. 2025). An ongoing farm-level consequence of the outbreak has been the need for increased biosecurity measures. The Australian Pork Industry Quality Assurance Program (APIQ) specifies standards for different aspects of production and covers 90% of pork production in Australia. Since the 2022 JEV outbreak, APIQ-certified producers have been required to include mosquito management and monitoring in their approved pest management plans (Australian Pork Limited 2022). However, given that feral pigs are likely to be an enabling or exacerbating factor in JEV transmission to domestic pigs (rather than a crucial link in the transmission cycle) it is not yet possible to determine the proportion of losses or expenditure that should be attributed to the presence of feral pigs.

5.2.2 Wider costs

Costs incurred at the farm level often have flow-on impacts to economic sectors linked to livestock production such as feed suppliers, livestock transporters and food or fibre processors. The presence of some diseases in livestock or horticultural production can also have ramifications for international trade or consumer preferences, which can result in a reduced demand for specific products. However, while the macroeconomic costs of diseases often outweigh private costs, they are rarely quantified because they require a model of the entire economic system (McInerney et al. 1992).

Producers in private markets generally have few incentives or mechanisms to invest in disease management strategies that provide benefits beyond their own enterprises (McCarthy et al. 2003). Consequently, government or industry investment is often required to deliver programs that reduce the economic and social costs of diseases or pest animals across the wider economy. These programs commonly include landscape-scale management and research and development projects. However, they generally address a variety of threats and risks, making it difficult to pinpoint the specific portions of expenditure attributable to a single threat, such as the maintenance and spread of disease in feral pigs. For example, the Australian government allocated \$69M to address the agricultural and human health impacts of the 2022 JEV outbreak in northern and southeastern Australia. More than half of this expenditure was specifically dedicated to protecting human health rather than agriculture, and in the absence of detailed information on the role of feral pigs in disease maintenance, amplification, and transmission, it is impossible to allocate a proportion of the remaining investment to feral pigs. Similarly, feral pigs are thought to be important contributors to the spread of *Fusarium oxysporum*, the soil-borne fungus that causes Panama disease Tropical race 4 (TR4) in bananas (Pegg et al. 2021). Following its detection in north QLD in 2015, the QLD government invested nearly \$24M (\$31.8M if adjusted to 2025) in response measures (AEC 2017), including fence construction and active feral pig control around infected properties, to reduce the risk of pigs spreading the pathogen (Mitchell-Whittington 2015). A 2020 cost-sharing agreement between the QLD government and banana growers committed a further \$16.8M (\$20.6M adjusted to 2025) over five years to manage and prevent its further spread (ABGC 2022). Fencing works and pig control programs conducted under these programs are thought to have helped slow the spread of TR4 by feral pigs (Pegg et al. 2021), but the proportion of the total government and industry costs that might be allocated to feral pigs is inestimable.

The examples discussed above relate to government and industry efforts to address market failures related to emerging diseases in which feral pigs play an important role. Governments must also invest in the prevention of incursions or the establishment of important exotic diseases that could become established in feral pigs, such as foot and mouth disease (FMD) and African swine fever (ASF). An outbreak of either of these diseases would have severe economic and reputational consequences to Australia.

Buetre et al. (2013) estimated that the cost of a widespread, multi-state incursion of foot and mouth disease (across the beef, sheep meat, pork, wool, and dairy industries) could exceed \$80B (c. \$111B inflation-adjusted from 2013 to 2025) to the Australian economy over ten years. Even a relatively small, isolated outbreak was expected to incur between \$5.6B and \$6.3B in lost revenue and control costs (\$7.8–\$8.7B inflation-adjusted from 2013 to 2025). For ASF, the cost of eradicating a small-scale outbreak in feral pigs was recently estimated to range between \$101M and \$127M over 5 years, at a 3% discount rate (c. \$107.2M–\$134.7M inflation-adjusted from 2023 to 2025, respectively; Slatyer et al. 2023). Assuming eradication of ASF is not economically or technically feasible, the long-term cost of ASF was estimated to be between \$439M and \$2.54B over 30 years at a 3% discount rate (c. \$465.8M–\$2.69B inflation-adjusted from 2023 to 2025, respectively). These long-term costs highlight the benefit of eradication as a management strategy, if it is achievable.

In 2022–23, the NSW government invested \$22.8M (\$24.2M adjusted to 2025) in prevention and preparedness measures for FMD as part of a wider emergency animal disease investment package. The FMD investment was delivered through three key project areas, including a major project to increase feral pig management capabilities across the state and to reduce feral pig densities through intensive control operations at several sites (New South Wales LLS 2022, 2023).

5.3 Pilot methods for better quantifying impacts and costs

5.3.1 Damage assessment methods

Unmanned aerial vehicle surveys

Nine paddocks across six properties were surveyed by UAV to collect RGB and LiDAR imagery for assessing methods for quantifying crop damage by feral pigs in the future (Table 3, Figures 17 and 18). Three paddocks (two canola, one wheat) across two properties were surveyed by UAV in October 2025. In January 2026, imagery in four sorghum paddocks were captured. Additionally, a small area of one chickpea paddock and one cotton paddock were also opportunistically surveyed in October 2025 and January 2026 (respectively), although little evidence of pig damage was apparent after on-foot field inspection. A total of 1,116 ha unique crop area was surveyed, although the application of multiple sensors/repeat surveys across these areas resulted in collection of a total of 2,628 ha of imagery data.

Yield mapping

Yield mapping was collated for the wheat paddock surveyed (Table 3). Landholders have committed to provide remaining yield maps from harvesters for the canola and sorghum paddocks surveyed, but those data were not available for this report.

Ground-truthing

A total of 333 patches in crops with missing or damaged plants were examined across the six surveyed paddocks by an observer on the ground. The remaining paddocks (Moreton Plains 2 [canola], Deer Park 2 [sorghum] and Deer Park 3 [cotton], Table 3) were not assessed due to limited pig activity/damage or time constraints. Across all paddocks, the majority of assessed patches ($n = 230$, 69%) showed indicative signs of pig activity and damage. Feral pig sign in damage patches usually included a combination of prints, scats or chewed and trampled plant material (see Figure 19 d–f). However, areas of crop damage were often not exclusive to feral pigs, with c. 11% ($n = 38$) of these patches coinciding with other damage, including that from other animals (particularly macropods). The remaining damaged or missing crop patches were a result of other causes (e.g. poor crop seeding or germination, waterlogging).

Stomach sampling

A small sample of 11 feral pig stomachs were collected from pigs shot near sorghum crops at Boomerang, KaySix and Melburra on 20–21 January 2026 (Figure 20). These samples have been sent to a commercial provider for dietary analysis but this was not available in time for this report.

Table 3. Details of UAV crop surveys completed in spring 2025 (October 2025) and summer 2025/26 (January 2026) growing seasons in Moree district, northern NSW. Crop type, number of ground truthed datapoints [n] per site, sensor used (RGB, LiDAR, Multi-spectral), image type (orthographic, smart oblique), flight height above ground level (AGL) in m, ground sampling distance (GSD), PCD (point cloud), flight speed (m/s), image overlap (as % side and % front overlap), and area surveyed (hectares) are indicated.

Site	Crop [n]	Date	Sensor	Image type	Height AGL (m)	GSD (cm)	PCD	Speed (m/s)	Overlap % Side	Overlap % Front	Hectares
Carrington	Chickpeas	5/10/2025	PI + 35mm	Ortho	50	0.63	NA	6.8	70	80	35
		5/10/2025	PI + 35mm	Ortho	120	1.51	NA	14.5	70	80	33.2
		5/10/2025	LI - LiDAR	Ortho	50	1.36	351	5.5	40	70	36.9
		22/01/2026	LI - LiDAR	Ortho	80	2.18	241	5	40	70	34.6
Carroll	Wheat [28]	4/10/2025	Multi-spectral	Smart Oblique	30	1.37	NA	4	70	80	25.6
		4/10/2025	PI + 35mm	Smart Oblique	50	0.63	NA	5	70	80	31.2
		4/10/2025	LI - LiDAR	Ortho	50	1.36	327	5.5	40	70	24.2
		4/10/2025	PI + 35mm	Ortho	50	0.63	NA	6.8	70	80	90.8
		4/10/2025	PI + 35mm	Ortho	50	0.63	NA	6.8	70	80	4.68
		4/10/2025	LI - LiDAR	Ortho	50	1.36	327	5.5	40	70	5.03
		22/01/2026	LI - LiDAR	Ortho	80	2.18	127	9.5	40	70	235
		22/01/2026	LI - LiDAR	Ortho	80	2.18	145	8.3	40	70	122.1
		22/01/2026	LI - LiDAR	Ortho	80	2.18	127	9.5	40	70	56.8
Moreton Plains 1	Canola [21]	2/10/2025	PI + 35mm	Ortho	50	0.63	NA	6.8	70	80	97.3
		2/10/2025	Multi- spectral	Ortho	14	0.65	NA	4	70	80	12.5
		2/10/2025	LI - LiDAR	Ortho	50	1.36	327	7	40	70	110
		2/10/2025	PI + 35mm	Ortho	120	1.5	NA	14.5	70	80	89.6
		3/10/2025	LI - LiDAR	Ortho	50	1.3	327	7	40	70	91.2
		3/10/2025	Multi- spectral	Ortho	14	0.65	NA	7	70	80	11
		3/10/2025	PI + 35mm	Ortho	120	1.4	NA	14.5	70	80	89.1
		3/10/2025	PI + 35mm	Ortho	50	0.63	NA	6.8	70	80	92.9
		22/01/2026	LI - LiDAR	Ortho	70	1.9	241	5	40	70	65.7
Moreton Plains 2	Canola	3/10/2025	PI + 35mm	Ortho	120	1.4	NA	14.5	70	80	172
KaySix	Sorghum [47]	21/01/2026	LI - LiDAR	Ortho	50	1.36	327	5.5	40	70	82.9
		21/01/2026	PI + 35mm	Ortho	70	0.88	NA	7.5	70	80	98.4

Boomerang	Sorghum [60]	21/01/2026	LI - LiDAR	Ortho	50	1.2	327	5.5	40	70	116
		21/01/2026	PI + 35mm	Ortho	70	0.88	NA	8.2	70	80	119
Deer Park 1	Sorghum [171]	20/01/2026	PI + 35mm	Ortho	70	0.88	NA	7.5	70	80	165
		20/01/2026	LI - LiDAR	Ortho	50	1.1	0.88	7.5	40	70	172
Deer Park 2	Sorghum	20/01/2026	PI + 35mm	Ortho	70	0.88	NA	7.5	70	80	117
		21/01/2026	LI - LiDAR	Ortho	50	1.3	327	7.5	40	70	120
Deer Park 3	Cotton	21/01/2026	PI + 35mm	Ortho	70	0.88	NA	7.5	70	80	72.2



Figure 17. Crops surveyed by UAV in the Moree district, northern NSW, in October 2025: (a) canola, Moreton Plains 1; (b) canola, Moreton Plains 2; (c) wheat, Carroll; (d) chickpeas, Carrington. See Table 3 for details.

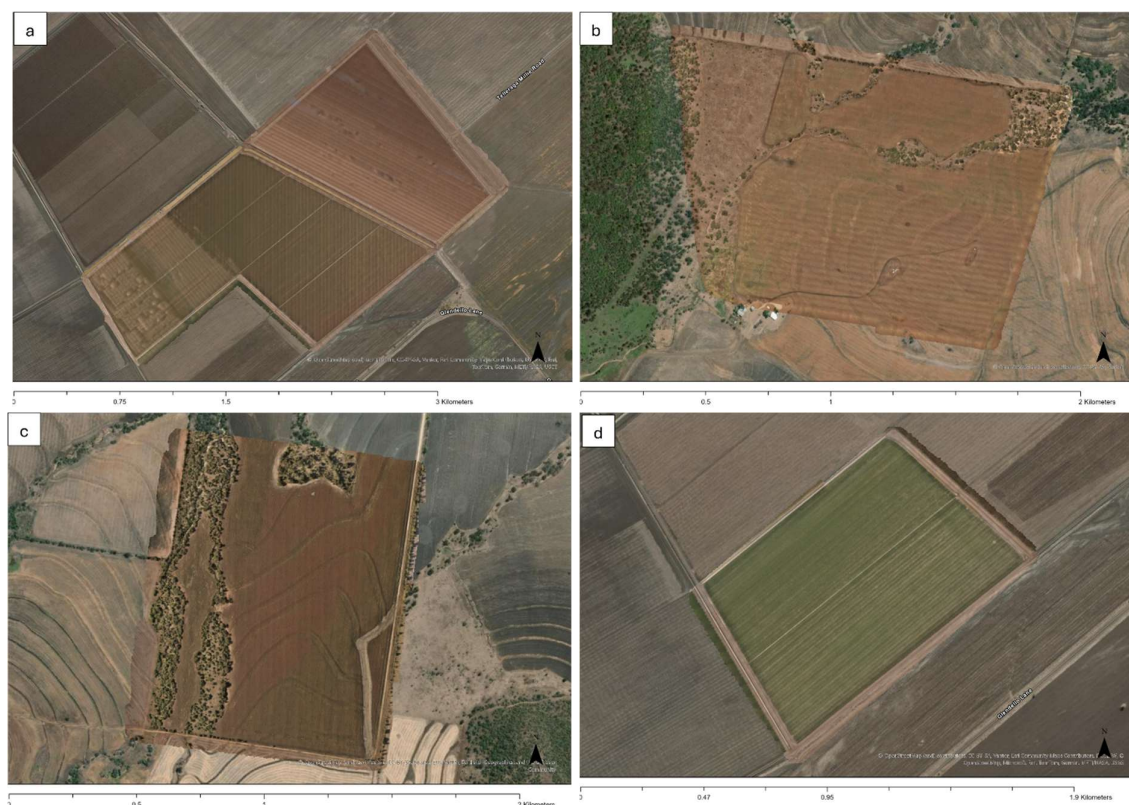


Figure 18. Crops surveyed by UAV in the Moree district, northern NSW, in January 2026: (a) sorghum, Deer Park 1 and 2; (b) sorghum, Boomerang; (c) sorghum, KaySix; (d) cotton, Deer Park 3. See Table 3 for details.

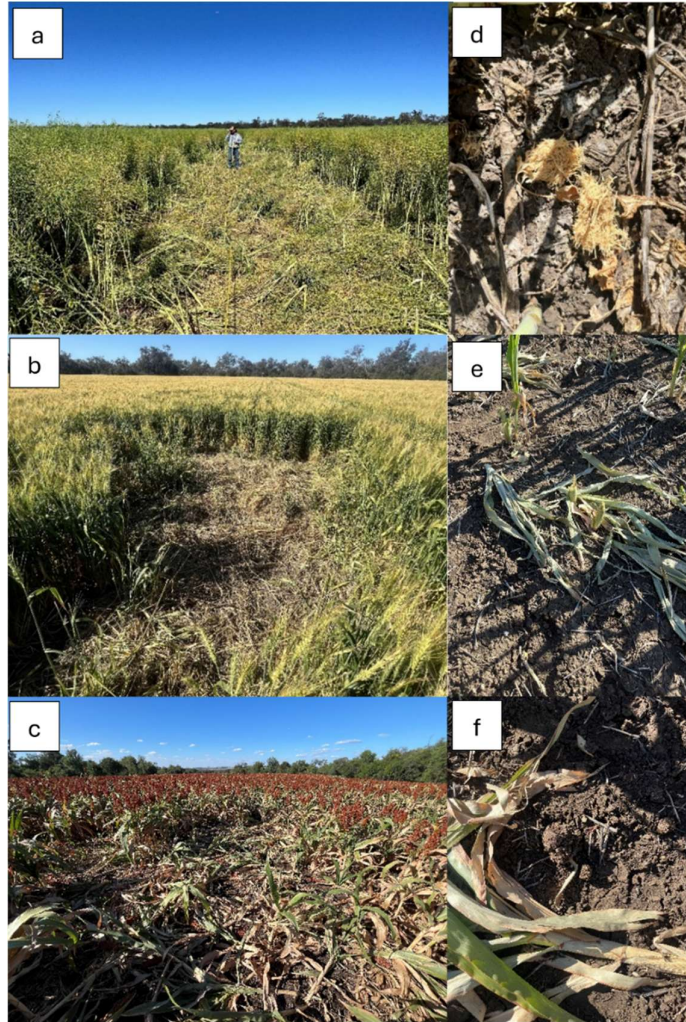


Figure 19. Feral pig damage to (a) canola, (b) wheat and (c) sorghum fields surveyed in the Moree district, northern NSW. (d–f) Indicative signs of pig activity present in damage patches includes plant disturbance as combinations of chewed or knocked down plant material, prints or scats.



Figure 20. Feral pig culled (as indicated with arrow) in a sorghum crop during an aerial shooting program, January 2026.

Table 4. Damage patch statistics in the assessed area of a canola paddock (79.2 ha). Severity is the relative contribution of feral pig damage to each damage patch.

Severity	Count (n)	Total (m ²)	% Assessed area
High (>80%)	233	4,140	0.52
Medium (>50 to 80%)	457	14,119	1.78
Low (<50%)	284	13,040	1.64
Other (0%)	188	2,014	0.25
Total	1162	33,313	4.19

5.3.2 Damage assessments in canola

The location, extent and severity of crop damage in a 79.2 ha section of one canola paddock (Moreton Plains 1, Figures 21 and 22) was delineated using a combination of elevation contours and manual refinement. The area of patches with identified feral pig damage ($n = 974$) totalled 3.12 ha, or 3.9% of the entire assessed area in the paddock. Most ($n = 690$, 59%) of these patches suffered medium to high levels of pig damage and represented 2.3% of the assessed area. Pig damage in the remaining patches ($n = 284$) were considered a secondary cause of lost yield (1.6% of assessed area). Damage from other causes represented only 0.3% of all patches (Table 4).

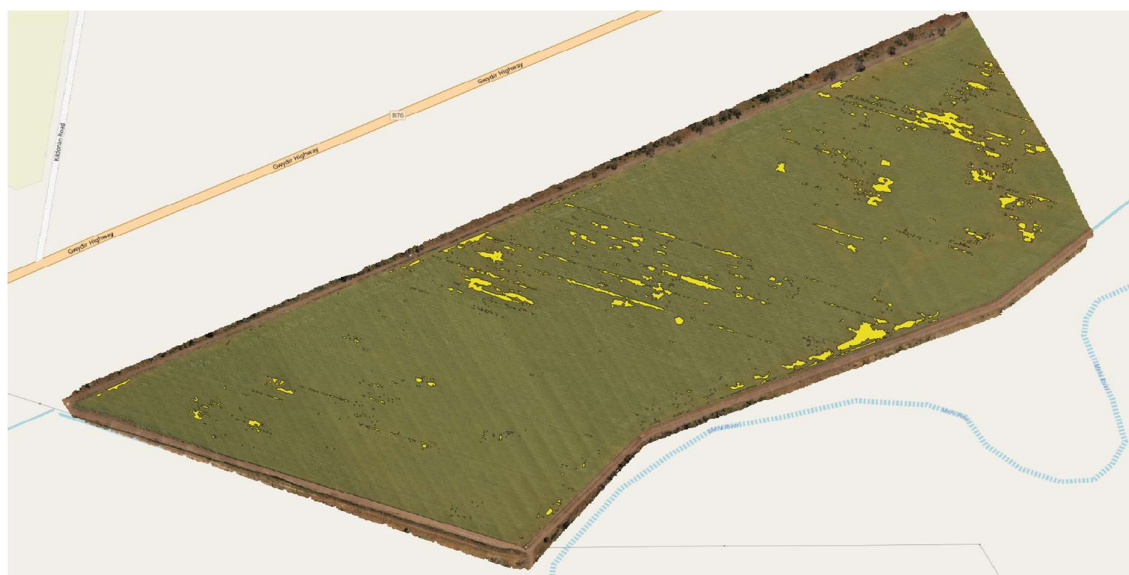


Figure 21. Section of canola paddock (Moreton Plains 1, see Figure 17a) showing the extent of the damage patches delineated in yellow.

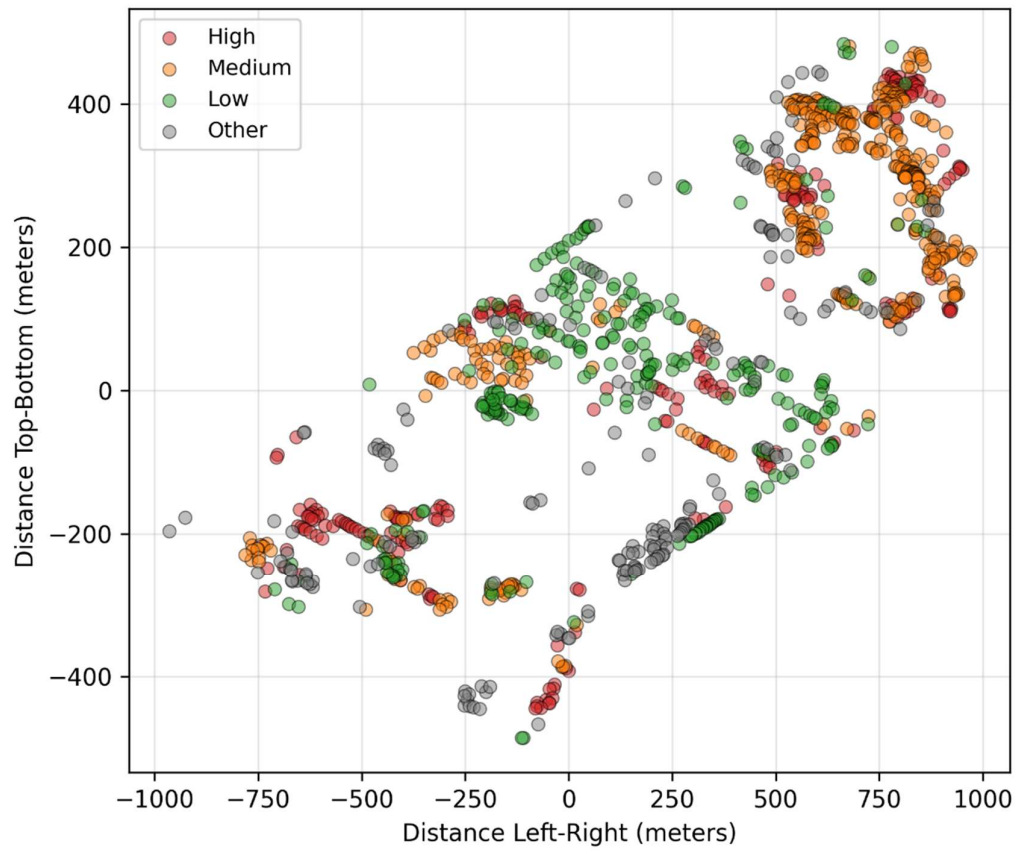


Figure 22. The spatial distribution of feral pig damage (low, medium and high intensity) and other damage (other) within the assessed area of a canola paddock in Moreton Plains I.

6. Discussion

6.1 Impacts and costs of feral pigs on agriculture

We estimated that the costs of feral pigs to agriculture (including horticulture) in Australia was \$190.8M (\$170.1M–\$212.6M) in 2022, \$179.4M (\$153.8M–\$205.2M) in 2019, and \$186.3M (\$153.4M–\$219.5M) in 2016. Our estimates include private expenditure on feral pig management as well as residual agricultural losses incurred despite control efforts. The estimates exclude public sector research and management costs, as well as costs related to damage to farm infrastructure, increased soil erosion, introduction of diseases, and spread of invasive weeds. Our key assumptions were: (1) land managers that reported minor problems with feral pigs did not incur any residual losses; (2) land managers' perceived effectiveness of their control efforts determined how much residual damage was incurred on the commodity they produced; (3) proportional yield losses (as extracted from the literature) did not vary in space and time. Moreover, our approach could not properly address impacts to some commodities in some areas (e.g. grain growers), or to some commodities as a whole (i.e. fruit and nut and rice growers), due to the resolution of PAWS, or the sample sizes of respondents in some of the ANZSIC categories. Despite this, we were able to derive consistent estimates across three time periods which include all the major industries that are affected by feral pigs in Australia. The temporal analysis shows an increase in management expenditure from 2016 to 2022, an increasing trend in the estimated agricultural losses avoided by such management, and a decreasing trend in the estimated residual agricultural losses, all three trends consistent with increased management reducing feral pig impacts.

6.1.1 Comparison with previous national estimates

Several previous studies have tried to estimate the total costs of feral pig damage to agriculture (including horticulture) in Australia. These estimates vary in terms of how quantitative they are, how they were computed, and which commodities were included.

Feral pigs were estimated to cause approximately \$106.5M (c. \$187.9M inflation-adjusted from 2004 to 2025) in agricultural damage in Australia each year (McLeod 2004). These costs (which include depredation of livestock, destruction of grain and other crops, and population control costs) place them as the second worst mammalian pest (after European rabbits, *Oryctolagus cuniculus*, which caused c. \$199.6M inflation-adjusted from 2004 to 2025) to the agricultural industry (McLeod 2004).

Gong et al. (2009) estimated the costs of feral pigs in Australia as \$11.4M in the year 2007–2008 (\$17.4M inflation-adjusted to 2025), including an overall loss in agriculture (including horticulture) of \$9.2M (c. \$14.05M inflation-adjusted from 2009 to 2025) and \$2.2M (c. \$3.36M inflation-adjusted from 2009 to 2025) in expenditure on feral pig control (excluding QLD and NT, see Table 4.4 in Gong et al. 2009). Expenditure on feral pig control in agricultural areas was notably high in WA (\$0.99M; c. \$1.51M inflation-adjusted from 2009 to 2025).

The comparatively high expenditure on control of feral pigs in WA may have contributed to the low reported costs of damage to the grain industry in that state (Gong et al. 2009), assuming population reductions were sufficient to mitigate damage. However, significant population reduction can result in compensatory population growth, whereby a resultant increase in fecundity and juvenile survival and/or recruitment occurs (Caughley 1980). Several studies of Australian feral pig demographics in a range of different environments have recorded high estimates for annual maximum rates of population growth (r_{max}): Giles (1980) 0.6–0.7; Caley (1993) 0.78; Choquenot (1998) 0.69; Hone (2002) 0.74 (also

see review by Bengsen et al. 2014). At the high end of the range of r_{max} values, Saunders (1993) estimated an annual growth rate of 1.34 after an aerial shooting program, but noted that this may have been inflated by immigration. Adams et al. (2019) suggested that similar demographic outcomes may be happening in some parts of WA following lethal control. If true, this could result in reductions in damage in the short-term (i.e. after lethal control) and an increase in damage in the mid-term if compensatory growth occurs and is not prevented by additional lethal control.

The pest animal survey data collected by ABARES have previously been analysed to estimate the costs of pest animals and weeds using responses to the 2019 PAWS (Hafi et al. 2023). This study estimated that private annual expenditure on feral pig management was \$110M whilst the average annual residual agricultural losses to major production systems averaged over five years was \$46M (c. \$131.4M and \$54.9M inflation-adjusted from 2021 to 2025, respectively). Hafi et al.'s (2023) 2021 estimate of \$186.3M is lower than Choquenot et al.'s (1996; also used in Bomford and Hart 2002) 1996 estimate of \$100M (\$213.9M inflation-adjusted from 1996 to 2025), but their estimate of \$54.9M in production losses (low end scenario: \$21.5M; high end scenario: \$89.6M) is much higher than the estimates of Gong et al. (2009; \$14.05M) and McLeod (2016; \$18.83M; range: \$16.7M–\$20.5M) (all estimates are inflation-adjusted to 2025). Hafi et al.'s (2023) estimates are more in line with our 2022 estimates (\$154.6M in management expenditure and \$36.2M residual agricultural losses) quite likely because the methodology used was similar between the two studies (albeit we assumed some land managers incurred half the damage by feral pigs, which was not the case in Hafi et al. 2023).

The data associated with the costs of feral pig management are likely to be relatively robust, though data on control effort are likely to be more variable. However, Channon et al. (2024) urged caution in adopting any of the values reported above because of different assumptions applied by different authors in their models and the significant lack of reliable data that are available for computing the estimates. There are, for example, inconsistent temporal trends in the national annual costs of feral pig damage estimates. Choquenot et al. (1996) estimated that the annual losses to agricultural production were \$203.1M (in 2025 dollars) in the mid-1990s (this value excludes the contingent cost of insuring against the outbreak of exotic diseases of livestock). This estimate is much higher than the subsequent national estimates by Gong et al. (2009), McLeod (2016), Hafi et al. (2023), and this study.

As feral pigs have recently expanded their geographic ranges and increased in abundance in some parts of Australia (West 2008; Cowled et al. 2009; Bengsen et al. 2017; Channon 2021; New South Wales (NSW) Government 2023 showing changes in state-wide distribution of feral pigs), one would predict a substantial increase in the costs associated with feral pig damage in newly invaded areas and regions where their numbers have increased. However, this trend is not apparent in national annual estimates of the costs of their damage. Given the comparatively small government and landowner expenditure on feral pig control (c. \$10.70M inflation-adjusted from 1996 to 2025) reported by Choquenot et al. (1996) in the mid-1990s, it seems unlikely that the agricultural damage caused by feral pigs was effectively reduced by management efforts. The inherent annual variability in Australian agricultural production systems and pest populations (Hone 1995; Choquenot 1998) might have contributed to some of the variability between national estimates of the costs of pig damage. However, as Choquenot et al. (1996) and Channon et al. (2024) have suggested, a more plausible explanation is that the available data are inadequate to accurately capture the full spatial and temporal costs associated with the damage that feral pigs cause at a national scale, especially when different assumptions and analytical methods are applied and used.

6.1.2 National versus regional estimates

We note similar disparities between national annual estimates of the costs of feral pig damage and management versus regional estimates. For example, out of 58 Pasture Protection Boards in NSW, Benson (1980) states that only 19 had estimated the costs of the damage caused by feral pigs in the late-1970s. A total annual cost of damages of \$5.5M (c. \$29.77M inflation-adjusted from 1980 to 2025) was reported for these 19 districts. The total estimated cost of the damage caused to agriculture (lambs, grain crops, water infrastructure, and fences) in the most impacted Pasture Protection Board (Walgett) was \$2.5M annually (c. \$13.53M inflation-adjusted from 1980 to 2025) (Benson 1980).

Similarly, the annual costs of lost agricultural production due to feral pigs from just two regions, North West NSW and Whitsunday Regional Council, have been estimated at a total of \$81.6M (\$66.2M and \$15.5M, respectively; Synergies Economic Consulting 2020; Powell 2024; all estimates are inflation-adjusted to 2025). Our estimated national annual residual loss to agricultural production was \$36.2M (range: \$15.1M to \$57.1M) in 2022 (estimated following the methods of Hafi et al. 2023). Therefore, the total annual costs of feral pig damage to agriculture from just two regions are larger than our national estimate.

Even if we use the upper estimate from our range (\$57.1M), it is probable that all regional estimates combined would dwarf our national estimate. We also report one regional estimate for the residual impact of feral pigs on sheep farming for NSW (\$42.46M in 2022, \$46.04M in 2019 and \$50.75M in 2016). These estimates were derived using an average impact per farm (within each survey strata) multiplied by the proportion of farms that suffered residual impacts and the number of businesses in each stratum. These estimates alone are very close to our nationwide estimate, suggesting that the high-level approach to estimate impacts for the whole of Australia might provide estimates that are too conservative.

Although the annual national estimates of the cost of feral pig damage reported by Gong et al. (2009) and McLeod (2016) were substantially lower than Choquenot et al.'s (1996) estimate, the national trend since the 1990s and early-2000s has shown an increase in the estimated costs associated with feral pig damage (see Gong et al. 2009; McLeod 2016; Hafi et al. 2023; this study). Although their study was only conducted at a regional level and over a relatively short time frame, Powell (2024) estimated that costs associated with feral pig damage had increased by 32% in North West NSW in 2022/23 compared with the 2020/21 financial year (\$47M in 2020/2021, \$56M in 2021/2022, and \$62M in 2022/2023; values not inflation-adjusted from Powell 2024; also see Powell and Revell 2021). Compared with 2021/22 (Powell and Revell 2021), the estimated costs of damage by feral pigs (as a percentage of yield) were higher in 2022/23 for barley, chickpeas, faba beans, maize, sorghum, sheep and wheat (Powell 2024).

While feral pig distribution and abundance increased substantially in North West NSW from 2020 to 2023 (Powell 2024), it does not explain the discrepancy between the large regional estimate relative to our national estimates (also see Gong et al. 2009; McLeod 2016; Hafi et al. 2023). Although it is desirable to collect empirical data that enable robust national estimates of the costs of feral pig damage to be computed, differences between regional and national estimates may remain difficult to reconcile. It is probable that national estimates will be more conservative than regional estimates due to a comparative lack of data, a greater number of spatial and temporal assumptions, and inherent nationwide variability in production systems. This may not matter if the goal is to compare national estimates longitudinally, so long as data collection, assumptions, and analyses are standardised. As

management occurs at a regional level, it may be more important that regional estimates have greater accuracy and precision.

In their paper, Didero et al. (2023) suggested improvements for estimating the costs of the impacts of wild pigs on agriculture in the United States. Didero et al. (2023) argued that the two most widely cited nationwide estimates of the costs of the damage caused by wild pigs in the United States (Pimentel et al. 2000; Pimentel 2007) are too simplistic and not based on systematic research methodologies. For example, Pimentel's (2007) estimate of US\$1.5B, which includes the costs of the damage to agriculture and control of wild pigs, is based on a nationwide population estimate of 5M wild pigs multiplied by an estimated US\$300 in crop damages and control costs per pig (Didero et al. 2023). The parameter estimates from Pimentel et al. (2000) and Pimentel (2007) were primarily derived from expert opinion rather than empirical data and they lacked scientific rigour. Didero et al. (2023) argued that the estimated costs of the damage that wild pigs cause to agriculture in the United States (Pimentel et al. 2000; Pimentel 2007) functioned as a good starting point for understanding the magnitude of the problem, but consistent and scientifically rigorous estimates are now required.

Channon et al. (2024) similarly called for consistency and an increase in data-based decision-making and scientific rigour for quantifying the economic costs caused by feral pigs and managing their populations. The true cost of the damage caused by feral pigs is unknown and varies temporally and spatially (Hone 1995; Choquenot 1998; Gentle et al. 2011). However, perceptions of the potential costs of damage can trigger lethal control as land managers attempt to mitigate the unwanted impacts caused by pigs. The cost of the sum of control operations should be allocated relative to the benefit that it accrues. Our analyses on individual commodities suggest that at least half of land managers achieved a 1:1 or higher return on control expenditure (range: 1:1–11:1). Likewise, Hafi et al (2023) estimated that \$30M (\$35.8M inflation-adjusted to 2025) expenditure in feral pig control avoided an estimated \$44M (\$52.6M inflation-adjusted to 2025) in agricultural losses (i.e. as 1.5:1 return on investment). Improving our knowledge of the costs of feral pig damage is therefore crucial to developing an understanding of the value of feral pig control. The relationship between the damage caused by feral pigs and pig density needs to be quantified (e.g. density–impact functions; Hone 1994; Norbury et al. 2015; Fleming et al. 2017). This would not be an easy task, because of the climate driven nature of both the pest and the production systems. However, paired with knowledge of the costs of control, this would enable robust cost–benefit analyses to be conducted, which would help optimise expenditure for the management of feral pigs.

6.1.3 Feral pig impact on different commodities

Our analysis of individual commodities highlights the spatial and temporal variation in feral pig impacts and expenditures that are incurred by agricultural land managers across Australia. Over 25% of land managers in QLD and over 20% in NSW considered feral pigs a major problem in 2022 and a further 25% and 15% considered them a minor problem, with most of these numbers up from those reported in previous years. However, in some local areas in both states, over 75% of landholders considered feral pigs a major and/or minor problem. Problems in other states were more localised, where between 6% and 25% of landholders considered feral pigs a major and/or minor problem in some areas. Across all industries, more than 60% of land managers that reported having a major problem with feral pigs reported impacts on their commodity (crop or livestock), although this percentage increased to more than 97% for sugarcane, cotton and grain producers. Depending on the production system, around 20–73% also reported impacts on infrastructure and water sources, and that pests cause erosion, and introduce weed seeds and diseases.

Across all industries assessed, more than 79% of land managers that reported having major problems with feral pigs in 2022 also reported spending money or labour managing them, although the amount spent varied widely depending on the industry: from an estimated \$2.9M spent by fruit and tree nut land managers across Wet Tropics, Burnett Mary and South East QLD NRMs, to \$47.1M spent by sheep farmers across the five sheep-raising regions with major feral pig problems. Estimated residual impact was also highly variable. Across all the commodities we assessed, we estimated that more than 25% of land managers suffered some residual impact. Estimated residual impact varied from an average impact per farm of \$2,690 for banana growers in Wet Tropics NRM to \$109,800 for cotton growers in Border Rivers Maranoa-Balonne, Central West or North West NSW NRMs.

6.1.4 Limitations

The availability of data on agricultural land managers' perspectives on feral pig damage and management obtained through PAWS was an important part of our work. This data set provides rigorous estimates of private management expenditure, and quantitative information on which to base estimates of residual agricultural losses caused by pest animals, albeit with assumptions. It also provides consistent data across time, which allows monitoring of evolving trends resulting from changes in species distribution and control efforts. There were a few commodities where the resolution of PAWS limited the insights that we could gain. For example, the 'Other Fruit and Tree Nut Growing' and the 'Other Grain Growing' ANZSIC categories include several different types of products, some of which are highly impacted by feral pigs whereas others are not. Yet we could not discern which land managers grew what type of product, so we were limited in the depth of analyses we could apply to these specific commodities.

Another limitation was the spatial resolution of the data that was available to us, which restricted our analyses to the NRM-level. Feral pig distribution and abundance can be highly variable within an NRM, but we had to assume that farmer-reported perspectives on how much of a problem they had with feral pigs reflected the impacts pigs had on the commodity produced. At a more general level, we used published estimates of the reductions that feral pigs cause on commodity yields. These estimates will not only be site-specific but also dependent on the density of feral pigs at the place and time where they were measured and on surrounding landscape context (e.g. availability of alternative food). For example, Mitchell and Dorney (2002) reported banana production lost to feral pigs in QLD farms ranged between 0.04% to 0.22% depending on the farm where it was measured. Likewise, Powell (2024) found that damage by feral pigs in North West NSW reduced chickpea yields by 2.86% in 2021/22 but only by 1.25% in 2022/23. We constructed low and high feral pig impact scenarios, as well as a most likely impact scenario, to reflect the uncertainty inherent in these values. Although it would be impossible to measure feral pig impacts everywhere they occur, a good starting point would be to derive density-impact relations for those commodities that are known to be most impacted by this pest.

6.1.5 General conclusions

Our estimates help to quantify the magnitude of the feral pig problem for Australian agricultural producers. Across states, the cost as a percentage of the local value of production varied from 0% (TAS) to 3% (QLD), with QLD and NSW having the largest costs as a percentage of the LVP (Table 5). This is probably due to feral pigs being very abundant in these states and imposing significant damage to crops (grain, cotton and sugarcane) as well as these states having the largest expenditures on

control measures. While our high-level estimates can help to identify broad problem areas (state, NRM within a state, industry), analyses at regional scales are still needed to identify more nuanced impacts that are generalised in the high-level analysis. Our temporal analysis of the PAWS data suggested that, from 2016 to 2022, agricultural land managers spent more on managing feral pigs and consequently incurred lower residual agricultural losses, a pattern that was also identified by Hafi et al. (2023) across multiple pest animals and weeds. The estimated avoided losses also showed an increasing trend (from 2016 to 2022), suggesting that more land managers were implementing management, and that this management was perceived as being more effective at reducing the impacts of feral pigs. Established pest animals such as feral pigs occur in landscapes where they cause agricultural, environmental, and social costs. Our study focused solely on the agricultural impacts. However, future studies that consider returns on investment and how benefits are distributed across productive and natural systems would provide valuable information that would help inform future investment decisions.

Table 5. Estimated costs to agricultural land managers by jurisdiction in 2022 (inflation-adjusted to 2025).

State	Cost of control (\$M)	Residual damage (\$M)	Total (\$M)	% of LVP ^b
NSW	67.7	19.4	87.0	1.21
QLD	75.4	15.5	90.9	2.98
SA	0.2	0	0.2	0.01
TAS ^a	0	0	0	0
VIC	1.8	0.1	1.9	0.03
WA	7.6	1.3	8.9	0.13
Total	154.6	36.2	190.8	0.74

^a There are no feral pigs in mainland TAS, but they do inhabit Flinders Island in the Furneaux Group.

^b Local Value of Production (LVP) of affected sheep meat, wool and crop industries (including oats, barley, sorghum, cotton, sugarcane). LVP was estimated as the average over the five years to 2021/22 (2017/18, 2018/19, 2019/20, 2020/21, 2021/22).

6.2 Risks from disease transmission

Reliable estimation of economic costs resulting from disease spillover from feral pigs to livestock is hindered by many interacting factors. These include: a scarcity of detailed data on the prevalence of different pathogens in feral pig populations; a poor understanding of transmission pathways between feral pigs and livestock or other susceptible assets; difficulty in isolating the costs associated with one disease from those of other diseases that are managed concurrently; a scarcity of transparent data on costs reported by producers; and the complexities of estimating indirect costs beyond those incurred by producers.

Cost estimation is also prone to over-simplification and contamination with biased data sources, which can lead to unreliable inferences. Consequently, although several studies have investigated the presence or prevalence of pathogens in feral pigs and livestock, few have attempted to quantify the economic consequences of feral pigs as hosts and spillover sources. Interestingly, we found no studies on the role of feral pigs in the spillover of poultry diseases, even though they can host important pathogens such as avian influenza viruses (Miller et al. 2017).

Addressing these knowledge gaps to provide robust estimates of the economic impacts caused by disease in feral pigs will require targeted, comprehensive studies on factors including: estimation of disease prevalence in feral pigs at wide spatial scales; characterisation of disease transmission pathways

between feral pigs, other wild hosts, and livestock; robust and transparent farm-level studies of losses and expenditures incurred as a result of disease in feral pigs; longitudinal studies to assess changes in prevalence and spillover in response to disease management efforts; and macroeconomic studies to investigate economic impacts beyond the farm. These studies would provide valuable insights for developing effective strategies to mitigate the agricultural costs associated with diseases in feral pig populations.

6.3 Pilot methods for better quantifying impacts and costs

Initial assessments using canola as a model crop are promising and support UAV imagery being used to accurately delineate damage to crop areas that is not available from any other methodology. The ready availability of commercial UAVs with RGB sensors suggest that data capture over cropping areas offers a flexible and potentially attractive option for growers. Such assessments will be likely to require ground truthing to help identify causes of crop loss, or at least recognition of other causes of damage, to correct for yield losses that do not result from feral pigs. However, improved education of growers or agronomists to identify pig damage to a range of crops is needed (Lockrey 2025). Relying on two-dimensional RGB imagery to quantify damage will require caution; these data can assist to delineate the extent of pig damage but the amount of damage within patches may vary markedly. Accurate measurements of lost crop yield within a patch will require more refinement, such as volumetric measurements of lost plant biomass using LiDAR.

Another approach that requires assessment is the application of object-based classifiers (e.g. Feature Analyst, Textron Systems Ltd.) in proprietary software (e.g. ARCGIS, ESRI). Where unique damage attributes exist, this may classify objects based on associated spatial criteria. This approach has been successfully used to delineate areas of pig damage to corn, cotton and peanut crops (Fischer et al. 2019; Smith et al. 2025), and may have application to cereal and other crop types. This approach requires both positive and negative training samples (i.e. damaged or undamaged areas for each crop), which are available in the current data set. RGB (i.e. visible spectrum bands), NDVI (or potentially LiDAR) could be assessed through object-based classifiers. Further research is needed and recommended on these approaches.

UAV or satellite imagery are recognised as potentially suitable sources to identify and quantify pig damage in crops in Australia (Lockrey 2025). Satellite imagery, in conjunction with yield mapping, is likely to offer the best potential for determining damage at regional scales for a reasonable cost. However, available resolution satellite imagery (30 cm GSD) may be insufficient, and high-resolution UAV imagery will, at least initially, be required to develop and validate such approaches for a broader application. Regardless of the imagery source, the level of resolution required to accurately delineate pig damage in the model crops examined here (canola, wheat and sorghum) needs to be investigated before recommendations on satellite imagery capture can be made.

Further assessments of the crop (canola, wheat and sorghum) damage data collected during the pilot trials to investigate methods to quantify feral pig damage are planned and needed. Improved, reliable damage assessment methods for use by producers or pest managers at scale would provide the ability to determine region or industry wide impacts from feral pigs, economic losses, and the outcomes (benefits) of pig management.

7. Recommendations

- *Develop reliable density–damage impact functions for specific high value commodities.*
 - These relationships are likely to vary regionally and temporally but are key to support robust agro-economic analyses and to determine appropriate minimum and maximum levels of investment in feral pig control. To achieve this, improved and scalable assessment methods will need to be developed for quantifying feral pig damage. This information remains crucial for estimating and monitoring economic losses caused by feral pigs and the need for, and effectiveness of, management practices to reduce such damage.
- *Quantify feral pig damage to pasture in beef and sheep raising areas based on robust data.*
 - There is probably little to no competition between livestock and feral pigs during high pasture availability, but this is likely not the case under extreme conditions such as during droughts.
- *Update lamb predation rates by feral pigs across NSW and QLD sheep regions.*
 - Feral pig predation of lambs is frequently raised as a concern, but most of our knowledge comes from old studies with limited geographic scope. Lambing and feral pig control practices have changed, and better technology is available to collect the necessary data to test this. Alternatively, data could be collected by interviewing land managers.
- *Assess whether specific fruit and nut crops incur economically important damage by feral pig (e.g. macadamia nuts in south-east QLD).*
 - How much damage is incurred? At what stage of development does most damage occur? How is damage spatially distributed in fruit and nut growing regions?
- *Increase the resolution of PAWS to include more information about the specific commodities produced at each farm.*
 - In particular, the horticulture and grain growing ANZSIC (Australian and New Zealand Standard Industrial Classification) categories include very different crops, some of which are of high value and can suffer significant losses.
- *Assess the reliability of self-reporting of perceived feral pig damage in PAWS.*
 - Land managers' reporting of feral pig damage could be highly subjective. Validation of this perceived damage against actual measured damage caused by feral pigs would be desirable but logistically challenging, as this could not be assessed for every PAWS participant. Alternatively, future iterations of the survey could include a question requesting a more descriptive measure of feral pig damage (e.g., to report the estimated percent damage caused by feral pigs to the commodity) rather than the three generic categories (none, minor, major).
- *Continue investment in surveillance, biosecurity, and coordinated feral pig management to reduce the likelihood and harm from potential future disease outbreaks.*
- *Further investigate data from our 2025 and 2026 pilot field trials to develop refined methodologies.*
 - Pilot field trials conducted in cereal crops in northern NSW in Spring 2025 and Summer 2026 provide a significant ground truthed data set on pig damage in canola, wheat, and sorghum crops. These spatial data should be further examined using the methods initiated in this study and additional spatial classification tools (e.g. using modelling approaches that incorporate machine learning and artificial intelligence). This analysis should aim to deliver refined, automated methods to quantify losses to a range of crops and identify potential applications

to other land systems (i.e. pasture, wetlands). However, significant resources are required to develop and validate spatial classification methods, and further support to deliver such outcomes is likely needed.

Future research questions

- Determine the positive economic and social impacts of feral pigs (e.g. commercial, recreational) and include these in future economic valuations.
- Investigate what mix of public and private investment in feral pig research and management is appropriate. What are the real market failures where public investment is appropriate, and under what circumstances are management costs being socialised while profits are privatised?
- Conduct a detailed agroeconomic analysis to determine why national level cost estimates are much lower than the sum of regional studies. How should national methods be recalibrated to avoid systematic underestimation? How reliable are regional studies?

8. Intellectual Property

There is no intellectual property arising from this project.

9. Literature cited

- Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) 2025a. Agricultural commodities report: September quarter 2025. ABARES, Canberra. Accessed 20 March 2026. <https://www.agriculture.gov.au/abares/research-topics/agricultural-outlook/september-2025>.
- Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) 2025b. Farm data portal. Accessed 20 March 2026. <https://www.agriculture.gov.au/abares/data/farm-data-portal>
- Australian Banana Growers' Council (ABGC) 2022. Discussion Paper - Panama TR4 Program Transition. Rocklea, Qld, Australian Banana Growers' Council.
- Adams PJ, Fontaine JB, Huston RM, Fleming PA 2019. Quantifying efficacy of feral pig (*Sus scrofa*) population management. *Wildlife Research* 46: 587–598.
- Agriculture and Environment Committee (AEC) 2017. Answers from Minister Byrne to pre-hearing questions from Government Members. Agriculture and Environment Committee, Queensland Parliament. Brisbane, Australia.
- Anonymous 2000. State and territory reports. *Animal Health Surveillance Quarterly* 5: 11.
- Anonymous 2011. State and territory reports. *Animal Health Surveillance Quarterly* 16: 1.
- Anonymous 2012. State and territory reports. *Animal Health Surveillance Quarterly* 17: 11.
- Aplet GH, Anderson SJ, Stone CP 1991. Association between feral pig disturbances and the composition of some alien plant assemblages in Hawaii Volcanoes National Park. *Plant Ecology* 95: 55–62.
- Arrington DA, Toth LA, Koebel Jr JW 1999. Effects of rooting by feral hogs *Sus scrofa* L. on the structure of a floodplain vegetation assemblage. *Wetlands* 19: 535–544.
- Aschim RA, Brook RK 2019. Evaluating cost-effective methods for rapid and repeatable national scale detection and mapping of invasive species spread. *Scientific Reports* 9: 7254.
- Ashton, D, Welsford-Brink, Q and Ryder J 2024. Financial performance of livestock farms: 2021/22 to 2023/24. ABARES, Canberra. <https://www.agriculture.gov.au/abares/research-topics/surveys/livestock>
- Australian Bureau of Agricultural and Resource Economics and Sciences & Commonwealth Scientific and Industrial Research Organisation (ABARES & CSIRO) 2024. National feral pig current distribution in Australia (2024), Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, December. <https://www.agriculture.gov.au/abares/research-topics/invasive-species/national-feral-pig-current-distribution-australia>
- Australian Bureau of Statistics (ABS) 2022. Value of Agricultural Commodities Produced, Australia. Accessed 15 August 2025. <https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia>
- Australian Bureau of Statistics (ABS) 2020/21a. Agricultural Commodities, Australia. Accessed 15 August 2025. <https://www.abs.gov.au/statistics/industry/agriculture/agricultural-commodities-australia>
- Australian Bureau of Statistics (ABS) 2020/21b. Value of Agricultural Commodities Produced, Australia. Accessed 15 August 2025. <https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia>
- Australian Bureau of Statistics (ABS) 2021/22a. Agricultural Commodities, Australia. Website accessed 15 August 2025. <https://www.abs.gov.au/statistics/industry/agriculture/agricultural-commodities-australia>
- Australian Bureau of Statistics (ABS) 2021/22b. Value of Agricultural Commodities Produced, Australia. Accessed 15 August 2025. <https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia>
- Australian Bureau of Statistics (ABS) 2024. Australian Agriculture: Horticulture. Accessed 25 July 2025. <https://www.agriculture.gov.au/agriculture-land/farm-food-drought/hort-policy>
- Australian Bureau of Statistics (ABS) 2025 Australian Agriculture: Broadacre Crops. Accessed 23 March 2026. <https://www.abs.gov.au/statistics/industry/agriculture/australian-agriculture-broadacre-crops/latest-release>

- Australian Pork Limited 2022. The Australian pork industry quality assurance program - standards manual. Version 5.2 12/2022. Australian Pork Limited. Canberra, Australia.
- Bain K, Kinnear K 2015. Feral pig control strategy for south west Western Australia: 2015–2020. Plan prepared for South West Catchments Council, Davenport, Western Australia.
- Ballari SA, Barrios-Garcia MN 2014. A review of wild boar *Sus scrofa* diet and factors affecting food selection in native and introduced ranges. *Mammal Review* 44: 124–134.
- Barrios-Garcia MN, Ballari SA 2012. Impact of wild boar (*Sus scrofa*) in its introduced and native range: a review. *Biological Invasions* 14: 2283–2300.
- Barrios-Garcia MN, Gonzalez-Polo M, Simberloff D, Classen AT 2023. Wild boar rooting impacts soil function differently in different plant community types. *Biological Invasions* 25: 583–592.
- Barrios-Garcia MN, Simberloff D 2013. Linking the pattern to the mechanism: how an introduced mammal facilitates plant invasions. *Austral Ecology* 38: 884–890.
- Bengsen AJ, Forsyth DM, Harris S, Latham ADM, McLeod SR, Pople A 2020. A systematic review of ground-based shooting to control overabundant mammal populations. *Wildlife Research* 47: 197–207.
- Bengsen AJ, Gentle MN, Mitchell JL, Pearson HE, Saunders GR 2014. Impacts and management of wild pigs *Sus scrofa* in Australia. *Mammal Review* 44: 135–147.
- Bengsen AJ, West P, Krull CR 2017. Feral pigs in Australia and New Zealand: range, trend, management, and impacts of an invasive species. In: Melletti M, Meijaard E DM eds. *Ecology, conservation and management of wild pigs and peccaries*. Cambridge, Cambridge University Press. Pp. 325–338.
- Benson R 1980. Evaluating feral pig damage and costs of control in western New South Wales. Research Workpaper no. 120. Division of Marketing and Economics, Department of Agriculture, Sydney.
- Bevins SN, Pedersen K, Lutman MW, Gidlewski T, Deliberto TJ 2014. Consequences associated with the recent range expansion of nonnative feral swine. *BioScience* 64: 291–299.
- Bomford M, Hart Q 2002. Non-indigenous vertebrates in Australia. In: Pimental D ed. *Biological invasions: economic and environmental costs of alien plant, animal and microbe species*. Boca Raton, CRC Press. Pp. 25–44.
- Bright J, Kaddatz B. 2020. Vertebrate pests in macadamia: pigs. Primefact 1769, First edition. New South Wales Department of Primary Industries. Accessed 07 July 2026. https://www.dpi.nsw.gov.au/_data/assets/pdf_file/0005/1258997/Vertebrate-pests-in-macadamia-pigs.pdf
- Brown VR, Bowen RA, Bosco-Lauth AM 2018. Zoonotic pathogens from feral swine that pose a significant threat to public health. *Transboundary and Emerging Diseases* 65: 649–659.
- Buetre B, Wicks S, Kruger H, Millist N, Yainshet A, Garner G, Duncan A, Abdalla A, Trestrail C, Hatt M 2013 Potential socio-economic impacts of an outbreak of foot-and-mouth disease in Australia. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.
- Caley P 1993. The ecology and management of feral pigs in the 'wet-dry' tropics of the Northern Territory. MAppSc thesis, University of Canberra, Australia.
- Caughley G 1980. Analysis of vertebrate populations. Wiley, New York, USA.
- Channon HA 2021. National Feral Pig Action Plan 2021–2031. Australian Pork Limited, Kingston, Australian Capital Territory.
- Channon HA, Dybing NA, Lewer D 2024. Data-based decision-making is essential for effective feral pig management in Australia. In: Timm RM, Woods DM eds. *Proceedings of the Vertebrate Pest Conference* 31, Paper No. 3.
- Choquenot D 1998. Testing the relative influence of intrinsic and extrinsic variation in food availability on feral pig populations in Australia's rangelands. *Journal of Animal Ecology* 67: 887–907.
- Choquenot D, Hone J 2002. Using bioeconomic models to maximize benefits from vertebrate pest control: lamb predation by feral pigs. In: Clark L, Hone J, Shivik R, Watkins K, Vercauteren K, Yoder J eds. *Human Conflicts with Wildlife: Economic Considerations*. National Wildlife Research Center, Fort Collins, USA, *Proceedings of the Third NWRC Special Symposium*. Pp. 65–79.

- Choquenot D, Lukins B 1996. Effect of pasture availability on bait uptake by feral pigs in Australia's semi-arid rangelands. *Wildlife Research* 23: 421–428.
- Choquenot D, Lukins B, Curran G 1997. Assessing lamb predation by feral pigs in Australia's semi-arid rangelands. *Journal of Applied Ecology* 34: 1445–1454.
- Choquenot D, McIlroy J, Korn T 1996. Managing vertebrate pests: feral pigs. Canberra, Bureau of Resource Sciences, Australian Government Publishing Service.
- Choquenot D, Ruscoe WA 2003. Landscape complementation and food limitation of large herbivores: habitat-related constraints on the foraging efficiency of wild pigs. *Journal of Animal Ecology* 72: 14–26.
- Coblentz BE, Baber DW 1987. Biology and control of feral pigs on Isla Santiago, Galapagos, Ecuador. *Journal of Applied Ecology* 24: 403–418.
- Cole RJ, Litton CM 2014. Vegetation response to removal of non-native feral pigs from Hawaiian tropical montane wet forest. *Biological Invasions* 16: 125–140.
- Cook DC 2014. Impact assessments for vertebrate pests in Western Australia. Agricultural Resource Risk Management, Strategic Report. Department of Agriculture and Food, Perth, Western Australia.
- Cooper A, Goullet M, Mitchell J, Ketheesan N, Govan B 2012. Serological evidence of *Coxiella burnetii* exposure in native marsupials and introduced animals in Queensland, Australia. *Epidemiology & Infection* 140: 1304–1308.
- Corey B, Radford I, Carnes K, Hatherley E, Legge S 2013. North-Kimberley landscape conservation initiative: 2010–12 Performance Report. Department of Parks and Wildlife, Kununurra, Western Australia. p. 45.
- Courchamp F, Chapuis J-L, Pascal M 2007. Mammal invaders on islands: impact, control and control impact. *Biological Reviews* 78: 347–383.
- Cowled BD, Giannini F 2007. Spatial predictive modelling for feral pigs in northern Australia (2.054R). Department of Agriculture, Fisheries and Forestry, Canberra.
- Cowled BD, Giannini F, Beckett SD, Woolnough A, Barry S, Randall L, Garner G 2009. Feral pigs: predicting future distributions. *Wildlife Research* 36: 242–251.
- Department of Agriculture, Fisheries and Forestry (DAFF) 2022. Wool. Accessed 25 July 2025. <https://www.agriculture.gov.au/agriculture-land/farm-food-drought/meat-wool-dairy/wool>
- DiBella L, Fuller S, Stallan R, Buckman M, Bacchiella D 2014. The impact and management of feral pigs in the Herbert cane growing region of north Queensland. *Proceedings of the Australian Society of Sugar Cane Technologists* 36: 156–164.
- DiBella L, Wood A, Nash M, Stewart R, Buckman M 2023. Learnings from the Hinchinbrook community feral pig management program. *Proceedings of the Australian Society of Sugar Cane Technologists* 44: 65–72.
- Didero NM, Ernst KH, McKee SC, Shwiff SA 2023. A call and suggested criteria for standardizing economic estimates of wild pig damage. *Crop Protection* 165: 106149.
- Don A 2022. No threat to global soil carbon stocks by wild boar grubbing. *Global Change Biology* 28: 685–686.
- Emanuel ML, Mackerras IM, Smith D 1964. The epidemiology of leptospirosis in North Queensland: I. General survey of animal hosts. *Epidemiology & Infection* 62: 451–484.
- Fischer JW, Greiner K, Lutman MW, Webber BL, Vercauteren, KC 2019. Use of unmanned aircraft systems (UAS) and multispectral imagery for quantifying agricultural areas damaged by wild pigs. *Crop Protection* 12: 104865.
- Fleming PJS, Ballard G, Reid NCH, Tracey JP 2017. Invasive species and their impacts on agri-ecosystems: issues and solutions for restoring ecosystem processes. *The Rangeland Journal* 39: 523–535.
- Forsyth DM, Woolnough AP, Nimmo DG, Ritchie EG, Kennedy M, Pople A, Watson I 2014. A comment on the influence of dingoes on the Australian sheep flock. *Australian Veterinary Journal* 92: 461–462.
- Freudenberger D, Hodgkinson K, Noble J 1997. Causes and consequences of landscape dysfunction in Rangelands. In Ludwig J, Tongway D, Freudenberger D, Noble J, Hodgkinson K eds.

- Landscape Ecology, Function and Management: Principles from Australia's Rangelands. CSIRO Publishing.
- Froese JG, Smith CS, Durr PA, McAlpine CA, van Klinken RD 2017. Modelling seasonal habitat suitability for wide-ranging species: invasive wild pigs in northern Australia. PLoS ONE 12: e0177018.
- Gentle M, Pople A 2013. Effectiveness of commercial harvesting in controlling feral-pig populations. Wildlife Research 40: 459–469.
- Gentle M, Pople A, Scanlan JC, Carter J 2019. The dynamics of feral pig (*Sus scrofa*) populations in response to food supply. Wildlife Research 46: 191–204.
- Gentle M, Pople T, Speed J, Aster D 2011. Assessing the role of harvesting in feral pig (*Sus scrofa*) management. Final Report to Blueprint for the Bush. Department of Employment, Economic Development and Innovation, Toowoomba, Australia.
- Gentle M, Speed J, Marshall D 2015. Consumption of crops by feral pigs (*Sus scrofa*) in a fragmented agricultural landscape. Australian Mammalogy 37: 194–200.
- Giles J 1980. The ecology of feral pigs in western New South Wales. PhD dissertation, University of Sydney, Australia.
- Gong W, Sinden J, Braysher M, Jones R 2009. The economic impacts of vertebrate pests in Australia.
- Hafi A, Arthur T, Medina M, Warnakula C, Addai D, Stenekes N 2023. Cost of established pest animals and weeds to Australian agricultural producers. Unpublished report. Canberra, Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).
- Hampton J, Spencer PBS, Elliot AD, Thompson RCA 2006. Prevalence of zoonotic pathogens from feral pigs in major public drinking water catchments in Western Australia. EcoHealth 3: 103–108.
- Harriott L, Amos M, Brennan M, Elsworth P, Gentle M, Kennedy M, Pople T, Scanlan J, Speed J, Osunkoya OO 2022. State-wide prioritisation of vertebrate pest animals in Queensland, Australia. Ecological Management and Restoration 23: 209–218.
- Hegel CGZ, Faria GMM, Ribeiro B, Salvador CH, Rosa C, Pedrosa F, Batista G, Sales LP, Wallau M, Fornel R, Aguiar LMS 2022. Invasion and spatial distribution of wild pigs (*Sus scrofa* L.) in Brazil. Biological Invasions 24: 3681–3692.
- Henderson WR 2009. Pathogens in vertebrate pests in Australia. Invasive Animals Cooperative Research Centre Report prepared for the Detection and Prevention Program's Project 8.D.3: Endemic disease literature review. Canberra, Australia.
- Hogeveen H, Van Der Voort M 2017. Assessing the economic impact of an endemic disease: the case of mastitis. Revue Scientifique et Technique (International Office of Epizootics) 36: 217–226.
- Hone J 1980. Effect of feral pig rooting on introduced and native pasture in north-eastern New South Wales. Journal of the Australian Institute of Agricultural Science 46: 130–132.
- Hone J 1988. Feral pig rooting in a mountain forest and woodland: distribution, abundance and relationships with environmental variables. Australian Journal of Ecology 13: 393–400.
- Hone J 1990. How many feral pigs in Australia? Wildlife Research 17: 571–572.
- Hone J 1994. Analysis of vertebrate pest control. Cambridge, Cambridge University Press.
- Hone J 1995. Spatial and temporal aspects of vertebrate pest damage with emphasis on feral pigs. Journal of Applied Ecology 32: 311–319.
- Hone J 2002. Feral pigs Namadgi National Park, Australia: dynamics, impacts and management. Biological Conservation 105: 231–242.
- Hone J 2021. How many feral pigs in Australia? An update. Australian Journal of Zoology 67: 215–220.
- Hone J, Buckmaster T 2014. How many are there? The use and misuse of continental-scale wildlife abundance estimates. Wildlife Research 41: 473–479.
- Howard K, Beattie L 2018. A national producer survey of sheep husbandry practices. Final report published by Meat and Livestock Australia, North Sydney.
- Invasive Species Council 2024. 2025/26 Tasmanian state budget submission. Katoomba, Invasive Species Council.

- Johnston BG, MacLeod ND, Young MD 1990. An economic perspective on future research directions for the Australian sheep-grazed rangelands. *Australian Rangeland Journal* 12: 91–115.
- Keast JC, Littlejohns JR 1963. The role of the feral pig as a disease reservoir. *Australian Veterinary Journal* 39: 99.
- Kneipp C, Marshall D, Westman M, Malik R, Stevenson M, Mor S, Wiethoelter A 2025 *Brucella suis* in feral pigs in Australia: what is the risk? *Australian Veterinary Journal* 103: 379–387.
- Kuželka K, Surový P 2018. Automatic detection and quantification of wild game crop damage using an unmanned aerial vehicle (UAV) equipped with an optical sensor payload: a case study in wheat. *European Journal of Remote Sensing* 51: 241–250.
- Latham ADM, Latham MC, Norbury GL, Forsyth DM, Warburton B 2020. A review of the damage caused by invasive wild mammalian herbivores to primary production in New Zealand. *New Zealand Journal of Zoology* 47: 20–52.
- Latham ADM, Warburton B, Byrom AE, Pech RP 2017. The ecology and management of mammal invasions in forests. *Biological Invasions* 19: 3121–3139.
- Lockrey T 2025. Estimating economic impacts of feral pigs to grain growers. In: *Proceedings of the National Feral Pig Conference, Gold Coast, Australia*. Pp. 21.
- Lockrey T, Marshall D 2019. The impact of feral pigs (*Sus scrofa*) on cotton and their effective control. *Australian Cotton Research Conference Program and Abstract Book, Armidale, Australia*. p. 45.
- Long JL 2003. *Introduced mammals of the world: their history, distribution, and influence*. Collingwood, CSIRO Publishing.
- Lowe S, Browne M, Boudjelas S, De Poorter M 2000. 100 of the world's worst invasive alien species: a selection from the Global Invasive Species Database. Auckland, Invasive Species Specialist Group, International Union for Conservation of Nature.
- Lumley T 2024. 'survey: analysis of complex survey samples.' R package version 4.4.
- Mason R, Fleming P, Smythe L, Dohnt M, Norris M, Symonds M 1998. *Leptospira interrogans* antibodies in feral pigs from New South Wales. *Journal of Wildlife Diseases* 34: 738–743.
- McCarthy N, McDermott J, Coleman P 2003. Animal health and the role of communities: An example of *Trypanosomosis* control options in Uganda. *International Food Policy Research Institute*. Washington, USA.
- McDonough MT, Ditchkoff SS, Smith MD, VerCauteren KC 2022. A review of the impacts of invasive wild pigs on native vertebrates. *Mammalian Biology* 102: 279–290.
- McIlroy JC, Nugent G 2021. *Sus scrofa*. Family Suidae. In: King CM, Forsyth DM eds. *The handbook of New Zealand mammals*, 3rd edn. Melbourne, CSIRO Publishing. Pp. 379–391.
- McInerney JP, Howe KS, Schepers JA 1992. A framework for the economic analysis of disease in farm livestock. *Preventive Veterinary Medicine* 13: 137–154.
- McLeod LJ, Saunders GR, McLeod SR, Dawson M, van de Ven R 2010 The potential for participatory landscape management to reduce the impact of the red fox (*Vulpes vulpes*) on lamb production. *Wildlife Research* 37: 695–701.
- McLeod R 2004. *Counting the cost: impact of invasive animals in Australia 2004*. Cooperative Research Centre for Pest Animal Control, Canberra.
- McLeod R 2016. *Cost of Pest Animals in NSW and Australia, 2013/14*. Report prepared for the NSW Natural Resources Commission by SYS Development Pty Ltd.
- Meat and Livestock Australia 2025. *Industry projections 2025*. Report prepared by Meat and Livestock Australia. Accessed 25 March 2026. https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/september-2025_mla-australian-sheep-industry-projections_3009252.pdf
- Meat and Livestock Australia 2024. *State of the industry report*. Report prepared by Meat and Livestock Australia. Accessed 25 March 2026. <https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/soti-report/mla-state-of-the-industry-report-2324-web.pdf>
- Meng X, Lindsay D, Sriranganathan N 2009. Wild boars as sources for infectious diseases in livestock and humans. *Philosophical Transactions of the Royal Society B: Biological Sciences* 364: 2697–2707.

- Miller RS, Sweeney SJ, Sloomaker C, Grear DA, Di Salvo PA, Kiser D, Shwiff SA 2017. Cross-species transmission potential between wild pigs, livestock, poultry, wildlife, and humans: implications for disease risk management in North America. *Scientific Reports* 7: 7821.
- Mitchell J, Dorney W 2002. Monitoring systems for feral pigs: monitoring the economic damage to agricultural industries and the population dynamics of feral pigs in the Wet Tropics of Queensland. Final Report to Bureau of Resource Science National Feral Animal Control Program. Queensland.
- Mitchell J, Mayer R 1997. Diggings by feral pigs within the Wet Tropics World Heritage Area of north Queensland. *Wildlife Research* 24: 591–601.
- Mitchell-Whittington A 2015. What Panama disease TR4 means for Australia, updated 2015-12-07: Accessed 15 November 2025. <https://www.brisbanetimes.com.au/national/queensland/what-panama-disease-tr4-means-for-australias-bananas-20151207-gh8uw.html>
- Moore KT, Mangan MJ, Linnegar B, Athni TS, McCallum HI, Trewin BJ, Skinner E 2024. Australian vertebrate hosts of Japanese encephalitis virus: a review of the evidence. *Transactions of The Royal Society of Tropical Medicine and Hygiene* 119: 189–202.
- Murphy MJ, Inman-Narahari F, Ostertag R, Litton CM 2014. Invasive feral pigs impact native tree ferns and woody seedlings in Hawaii forest. *Biological Invasions* 16: 63–71.
- Nogueira-Filho SL, Nogueira SSC, Fragoso JMV 2009. Ecological impacts of feral pigs in the Hawaiian Islands. *Biodiversity and Conservation* 18: 3677–3683.
- Norbury GL, Pech RP, Byrom AE, Innes J 2015. Density–impact functions for terrestrial vertebrate pests and indigenous biota: guidelines for conservation managers. *Biological Conservation* 191:409–420.
- New South Wales (NSW) Government 2023. Distribution maps for vertebrate pests. Accessed 23 March 2026. https://www.dpi.nsw.gov.au/_data/assets/image/0006/1649733/Feral-pig-relative-abundance-and-distribution-change-2020-2023.jpg
- New South Wales (NSW) LLS 2022. Intensive pest control zones. Accessed 21 May 2025. <https://www.lls.nsw.gov.au/help-and-advice/pest-control/intensive-pest-control-zones>
- New South Wales (NSW) LLS 2023. Foot-and-mouth disease prevention and preparedness program. Accessed 20 May 2025. <https://www.lls.nsw.gov.au/what-we-do/our-major-projects/foot-and-mouth-prevention-and-preparedness-program>
- Nugent G, Gortázar C, Knowles G 2015. The epidemiology of *Mycobacterium bovis* in wild deer and feral pigs and their roles in the establishment and spread of bovine tuberculosis in New Zealand wildlife. *New Zealand Veterinary Journal* 63: 54–67.
- O'Brien PH 1987. Socio-economic and biological impact of the feral pig in New South Wales: an overview and alternative management plan. *Australian Rangeland Journal* 9: 96–101.
- O'Bryan CJ, Patton NR, Hone J, Lewis JS, Berdejo-Espinola V, Risch DR, Holden MH, McDonald-Madden E 2022a. Unrecognized threat to global soil carbon by a widespread invasive species. *Global Change Biology* 28: 877–882.
- O'Bryan CJ, Patton NR, Hone J, Lewis JS, Berdejo-Espinola V, Risch DR, Holden MH, McDonald-Madden E 2022b. Invasive wild pigs (*Sus scrofa*) as a human-mediated source of soil carbon emissions: uncertainties and future directions. *Global Change Biology* 28: e1–e3.
- Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE and others 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 372: n71.
- Palencia P, Blome S, Brook RK, Ferroglio E, Jo Y-S, Linden A, Montoro V, Penrith M-L, Plhal R, Vicente J, Viltrop A, Gortázar C 2023. Tools and opportunities for African swine fever control in wild boar and feral pigs: a review. *European Journal of Wildlife Research* 69: 69.
- Parkes JP, Easdale TA, Williamson WM, Forsyth DM 2015. Causes and consequences of ground disturbance by feral pigs (*Sus scrofa*) in a lowland New Zealand conifer–angiosperm forest. *New Zealand Journal of Ecology* 39: 34–42.
- Pavlov P 1988. Health risks to humans and domestic livestock posed by feral pigs (*Sus scrofa*) in North Queensland. *Proceedings of the 13th Vertebrate Pest Conference, 1988*. Pp. 141–144.
- Pavlov P, Edwards E 1995. Feral pig ecology in the Cape Tribulation National Park, North Queensland, Australia. *Ibex JME* 3: 148–151.

- Pavlov PM 1980. The diet and general ecology of the feral pig (*Sus scrofa*) at Girilambone, N.S.W. MSc thesis, Monash University, Melbourne, Australia.
- Pavlov PM, Hone J 1982. The behaviour of feral pigs (*Sus scrofa*) in flocks of lambing ewes. *Australian Wildlife Research* 9: 101–109.
- Pavlov PM, Hone J, Kilgour RJ, Pedersen H 1981. Predation by feral pigs on merino lambs at Nyngan, New South Wales. *Australian Journal of Experimental Agriculture and Animal Husbandry* 21: 570–574.
- Pearson HE, Toribio J-ALML, Hernandez-Jover M, Marshall D, Lapidge SJ 2014. Pathogen presence in feral pigs and their movement around two commercial piggeries in Queensland, Australia. *Veterinary Record* 174: 325–325.
- Pearson HE, Toribio J-AL, Lapidge SJ, Hernández-Jover M 2016. Evaluating the risk of pathogen transmission from wild animals to domestic pigs in Australia. *Preventive Veterinary Medicine* 123: 39–51.
- Pegg K, Summerell B, O'Neill W 2021. 2021 Panama TR4 Epidemiological Review. Biosecurity Queensland. Brisbane, Australia.
- Pimentel D 2007. Environmental and economic costs of vertebrate species invasions into the United States. In: Witmer GW, Pitt WC, Fagerstone KA eds. *Managing vertebrate invasive species: proceedings of an international symposium*. USDA/ APHIS/WS, National Wildlife Research Center, Fort Collins, Colorado.
- Pimentel D, Lach L, Zuniga R, Morrison D 2000. Environmental and economic costs of nonindigenous species in the United States. *Bioscience* 50: 53–65.
- Plant JW, Marchant R, Mitchell TD, Giles JR 1978. Neonatal lamb losses due to feral pig predation. *Australian Veterinary Journal* 54: 426–429.
- Powell J 2024. Economic impact of feral pigs on agricultural production in NW NSW. Final report including 2022/23 seasonal analysis. Report prepared by AgEcon for the North West Local Land Services (NSW). Namoi Valley, New South Wales.
- Powell J, Revell G 2023. Economic impact of feral pigs on agricultural production in North West NSW: 2021/22. Unpublished Report, AgEcon, Namoi Valley, New South Wales.
- Pullar EM 1953. The wild (feral) pigs of Australia: their origin, distribution and economic importance. *Memoirs of the National Museum, Melbourne* 18: 7–23.
- Richards K, Pointon A, Cutler R 2025. A qualitative risk assessment for the importation of fresh porcine semen into Australia. *Australian Veterinary Journal* 103: 603–613.
- Ridoutt C, Lee A, Moloney B, Massey PD, Charman N, Jordan D 2014. Detection of brucellosis and leptospirosis in feral pigs in New South Wales. *Australian Veterinary Journal* 92: 343–347.
- Risch DR, Ringma J, Price MR 2021. The global impact of wild pigs (*Sus scrofa*) on terrestrial biodiversity. *Scientific Reports* 11: 13256.
- Roemer GW, Donlan CJ, Courchamp F 2001. Golden eagles, feral pigs, and insular carnivores: How exotic species turn native predators into prey. *Proceedings of the National Academy of Sciences* 99: 791–796.
- Rowland PI, Lovelock CE 2024. Global impacts of introduced ungulates on wetland carbon and biodiversity: a review. *Biological Conservation* 290: 110432.
- Saunders G 1993. Observations on the effectiveness of shooting feral pigs from helicopters in western New South Wales. *Wildlife Research* 20: 771–776.
- Seward NW, VerCauteren KC, Witmer GW, Engeman RM 2004. Feral swine impacts on agriculture and the environment. *Sheep and Goat Research Journal* 19: 34–40.
- Shamsi S, Brown K, Francis N, Barton DP, Jenkins DJ 2024. First findings of *Sarcocystis* species in game deer and feral pigs in Australia. *International Journal of Food Microbiology* 421: 110780.
- Sheep Sustainability Framework 2022. Sheep sustainability framework: on-farm insights from the National Producer Survey – October 2022. Accessed 10 September 2025. <https://www.sheepsustainabilityframework.com.au/globalassets/sheep-sustainability/media/ssf-on-farm-insights-report-web-25oct2022.pdf>
- Sheep Sustainability Framework 2024. Sheep sustainability framework. Annual Report 2024. Accessed 10 September 2025.

- <https://www.sheepsustainabilityframework.com.au/globalassets/sheep-sustainability/media/240731-ssf-2024-annual-report---web.pdf>
- Slatyer R, Hafi A, Richards K, Cozens M, Addai D, Cao L, Mornement C, Keighley M, Arthur T 2023 Potential economic consequences of African swine fever in Australia. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.
- Smith JL, Lowe RC, Conner LM, Mengak MT 2025. Quantifying wild pig (*Sus scrofa*) damage to corn, cotton, and peanut fields using unmanned aerial systems (UAS) in southwestern Georgia, USA. *Crop Protection* 194: 107233.
- State of Queensland 2016. Surveillance Program for Panama disease tropical race 4 – Monitoring and Compliance under the Biosecurity Act 2014. Biosecurity Queensland, Department of Agriculture and Fisheries. Accessed 10 July 2025.
- Statham M, Middleton M 1987. Feral pigs on Flinders Island. *Papers and Proceedings of the Royal Society of Tasmania* 121: 121–124.
- Stenekes N, Ticehurst J, Arthur T 2023. Pest Animal and Weed Management Survey 2016/2019/2022: NSW land manager survey custom results. ABARES research report to client 24.02, Canberra.
- Synergies Economic Consulting 2020. Estimating the economic impact of feral pigs in the Whitsunday Regional Council. Final report to Whitsunday Regional Council. Brisbane, Australia.
- Tisdell CA 1982. Wild pigs: environmental pest or economic resource? Sydney, Pergamon Press.
- Tisdell CE 1977. Simple economic models of pest control: models with possible application to the control of feral pigs and other wild animals. Research Report No.33. Department of Economics, University of Newcastle, New South Wales, Australia.
- Topp V, Litchfield F, Coelli R, Ashton D 2021. Financial performance of sugarcane farms 2020/21 to 2021/22. ABARES, Canberra. D
- VerCauteren KC, Beasley JC, Ditchkoff SS, Mayer JJ, Roloff GJ, Strickland BK 2020. Invasive wild pigs in North America: ecology, impacts, and management. Boca Raton, CRC Press.
- Ward MP, Cowled BD, Galea F, Garner MG, Laffan SW, Marsh I, Negus K, Sarre SD, Woolnough AP 2013. Salmonella infection in a remote, isolated wild pig population. *Veterinary Microbiology* 162: 921–929.
- West P 2008. Assessing invasive animals in Australia 2008. Canberra, National Land and Water Audit and Invasive Animals Cooperative Research Centre.
- Wilson G, Choquenot D 1995. Review of feral pigs and exotic disease preparedness. Unpublished Report. Wildlife and Exotic Diseases Preparedness Program, Bureau of Resource Sciences, Sydney.
- Wishart J, Braysher M, Lapidge S, Sarre S, Hone J 2015. Observations on effects of feral pig (*Sus scrofa*) age and gender on diet. *Wildlife Research* 42: 470–474.
- Young JM, Brown DJ, Brien FD 2025. Pregnancy scanning of feral sheep in southern Australia. I. Scanning for litter size was profitable across all modelled regions, times of lambing and genotypes. *Animal Production Science* 65: AN24278.

10. Publications Arising

None at this time.

II. Appendix I – Maps of NRM regions and proportion of land managers reporting problems with feral pigs by NRM region and agricultural commodity

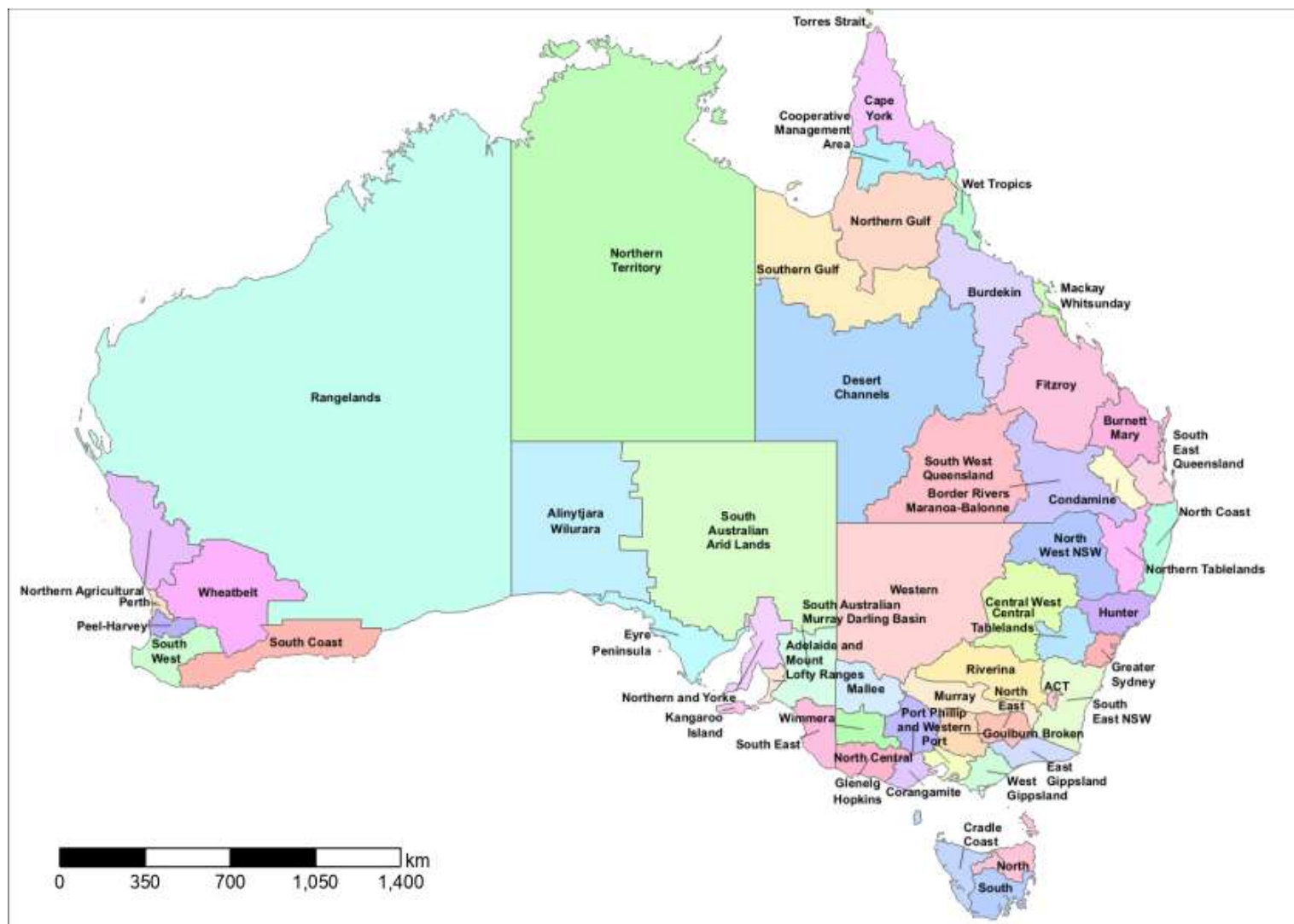


Figure A1.1. Natural Resource Management (NRM) regions, 2016.

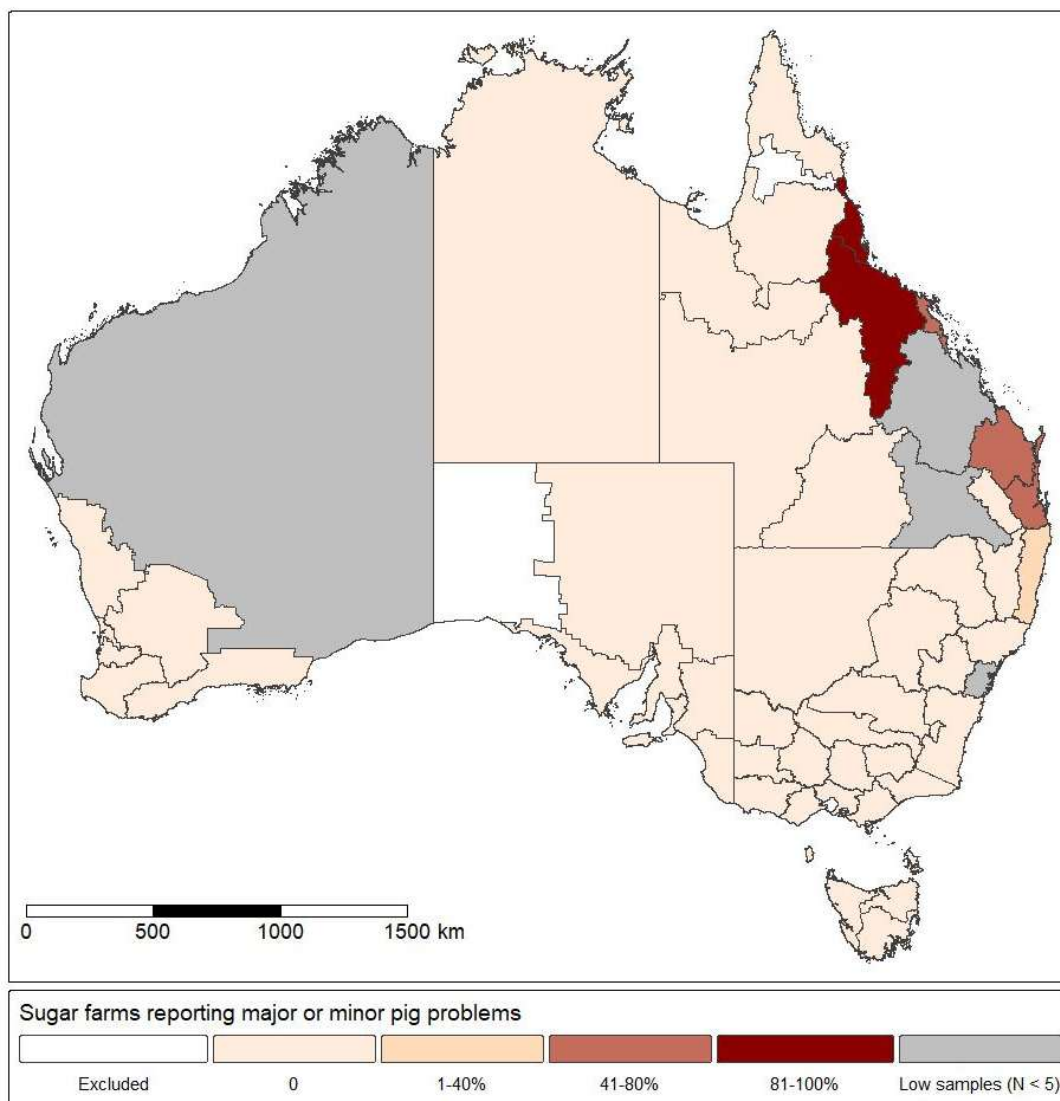


Figure A1.2. Percentage of sugar farms reporting major or minor problems with feral pigs in each of the NRM regions in 2022. Alinytjara Wilurara NRM (SA) and Cooperative Management Area NRM (QLD) were excluded from the ABARES-PAWS due to an insufficient sample of farms. Note: the grey category 'Low samples (N < 5)' are NRM regions where there was an adequate number of survey samples, but a very low number of sugar farms who reported a feral pig problem.

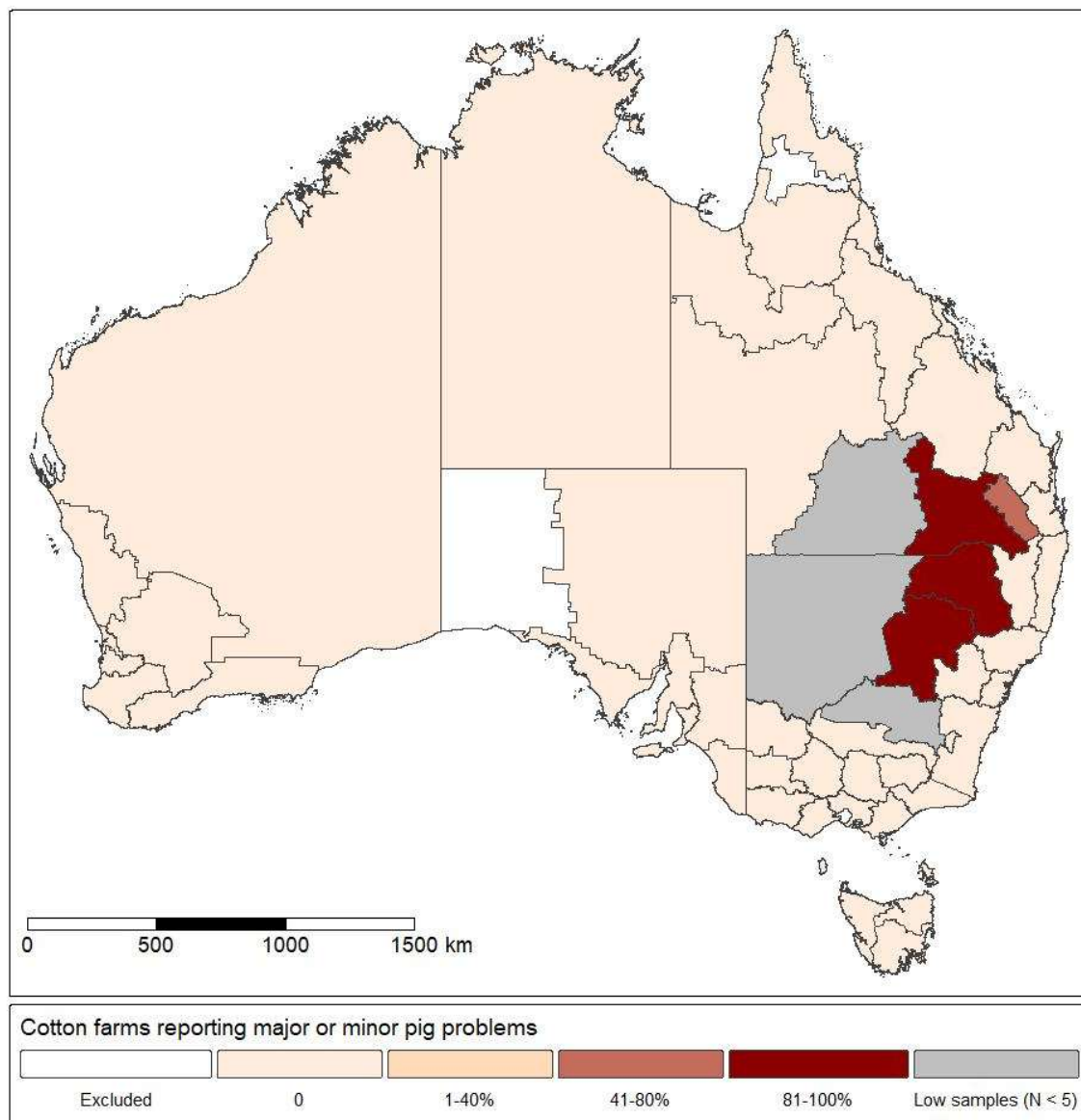


Figure A1.3. Percentage of cotton farms reporting major or minor problems with feral pigs in each of the NRM regions in 2022. Alinytjara Wilurara NRM (SA) and Cooperative Management Area NRM (QLD) were excluded from the ABARES-PAWS due to an insufficient sample of farms. Note: the grey category 'Low samples (N < 5)' are NRM regions where there was an adequate number of survey samples, but a very low number of cotton farms who reported a feral pig problem.

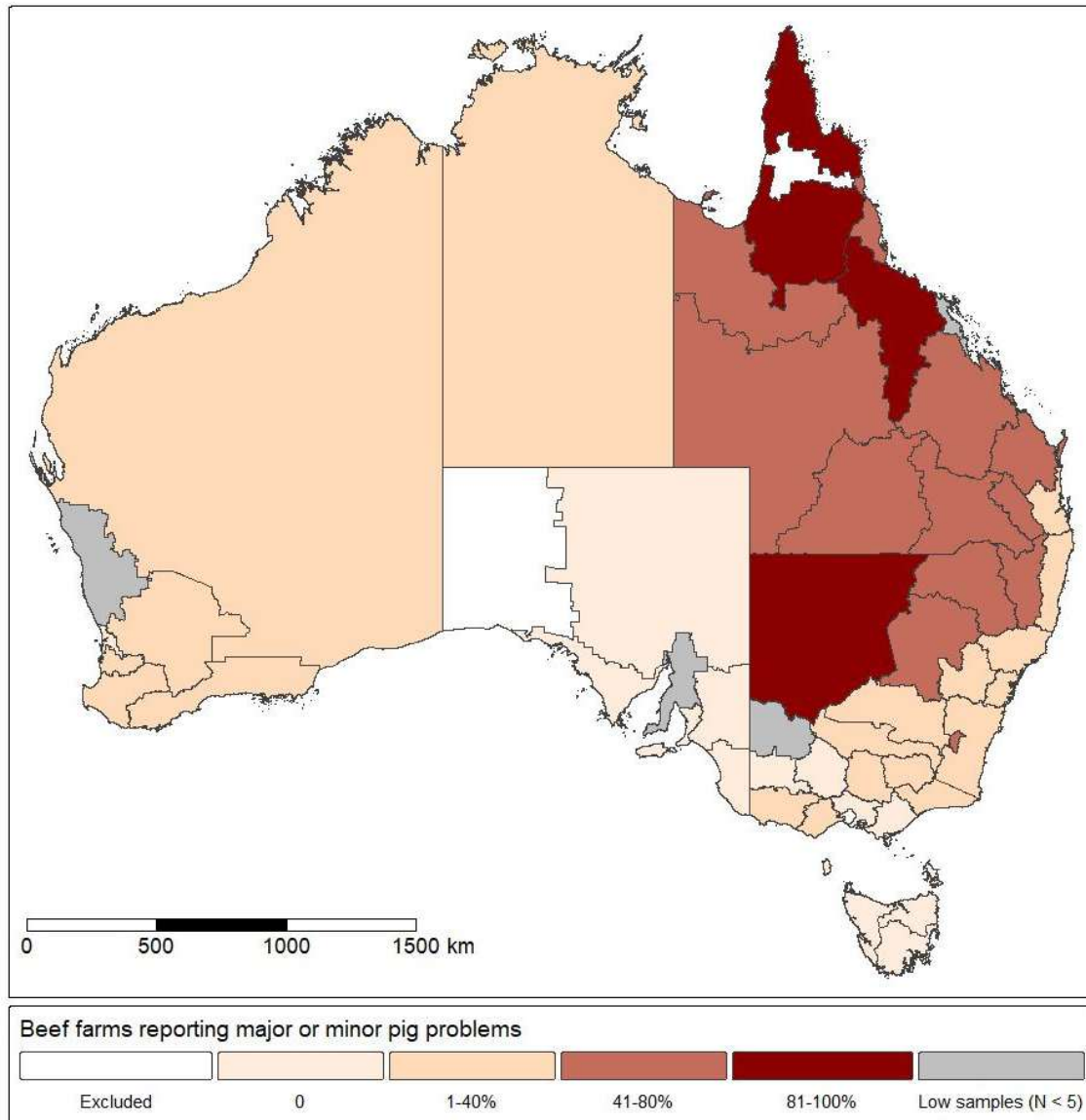


Figure A1.4. Percentage of beef farms reporting major or minor problems with feral pigs in each of the NRM regions in 2022. Alinytjara Wilurara NRM (SA) and Cooperative Management Area NRM (QLD) were excluded from the ABARES-PAWS due to an insufficient sample of farms. Note: the grey category 'Low samples (N < 5)' are NRM regions where there was an adequate number of survey samples, but a very low number of beef farms who reported a feral pig problem.

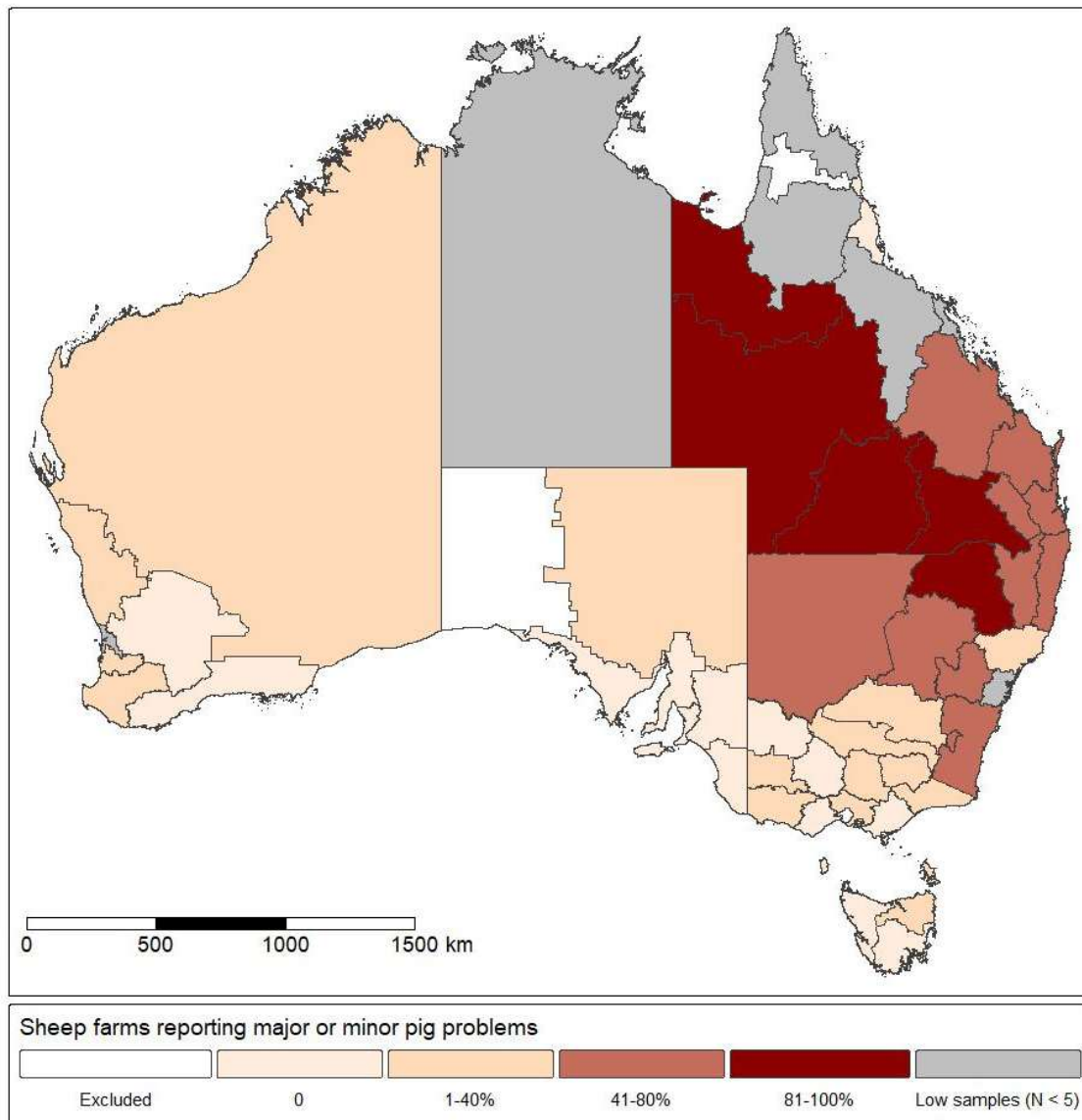


Figure A1.5. Percentage of sheep farms reporting major or minor problems with feral pigs in each of the NRM regions in 2022. Alinytjara Wilurara NRM (SA) and Cooperative Management Area NRM (QLD) were excluded from the ABARES-PAWS due to an insufficient sample of farms. Note: the grey category 'Low samples (N < 5)' are NRM regions where there was an adequate number of survey samples, but a very low number of sheep farms who reported a feral pig problem.

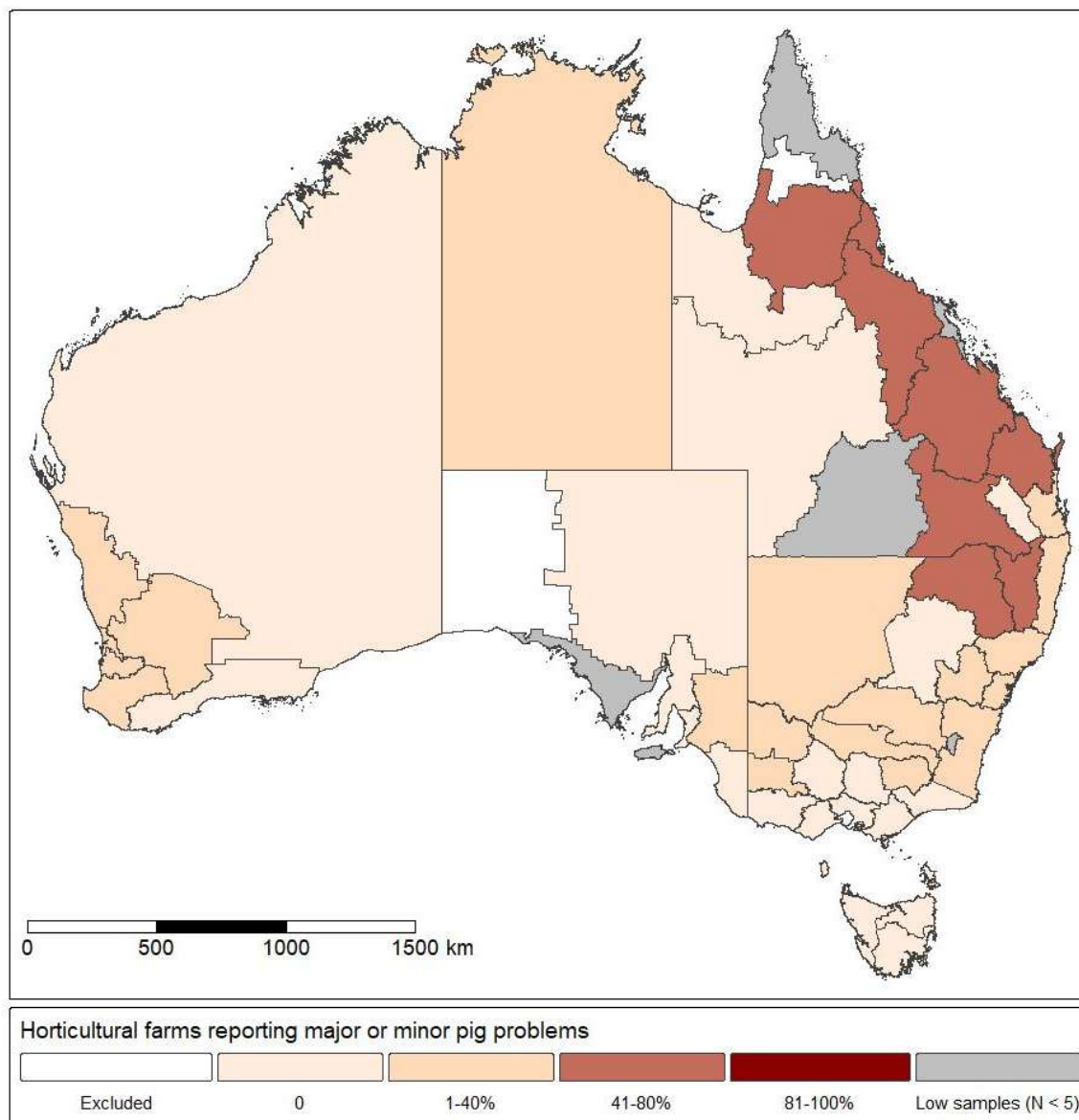


Figure A1.6. Percentage of horticultural farms reporting major or minor problems with feral pigs in each of the NRM regions in 2022. Alinytjara Wilurara NRM (SA) and Cooperative Management Area NRM (QLD) were excluded from the ABARES-PAWS due to an insufficient sample of farms. Note: the grey category 'Low samples (N < 5)' are NRM regions where there was an adequate number of survey samples, but a very low number of horticultural farms who reported a feral pig problem.

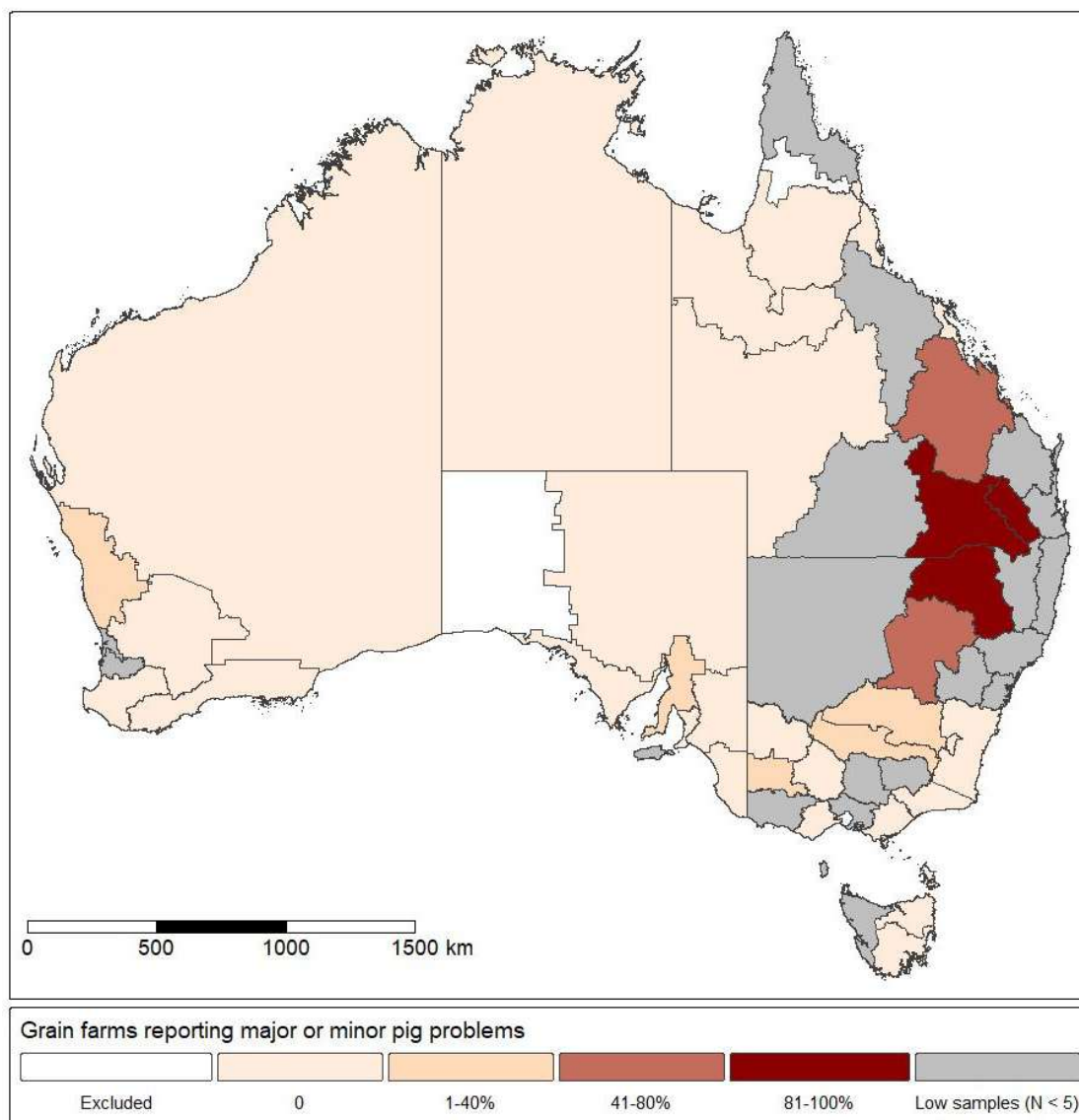


Figure A1.7. Percentage of grain growing farms reporting major or minor problems with feral pigs in each of the NRM regions in 2022. Alinytjara Wilurara NRM (SA) and Cooperative Management Area NRM (QLD) were excluded from the ABARES-PAWS due to an insufficient sample of farms. Note: the grey category 'Low samples (N < 5)' are NRM regions where there was an adequate number of survey samples, but a very low number of grain growing farms who reported a feral pig problem.

12. Appendix 2 – Detailed description of the methods used to estimate agricultural residual impact, total losses and avoided losses due to feral pigs

We calculated residual agricultural losses assuming that these were suffered by those land managers who indicated pigs were a major problem for them and that their control of pigs was not highly or moderately effective. Residual agricultural losses were estimated at national and state levels, as well as for the three periods covered by PAWS. We applied a slight modification to Hafi et al. (2023)'s methods by assuming:

- (i) Full residual impact is suffered by those land managers experiencing a major problem with feral pigs if they do not report that any form of management is moderately or very effective.
- (ii) Half of the residual impact is suffered by those land managers experiencing a major problem with feral pigs but reporting that any form of management is moderately effective.
- (iii) No residual impact is suffered by land managers experiencing a major problem with feral pigs but reporting that at least one form of management is very effective.

We also estimated total losses due to feral pigs by assuming full residual impact for all land managers who indicated pigs were a major problem (including those conducting very or moderately effective management) and derive avoided losses as the difference between total losses and residual impacts. For those land managers suffering residual impacts, the estimated magnitude of the impact was based on studies reported previously and the value of the commodities they produce (extracted from the Australia Bureau of Statistics (ABS) 'Value of Agricultural Commodities' data series). We provide estimates for a most-likely feral pig impact scenario, as well as low and high impact scenarios using the percentage impact values presented in Tables A2.1 and A2.2.

The ABS reports the state-level yearly Local Value of Production (LVP) for a large number of agricultural commodities that are produced in Australia. The LVP is measured after a pest animal, such as feral pigs, has inflicted damage on the commodity, depending on their local density and the degree of the damage. The LVP of industry I in state S after damage has been caused by feral pigs with severity D (denoted LVP_{aISD}), can be expressed in terms of the corresponding LVP in the absence of damage from feral pigs (denoted LVP_{0ISD}), the production loss fraction (PL_{ID} , given in Tables A2.1 and A2.2) and the estimate of the proportion of land managers incurring full (PF_{IS}) or half (PH_{IS}) residual impact (Table A3):

$$LVP_{aISD} = LVP_{0ISD} * (1 - PF_{IS} - PH_{IS}) + LVP_{0ISD} * PF_{IS} * (1 - PL_{ID}) + LVP_{0ISD} * PH_{IS} * \left(1 - \frac{PL_{ID}}{2}\right)$$

And rearranging this equation to estimate the LVP lost to feral pigs:

$$\Delta LVP_{ISD} = LVP_{0ISD} - LVP_{aISD} = LVP_{aISD} * \left(\frac{1 - x}{x}\right)$$

Where:

$$x = (1 - PF_{IS} - PH_{IS}) + PF_{IS} * (1 - PL_{ID}) + PH_{IS} * \left(1 - \frac{PL_{ID}}{2}\right)$$

Because we did not have state-specific feral pig densities, we assumed the same production loss fraction (PL_{ID}) for a given commodity for all states, which was then adjusted by the proportion of land managers reporting major problems with feral pig in each state. We did, however, estimate residual impact under three different values of PL_{ID} , to provide low-impact, most-likely impact, and high-impact estimates.

We used the above equations to estimate residual agricultural losses to grain crops, sugarcane and cotton. LVP for each of these industries for each year of the PAWS series were estimated as the average over the previous five years (e.g. for 2022 we used datasets from 2017/18, 2018/19, 2019/20, 2020/21, 2021/22) using data obtained from ABS (2022).

To estimate residual stock losses from pig predation on livestock, we treated young and adult livestock differently, to take account of their different mortality rates from feral pig predation (as was done by Hafi et al. 2023; Table A2.2). The livestock numbers slaughtered belonging to different age groups reported by ABS have been measured after feral pigs have caused deaths, if any, depending on their density and the associated degree of predation. The equation below expresses the total number of animals slaughtered ($TNAa_{ITSD}$) of livestock type I , age group T , in state S , after being subject to feral pig predation with severity D , as a function of the total number of animals in the absence of feral pig predation ($TNA0_{ITSD}$), the production loss fraction (PL_{ITD} , given in Table A2.2) and the estimate of the fraction of land managers incurring full (PF_{IS}) or half (PH_{IS}) residual impact (Table A2.3):

$$TNAa_{ITSD} = TNA0_{ITSD} * (1 - PF_{IS} - PH_{IS}) + TNA0_{ITSD} * PF_{IS} * (1 - PL_{ITD}) + TNA0_{ITSD} * PH_{IS} * \left(1 - \frac{PL_{ITD}}{2}\right)$$

And rearranging this equation to estimate the residual impact as the number of livestock killed due to feral pig predation:

$$\Delta TNA_{ITSD} = TNA0_{ITSD} - TNAa_{ITSD} = TNAa_{ITSD} * \left(\frac{1 - x^T}{x^T}\right)$$

Where:

$$x^T = (1 - PF_{IS} - PH_{IS}) + PF_{IS} * (1 - PL_{ITD}) + PH_{IS} * \left(1 - \frac{PL_{ITD}}{2}\right)$$

The value of livestock lost (VLL_{ISD}) due to feral pig predation is calculated from the replacement value of an animal of age T of livestock type I in state S (RVA_{ITS} , in \$/head), where \$ are AUD:

$$VLL_{ISD} = \sum_{T=1}^T \Delta TNA_{ITSD} * RVA_{ITS}$$

For sheep meat production, $TNAa_{ITSD}$ was defined as state-level and age-specific livestock slaughtered. These were obtained from the ABS 'Table 17 Annual livestock slaughtered' (ABS 2025) while appropriate stock replacement values (RVA_{ITS}) were extracted from sheep and cattle transaction data time series published by Meat and Livestock Australia (Meat and Livestock Australia 2025). For sheep, average price paid for animals weighing up to 12 kg and those weighing more than 12 kg were used as the replacement value of young and adult animals, respectively.

To estimate the VLL_{ISD} for wool production, we defined TNA_{dISD} as the state-level numbers of sheep shorn (in this case we only considered adult sheep). These were obtained from the Australian Wool Innovation Limited Wool Production Forecast Reports (AWI 2025). The replacement value of wool obtained per adult sheep shorn (RVA_{IS}) was estimated as the average weight of greasy wool obtained per sheep (kg) $\times$ the assumed yield (%) $\times$ price of clean wool (\$/kg). State-level weight of greasy wool obtained per sheep and assumed yield was obtained from the Wool Production Forecast Reports (AWI 2025), whereas the price per kg of clean wool was obtained from indexmundi (2025).

LVP and TNA for each period covered by PAWS were calculated as the average over the previous 5 years, as done by Hafi et al. (2023).

The *total agricultural losses* were also estimated assuming that all land managers who report feral pigs as a major problem, including those who consider their management approach is very or moderately effective, will suffer full agricultural losses. The difference between the total agricultural losses and the residual agricultural losses (assuming some benefit of management) approximates the revenue losses avoided by effective management.

Table A2.1. Percentage of residual agricultural losses due to feral pigs' impacts ($PLID$), by crop type and impact scenario (Table 17 from Hafi et al. 2023).

Crop	Low impact	Most-likely impact	High impact
Barley	0.05	1.28	2.50
Chickpeas	3.00	6.40	9.80
Cotton	0.30	1.00	1.70
Maize	0.50	1.40	2.30
Sorghum	1.70	3.35	5.00
Wheat	0.80	3.20	5.60
Sugarcane	1.40	4.10	6.80
Bananas	0.00	0.10	0.20
Oats	1.70	3.10	4.50

Source: Slatyer et al. (2023), who compiled the information from Tisdell (1982), Choquenot et al. (1996), Mitchell & Dorney (2002), Tanger et al. (2015), and Powell et al. (2020).

Table A2.2. Percentage of residual adult and young livestock losses to feral pigs (PL_{ITD}) by livestock type and impact scenario (Table 18 from Hafi et al. 2023).

Livestock	Age category	Low impact	Most likely impact	High impact
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Beef	Adult	0	0	0
	Young	0	0	0
Sheep meat	Adult	1	1.5	2
	Young	2	3.5	5
Sheep wool	Adult	1	1.5	2
	Young	2	3.5	5

Source: Gong et al. (2009) and McLeod (2016).

Table A2.3. Percentage of land managers assumed to suffer full (PFIS) and half (PHIS) residual impact from feral pig damage, by industry, state, and year of PAWS. State names abbreviated to standard formats.

Yr	Industry*	NSW		NT		QLD		SA		TAS		VIC		WA	
		PF	PH	PF	PH	PF	PH	PF	PH	PF	PH	PF	PH	PF	PH
2016	Cotton	13	14	0	0	14	12	0	0	0	0	0	0	0	0
	Grain crops	6	9	0	0	19	19	0	0	0	0	0	0	0	1
	Sheep meat	5	7	0	0	7	29	0	0	0	0	0	0	2	2
	Sheep wool	5	7	0	0	7	29	0	0	0	0	0	0	2	2
	Sugarcane	0	0	0	0	33	9	0	0	0	0	0	0	0	0
2019	Cotton	22	24	0	0	11	10	0	0	0	0	0	0	0	0
	Grain crops	4	5	0	0	17	14	0	0	0	0	0	0	0	1
	Sheep meat	3	5	0	0	7	21	0	0	0	0	0	0	3	0
	Sheep wool	3	5	0	0	7	21	0	0	0	0	0	0	3	0
	Sugarcane	0	0	0	0	25	6	0	0	0	0	0	0	0	0
2022	Cotton	14	28	0	0	0	10	0	0	0	0	0	0	0	0
	Grain crops	7	9	0	0	5	11	0	0	0	0	0	0	0	1
	Sheep meat	4	9	0	0	4	14	0	0	0	0	0	0	0	2
	Sheep wool	4	9	0	0	4	14	0	0	0	0	0	0	0	2
	Sugarcane	0	10	0	0	17	5	0	0	0	0	0	0	0	0

* The ANZSIC categories considered for each industry are: Cotton = 'Cotton Growing'; Grain crops = 'Other Grain Growing' and 'Grain-Sheep or Grain-Beef Cattle Farming'; Sheep meat and sheep wool = 'Sheep Farming (Specialised)', 'Sheep-Beef Cattle Farming', and 'Grain-Sheep or Grain-Beef Cattle Farming'; sugarcane = 'Sugar Cane Growing'.

References

- Australian Bureau of Statistics (ABS) 2022. Value of Agricultural Commodities Produced, Australia. Accessed 15 August 2025. <https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia>
- Australian Bureau of Statistics (ABS) 2025. Livestock products. Table 17. Annual livestock slaughtered - excluding chickens: original ('000). Accessed 15 August 2025. <https://www.abs.gov.au/statistics/industry/agriculture/livestock-products/latest-release>
- AWI 2025. Wool Production Forecasts. <https://www.wool.com/market-intelligence/wool-production-forecasts/>

- Choquenot D, McIlroy J, Korn T 1996. Managing vertebrate pests: Feral pigs. Bureau of Resource Sciences, Australian Government Publishing Service, Canberra.
- Gong W, Sinden J, Braysher M, Jones R 2009. The economic impact of vertebrate pests in Australia. Invasive Animals Cooperative Research Centre, Canberra.
- Hafi A, Arthur T, Medina M, Warnakula C, Addai D, Stenekes N 2023. Cost of established pest animals and weeds to Australian agricultural producers. Unpublished report. Canberra, Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).
- indexmundi 2025. Fine Wool Monthly Price - Australian Dollar per Kilogram. <https://www.indexmundi.com/commodities/?commodity=fine-wool&months=240¤cy=aud>
- McLeod R 2016. Cost of Pest Animals in New South Wales and Australia, 2013-14. eSYS Development Pty Ltd. Report prepared for the NSW Natural Resource Commission.
- Meat and Livestock Australia 2025. Australian Saleyard Sheep Transactions. <https://www.mla.com.au/prices-markets/statistics/sheep-transactions/>
- Mitchell J, Dorney W 2002. Monitoring systems for feral pigs: monitoring the economic damage to agricultural industries and the population dynamics of feral pigs in the wet tropics of Queensland. Final report to Bureau of Resource Science National Feral Animal Control Program.
- Powell J, Welsh J, Marshall A, Revell G 2020. Cost benefit analysis of feral pig control in North West NSW. AgEcon, Report prepared for North West Local Land Services, New South Wales.
- Slatyer R, Hafi A, Richards K, Cozens M, Addai D, Cao L, Mornement C, Keighley M, Arthur T 2023. Potential economic consequences of African swine fever in Australia. ABARES research report 23.07, Canberra, DOI: <https://doi.org/10.25814/rznz-8y79>.
- Tanger SM, Guidry KM, Nui H 2015. Monetary estimates of feral hog damage to agricultural producers in Louisiana. Journal of the National Association of County Agricultural Agents 8: 2.
- Tisdell CA 1982. Wild pigs: environmental pest or economic resource? Sydney, Pergamon Press.

13. Appendix 3 – ANZSIC categories

Table A3.1. ANZSIC names, simplified names used in the current report (Industry name), and description of the types of industries included in each category (Description).

ANZSIC name	Industry name	Description
0193 Beekeeping	Beekeeping	Units mainly engaged in raising bees, including collecting honey, royal jelly, bees' wax, or other bee products.
0152 Cotton Growing	Crop: Cotton	Units mainly engaged in growing cotton.
0159 Other Crop Growing n.e.c.	Crop: Other	Units mainly engaged in growing horticultural crops and plants not elsewhere classified, including animal fodder crops such as hay, sudan grass and silage.
0151 Sugar Cane Growing	Crop: Sugar Cane	Units mainly engaged in growing sugarcane.
0139 Other Fruit and Tree Nut Growing	Fruit&nuts: Other	Units mainly engaged in growing tree nuts, tropical fruit, subtropical fruit, and other fruit not elsewhere classified.
0134 Apple and Pear Growing	Fruit: Apple&Pear	Units mainly engaged in growing apples, pears or other pome fruit such as nashi pears or quinces
0133 Berry Fruit Growing	Fruit: Berries	Units mainly engaged in growing berry fruit.
0136 Citrus Fruit Growing	Fruit: Citrus	Units mainly engaged in growing citrus fruit.
0131 Grape Growing	Fruit: Grapes	Units mainly engaged in growing table or wine grapes; or sun drying grapes.
0132 Kiwifruit Growing	Fruit: Kiwifruit	Units mainly engaged in growing kiwifruit.
0137 Olive Growing	Fruit: Olives	Units mainly engaged in growing olives.
0135 Stone Fruit Growing	Fruit: Stone fruit	Units mainly engaged in growing stone fruit such as apricots, cherries, nectarines, peaches and plums.
0149 Other Grain Growing	Grain: Other	Units mainly engaged in growing cereal or coarse grains or other cereal crops (except rice). Also included are units mainly engaged in growing oilseeds, pasture seeds, lupins, field peas or beans
0146 Rice Growing	Grain: Rice	Units mainly engaged in growing rice.
0142 Beef Cattle Farming (Specialised)	Livestock: Beef	Units mainly engaged in farming beef cattle.
0160 Dairy Cattle Farming	Livestock: Dairy	Units mainly engaged in farming dairy cattle. Also included are units mainly engaged in sharemilking i.e. where the unit is contracted to milk the herd and/or perform other farm duties for a share of the milk income.
0180 Deer Farming	Livestock: Deer	Units mainly engaged in farming deer.

0191 Horse Farming	Livestock: Horses	Units mainly engaged in farming horses.
0199 Other Livestock Farming n.e.c.	Livestock: Other	Units mainly engaged in breeding or raising farm or domestic animals not elsewhere classified.
0192 Pig Farming	Livestock: Pigs	Units mainly engaged in farming pigs.
0144 Sheep-Beef Cattle Farming	Livestock: S&B	Units mainly engaged in farming both sheep and beef cattle.
0145 Grain-Sheep or Grain-Beef Cattle Farming	Livestock: S&B&Grain	Units mainly engaged in growing grain in conjunction with sheep farming or beef cattle farming.
0141 Sheep Farming (Specialised)	Livestock: Sheep	Units mainly engaged in farming sheep.
0172 Poultry Farming (Eggs)	Poultry: eggs	Units mainly engaged in farming poultry for production of eggs or in hatching egg breed chicks.
0171 Poultry Farming (Meat)	Poultry: Meat	Units mainly engaged in raising poultry for production of meat or in hatching meat breed chicks. This class also includes the raising of game birds for meat or in hatching game birds for raising for meat.
0122 Vegetable Growing (Under Cover)	Vegetable: Indoors	Units mainly engaged in growing vegetable crops under cover (including hydroponic systems). 'Under cover' is generally defined as greenhouses, cold frames, cloth houses and lath houses.
0121 mushroom Growing	Vegetable: Mushroom	Units mainly engaged in growing cultivated mushrooms in climate-controlled environments.
0123 Vegetable Growing (Outdoors)	Vegetable: Outdoors	Units mainly engaged in growing vegetable crops outdoors in open fields. Units mainly engaged in growing fresh herbs, melons, and tomatoes (outdoors) are also included in this class.

14. Appendix 4 – Farm expenditure on feral pig management

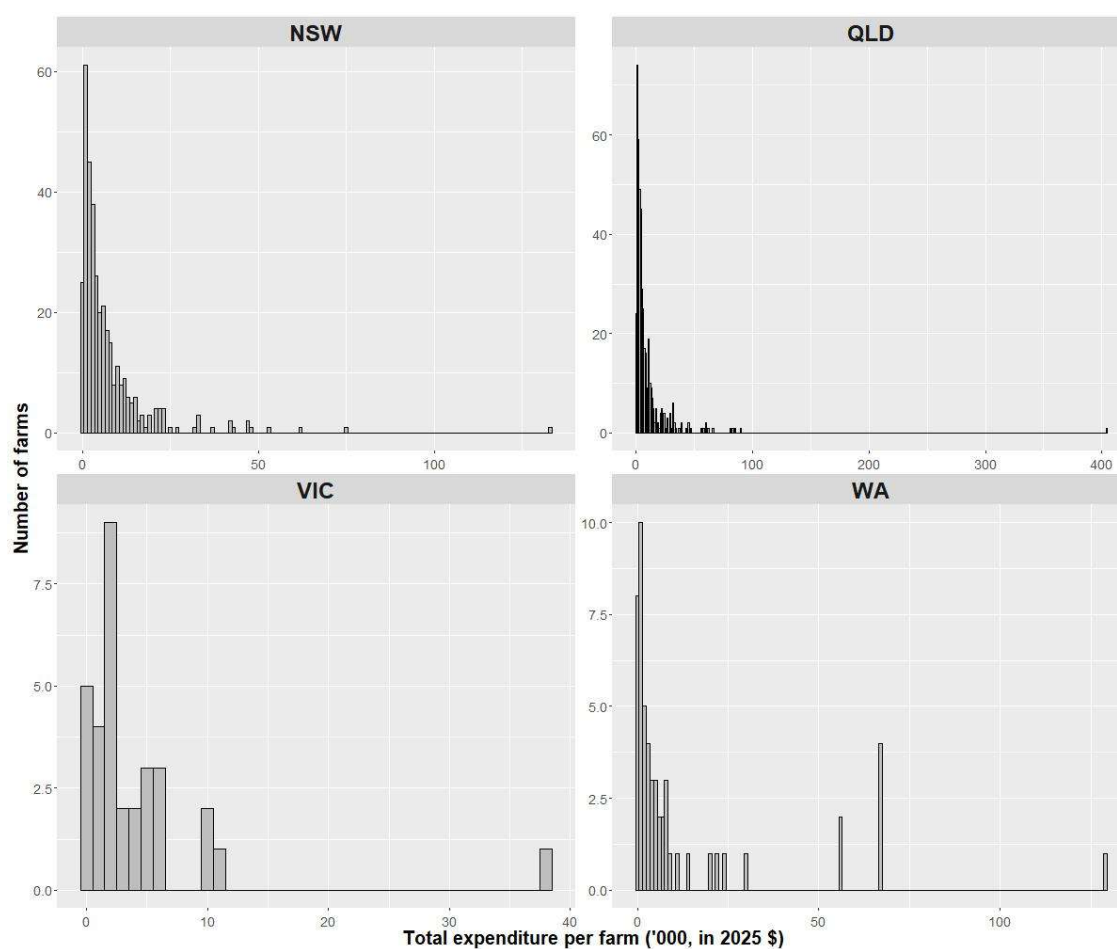


Figure A4.1. Distribution of per farm expenditure on feral pig management in 2022 in New South Wales, Queensland, Victoria, and Western Australia. Only states with more than 30 agricultural land managers reporting some amount of expenditure are included. Note that scales on both axes differ between panels. Each bar represents AU\$1,000 increments.