# SMALLHOLDER PRODUCTION IN AUSTRALIA

# FINAL REPORT

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## Acknowledgements

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# Executive summary

Anecdotally, the phenomenon of the "tree change" is flourishing in Australia. Houston (2005) observed that "the past decade has seen a range of reports confirming the significance of peri-urban regions … as major locations of population growth."(p210). The complexity of this group makes for a challenging research environment. Definitions are fraught with conjecture; however, what is clear is that the demographic characteristics, on-farm practices and stakeholder networks of smallholders are not fully understood. In Australia, commercial animal production is regulated, minimizing biosecurity risks. Smallholders are a group that may exist on the fringe of this regulation and as such, pose undefined but potentially significant biosecurity risks.

This study sought to characterize smallholder production in Australia. To achieve this objective, different activities were conducted, including a literature review, consultation with stakeholders, and the distribution of a questionnaire amongst identified smallholders.

An analysis of research in the area of smallholder biosecurity was completed, with the conclusion that whilst a significant amount of research into the motivations and practices of smallholders was undertaken prior to 2008, the level of research since that time has declined. The literature review considers this earlier research in light of the current state of smallholders and biosecurity research within Australia.

One of the difficulties in conducting research into smallholders is the lack of a formal definition. As mentioned, property size is commonly used in definitions, however in terms of biosecurity risk, it is the number and types of animals and on-farm practices that are significant. To gain a greater understanding of the smallholder population and to assist in the distribution of the questionnaire, a national stakeholder consultation was undertaken. Attempts were made to contact thirty eight identified stakeholder organisations including state based government departments/authorities, Natural Resource Management groups (NRM), Catchment Management Authorities (CMA), Landcare Networks and special interest, industry and community groups. From this group, eighteen stakeholders provided information and/or agreed to assist with the distribution of the questionnaire; ten provided limited information and ten were not successfully contacted. It is noted that the decision to not follow up on organisations that were initially not successfully contacted was based on the researchers being satisfied with the information provided by other stakeholder in that state. It cannot be assumed that these organisations would not have participated had further follow up occurred, however their non inclusion is not considered to have resulted in selection bias.

Variations in both knowledge of the sector and the level of direct association with smallholders was evident nationally, with only Western Australia currently providing a state government standalone support service to smallholders. In general, state government departments in other states support smallholders as part of broader agricultural and biosecurity services. Not surprisingly consultation with stakeholders did not yield a universal definition for smallholders. Land size was often used as a defining feature; however, this was commonly a general figure ranging from 1 to 100 hectares bearing little association with the number of animals kept at the property.

The next stage in the research was the distribution of a questionnaire to smallholders. A questionnaire (general) targeting smallholders keeping less than 50 cattle and/or 50 sheep and a

questionnaire (pigs) targeting smallholders keeping less than or equal to 50 sows were developed. The decision was taken to develop a separate questionnaire for pig producers so that specific questions related to small scale pig production could be included. Both questionnaires consisted of 5 sections - demographics and general husbandry, animal movements, biosecurity, herd/flock and health management, and communication and comprised short closed, semi-closed and open questions. With regards to the distribution of the questionnaires it was identified that there were differences between states with regards to both the availability and type of contact details for smallholders and the level of assistance that stakeholders were able to provide. It was not possible to administer the smallholders (general) questionnaire at a national level using a standard approach, resulting in the development of a tailored method of distribution for each state. The questionnaire (pigs) was able to be primarily administered through a national database (APL Pig Pass).

The final numbers for analysis were 746 smallholders (general) and 198 smallholders (pigs). Results from the postal survey suggest that smallholders, as defined in the current project, are mainly distributed closer to the coast in Queensland, New South Wales and Western Australia, compared to Victoria and Tasmania, where smallholders are evenly distributed across all of each state. Based on the data available, those smallholders keeping pigs (smallholder (pigs)) seem to be distributed more inland in NSW than smallholders (general).

Most smallholder respondents were male, over 45 years of age and of Australian background. In addition, over 40% were involved in other agricultural and environmental activities. Extra income and home consumption were the main reasons for keeping livestock. Among smallholders (general), most own relatively small properties (<80 ha) and define themselves as hobby farmers (with older producers less likely to define themselves as hobby farmers). Most keep cattle, almost 40% keep sheep and approximately 30% keep poultry and horses. Among pig smallholder respondents, reported property size was larger than among smallholders (general), approximately half of participants having properties with more than 80 ha. Data indicates that pig smallholders who also keep cattle and sheep in the property have larger size properties. The majority of pig smallholders keep between 1 and 10 sows with a median number of 5 sows. Producers keeping less than 10 sows and those keeping poultry were also more likely to keep pigs as conservation of rare breeds than other producers, and those pig producers also keeping cattle were more likely to have pigs for home consumption than other producers. One of the limitations of the study is that the number of cattle and sheep kept on the property by pig smallholders was not recorded and as such, some pig producers identified as smallholders in relation to pig production, might not have been smallholders for sheep and/or cattle production.

Between 40 and 50% of smallholders introduced animals in the previous year, from other farms and saleyards. In addition, most smallholders moved livestock off their property in the previous year, mainly to saleyards and abattoirs. Most smallholders keep records of animal movements; however, these records are mainly kept on paper only. Among smallholders (general), producers with only sheep were less likely to move animals on and off their property than other smallholders and when sheep were introduced they were more likely to be sourced from another farm. Movement of animals off the property was more likely among producers who have kept livestock for more than 15 years and have properties with more than 10 ha. Among smallholders (pigs), producers with more than ten sows were more likely to have introduced pigs in the previous 12 months and used other farms as the source of their pigs. The more grower pigs kept the more likely a producer had moved pigs off the property in the previous year and had used an abattoir as the destination of these pigs.

The level of understanding of the term biosecurity among smallholders was variable, with the definitions provided by approximately half of the respondent indicating at least a moderate level of understanding of the term. The knowledge of the term biosecurity seemed to be lower among smallholders (pigs) than smallholders (general). Among all smallholders, biosecurity practices related to animal handlers, visitors and isolation of incoming animals were generally inadequate, with most respondents not following correct protocols. For example, approximately 40% of smallholders do not isolate incoming livestock, with the most frequently reported reason for not isolating new livestock on arrival being the perception that there was no need to implement this practice on their property. In addition, keeping a record of visitors and requiring people who handle the animals to wash their hands before and after animal handling were limited.

Low veterinary contact was observed, with almost 30% of smallholders reporting that they never contacted a veterinarian. Interestingly, smallholders would call the veterinarian if they saw unusual symptoms of disease or behaviour in their livestock. However, most would also treat animals themselves or call another producer, and over a third would do nothing and expect that it would get better with time. Approximately half and between 60 and 70% of smallholders would never contact the State DPI or the exotic disease hotline, respectively. Between 50 and 70% of smallholders record information on animals with disease, animal deaths and treatment routines. Among smallholders (general), it seems that those producers keeping cattle and sheep, keeping horses and with better biosecurity knowledge were more likely to have used a veterinarian in the past 12 months. Among smallholders (pigs), producers with more than 10 sows were more likely to have contacted a veterinarian in the previous year than producers with smaller herds.

Most smallholders seek information on the health of their livestock and veterinarians were considered the most useful information source, followed by the State Department of Primary Industries / Agriculture and other smallholders. In addition, rural suppliers were also considered an important useful source of information among smallholders (general); while smallholders (pigs) also considered non-government internet sites as important sources of information. Younger producers and those with less experience raising livestock were more likely to seek information on health and management of their livestock. Among smallholders (general), producers from NSW and Western Australia were more likely to consider the State DPI a useful source of information than producers from other states. The most useful methods of information delivery were newsletters, email and websites. However, internet based methods were preferred by younger smallholders, with older producers preferring paper based methods.

Results from this study provide baseline information on the demographics and practices of livestock producers keeping less than 50 cattle, sheep and/or pigs. The questionnaire was provided in English only, and it is noted that there may be a potential bias on the information collected from respondents due to the English language requirements for completion of the questionnaire.

This study used this definition for smallholders based on findings from previous studies and in consultation with government and industry stakeholders. However, it is still uncertain how best to define a smallholder. The number of animals kept is definitely an important characteristic which affects the practices conducted on-farm, such as animal movements, biosecurity, health management and communications. However, other characteristics, such as the motivations for keeping animals and how a producer defines his/her own enterprise might also be significant and affect their practices. Independently of how we define them, findings from this study suggest that there is a lack of awareness and practice of biosecurity and health management, and that the animal

movement patterns among smallholders are similar to those of commercial producers, regarding frequency and sources and destinations of animals. Smallholders seek information on the health and management of their livestock; however, a significant proportion of smallholders do not consider the government as a useful source of information. The main recommendations arising from this project are the following:

1. **State registers with up to date information on livestock producers, including location and number and type of animals kept**

2. **A better understanding of the extension programs and communication channels used among smallholders and how these influence their practices**

3. **Use of trusted sources of information to implement and deliver extension programs.**

This project identified a lack of up to date registers of livestock producers within the State government agencies as well as within non-government organizations and groups. The high turnover of ownership among producers with low number of animals makes it difficult to keep up to date information; however, efforts should be focused on maintaining updated information, to minimize the potential impact of a disease outbreak.

This project only gathered baseline information on the communication network of smallholders. However, there is a lack of clear understanding of the methods currently used to engage smallholders with biosecurity and disease recognition and reporting. Findings from this study indicate that the sources of the information smallholders receive and the methods used for delivery of this information are crucial for engaging producers. Similarly, the amount of information they receive might also affect how they respond to this information and the influence this information has on their practices. In addition, effectiveness of the current communication strategies is uncertain; however, the low level of biosecurity practices applied on farm among smallholders as well as some of their health management practices might indicate that these strategies are not as effective as they should be. Further research is warranted to understand how effective the current communication strategies are and how to develop appropriate strategies that are effective for the target audience and would achieve the desired practice change.

The current study identifies veterinarians as the most trusted sources of information; however, contact with veterinarians is not frequent, limiting the potential influence that the veterinarian could have on the practices of smallholders. Other producers are also identified as one of the most useful sources of information. Direct engagement of what we could define as ‘champion’ producers on the delivery of extension programs might increase producer engagement.

There is a need for a coordinated approach among government and industry organizations, including all stakeholders involved with smallholders, to develop appropriate communication strategies, with clear messages, and delivered by trusted stakeholders.

# 1. Introduction

Smallholders are often believed to pose a higher biosecurity risk than that posed by commercial producers, regarding the introduction and spread of endemic and exotic livestock diseases. Previous research on smallholders aimed to define demographic characteristics, motivations and biosecurity-related practices and attitudes. Findings from these studies suggest that some of the reasons for the perception that smallholders pose a biosecurity risk are the lack of prior agricultural knowledge and experience of small-scale and peri-urban producers and the lack of local communication networks supporting these producers (Hollier and Reid, 2007). In addition, most of these producers do not keep livestock as a primary source of income (Aslin et al., 2004; Schembri, 2009). Research among small-scale pig producers selling at livestock markets identified poor on-farm biosecurity practices, poor disease knowledge and understanding of swill feeding, and limited veterinary contact (Schembri, 2009). A study among small-scale poultry keepers trading at live bird sales reported a poor understanding of biosecurity, a limited application of on-farm biosecurity practices and a lack of adequate quarantine practices (Hernández-Jover et al., 2009a). A recent cross-sectional study among poultry exhibitors in Australia indicated that these poultry keepers have a moderate to good knowledge of biosecurity and are committed to the health of their birds; however, some practices, such as allowing wild birds to contact domestic birds, the high frequency of bird movements to attend shows and the lack of a traceability system, might predispose to the introduction and spread of diseases (Hernández-Jover et al., 2013).

Findings from these studies support the perception that smallholders pose higher biosecurity risks than commercial operations; however, some of this research is based on qualitative and descriptive studies with the preconceived premise that smallholders posed a significant biosecurity risk to the Australian agriculture industries, without quantification of the risk posed by both smallholders and commercial operations.

A recent study conducted a comparative assessment of the biosecurity risks posed by small landholders and commercial producers for different animals species (Martin et al., 2012). These assessments evaluated the likelihood of introduction and spread of hazards exotic to Australia into these two types of operations. The overall conclusion from this study was that hazards were more likely to be introduced and establish in livestock owned by smallholders than in those owned by commercial producers, due to their locations, biosecurity practices and relative lack of quality assurance programs. However, spread was more likely for commercial producers than smallholders, mainly due to the higher number of animals kept and traded by commercial producers. As such, the study concluded that commercial producers pose greater overall risks to livestock biosecurity than smallholders. These results were presented in a National Stakeholder Forum, involving individual producers from various industries, and representatives of national and state/territory government departments, Animal Health Australia, universities and livestock organisations.

The main recommendations from the forum presentations and discussions were the need for: 1) Increased communication with industry bodies and producers of all sizes, and with government agencies responsible for biosecurity policy and extension, concerning shared risk and shared responsibility; and, 2) further research on producer practices for specific subgroups of small-scale producers in certain livestock industries.

Another significant issue identified in previous research was the lack of adequate communication networks between smallholders and industry and government stakeholders (Hollier and Reid, 2007; Schembri, 2009; Hernández-Jover et al., 2013). Better extension and communication networks could increase producers' active engagement and participation within their industry, and as a consequence potentially decrease the risk of disease introduction and spread (Hernández-Jover et al., 2012a).

Identifying relevant stakeholders has been seen to be a key component to an effective risk communication strategy. In relation to biosecurity and smallholders this is crucial as the more traditional modes of communication may not be effective. Larger mainstream producers are generally the target for educational and information campaigns. Beale et al. (2008) state that "Existing programs should be expanded to communicate biosecurity responsibilities to hobby farmers and small part-time producers" (p 83-84).

This project aimed to identify the current gaps in information available on smallholder livestock production in Australia and to gain a better understanding of this sector, focusing on those smallholders keeping cattle, sheep and pigs. It investigated the definitions previously used to describe smallholders and reviewed previous research and reports on smallholders and biosecurity within Australia.

# 2. Literature Review

## 2.1 Definition of smallholders

Researchers, industry, government and non-government organisations have attempted to define smallholders in Australia. The boundaries are blurred with at times arbitrary cut off points being used. Past attempts appear to have been unsuccessful in establishing a universally accepted definition, indeed Francis (2002) suggests that:

> *There is no single widely accepted definition of this term and it should be acknowledged that there are farms of small size which are classified as commercial, and that the perception of small can vary throughout the state from less than 10 hectares (ha) up to 300ha...* (p.1)

In Australian research, land size is a key defining feature of smallholders. It is used either independently or in combination with other features such as the level of income derived or the landholder's motivation for land use. Previous studies have obtained information on property size through local government databases, and Estimated Value of Agricultural Operations (EVAO) information through the Australia Bureau of Statistics Agricultural Census Data (Hollier and Reid, 2007). While these data sources are useful in setting parameters they fail to capture the more subtle information about this group. Hollier and Reid (2007) recognize that the $5000 EVAO excludes many smallholders. Based on ABS (2004) data, they suggested that there could be as many as 25,000 properties that may be unaccounted for utilising the EVAO as a definition. Local government databases contain information on property size and classifications however this does not necessarily provide accurate information on land use and is a broad brush approach to identifying this group.

Similar approaches to defining smallholders have been used overseas with the examples from the EU and USA suggestive of the same types of definitional issues that are experienced in Australia. (European Commission Agriculture and Rural Development, 2011), (Hoppe and Banker, 2010). (Appendix A)

Buxton et al. (2006) conducted an extensive review of peri-urban literature and concluded that:

> *There is no universally accepted definition of peri-urban landscapes as a distinct form of urban settlement. The literature of peri-urban regions and the process of peri-urbanization reveals a range of definitions for these terms, and experiences vary from country to country.* (p.25)

Definitions currently used for both research and service provision purposes highlight the cross over and disparity in the ways in which smallholders are defined. Tables 1-3 present examples of definitions currently being used in research and industry.

Table 1. Definitions of smallholders - Australia (Research)

| Reference | Definition |
|---|---|
| Houston (1993) as cited in Aslin et al. (2004) | Rural urban extends 100km from CBD |
| Francis (2002) | Loosely applied term. Need for common description noted. |
| Hollier et al. (2004) | • Manages between 2-100 ha<br>• Derives most income off-farm, and<br>• Estimated Value of Agricultural Operations (EVAO) less than $75 000 per year. |
| Rural Industries Research and Development Corporation (RIRDC, 2007) | • Land size between 5-100 hectares<br>• Low EVAO-majority of income generated from off-farm sources<br>• Reduced reliance on agricultural economics as a driver of land-use change<br>• Strong lifestyle and well-being focus. |
| Maller et al. (2007) | 1–200 ha. Loosely applied definition. |
| Hollier et al. (2008) | • 2 to 100 hectares<br>• Low EVAO<br>• Significant off-farm income source(s)<br>• Rural lifestyle property as a primary or secondary residence (absentee landholder). |
| Gilmour et al. (2010) | Initial thought was to have 2-200 ha in study. Decision that they would not limit study. |
| Martin et al. (2012) | FMD pigs - 100 sows<br>SWF beef cattle - ≤50 cattle<br>Residues in meat - <30 cattle;<br><50 sheep or goats;<br><150 pigs;<br><50 Ha of cropping; and<br><1 Ha of horticulture |
| Hernández-Jover et al. (2012b) | Less than 100 sows |

Table 2. Definitions of smallholders - Australia (Industry/Service provision)

| National | Definition |
|---|---|
| Australian Pork Industry Quality Assurance Program (APIQ) | Maintains a breeding sow herd of 50 or less sows; AND/OR produces, trades or sells live, or to slaughter, up to 1000 pigs in a financial year. |

Smallholders are not a homogenous group and as Aslin et al. (2004) suggest "there are ambiguities in defining farm and farmer, and in defining on-and off-farm activities and income sources. These ambiguities and blurring of boundaries make identifying and describing hobby or lifestyle farmers correspondingly difficult" (pp 6-7). A general search for descriptive labels currently used in research, service provision and colloquially to define smallholders yielded more than 10 different terms (Appendix B).

There have been studies that have used the number of animals on a property as criteria for inclusion in research however, this is generally based on an industry definition and can vary between and

within states and species. While it is clear from previous research that the number of livestock on a property is generally not a feature used to define a smallholder, from a biosecurity perspective it should be taken into serious consideration. It has been found that the number of animals plays a critical role in biosecurity risk with smallholders being associated with an increased risk for disease introduction (Martin et al., 2012). As part of a project assessing animal biosecurity related risks and smallholders, Martin et al. (2012) consulted cattle industry leaders, producers and government departments and found wide variation in the definition of a small landholder. For the purposes of their research into screw worm fly ≤ 50 cattle kept was used to define a small landholder. Similarly < 50 sheep was used to define smallholders for the risk assessment pertaining to chemical residues in meat.

Consultation with stakeholders for the current project did not yield a universal definition for smallholders. Land size was often used as a defining feature; however this was commonly a general figure ranging from 1 to 100 hectares bearing little association with the number of animals kept at the property. Australian Pork Limited (APL) classifies smallholders as those keeping between 8 and 50 pigs, with other classifications for those keeping lesser numbers (Table 3). (Appendix C)

Table 3. Australian Pork Limited pig number classification

| Number of Sows | Classification band |
|---|---|
| Up to 2 pigs (or 2 sows) | Own use |
| < 8 | Pig keeper |
| 8-50 | Small holder or Small producer |

For the purposes of this research the term “smallholder” will be used to encompass a variety of terms. These terms include smallholder, small landholder, peri-urban, hobby farms, tree changers and lifestyle farmer. The APL combined classifications of up to 50 sows will be used to define smallholders (pigs). Cattle and sheep smallholders will be defined according to a number pre-determined by the researchers of < 50 of either or both species.

## 2.2 Location of smallholders

There have been a number of studies mapping the geographical location of smallholders in Australia. Houston (2005) found that the peri-urban regions comprised 2.95% of the total land base used for agriculture. Hollier and Reid (2007) similarly, citing Nelson et al. (2004) estimate that small commercial farms represent five per cent of total agricultural land. They do however acknowledge that these figures are based on ABS data and as such should be considered a conservative estimate. Hollier et al. (2008) in a study of biosecurity risks of smallholders, mapped on a state by state basis the areas that could be considered as potential hot spots.

These locations are;

- South East coast of Australia.
- Victoria - extending from around peri-urban areas of Melbourne through to Albury-Wodonga.
- NSW - including regional inland cities and the Southern Highlands.
- South Australia- South of Adelaide and the peri-urban fringe, especially the Adelaide Hills.

- Western Australia - Peri-urban Perth from Northam to the Margaret River area and around Albany.
- Tasmania - Peri-urban Hobart and the northern rural districts towards Launceston.

Hollier and Reid (2007) describe similar settlement patterns. In a scoping study, Aslin et al. (2004) remapping work from Burnley and Murphy (2004) identified the following locations as areas where smallholders are located or as they describe areas of "population turnaround" (p12).

- Victoria - Melbourne hinterland and most of eastern Victoria, Riverland
- NSW - Coastal fringe of New South Wales and western Sydney
- South Australia - Adelaide hinterland, western Eyre Peninsula, Riverland
- Western Australia - Perth hinterland; south-west and parts of far north Western Australia
- Queensland - Brisbane hinterland and far north Queensland.

The aforementioned studies provide a relatively consistent view of where smallholders are geographically located. The arguably more difficult research question "what are they doing" needs to be quantified and is the basis for the present research. What must also be noted, contrary to general opinion, is that some small land holdings are actually commercial farms and, some large land holdings are not run as commercial farms. Similarly it has been demonstrated that larger land holdings may not necessarily hold large numbers of particular species of livestock. Illustrating this point, Schembri et al. (2010b) found that while 12 out of 13 participants in their study were small scale (<100sows), the property size of the operations ranged from 17.5 to 3700 acres. The complexity of the group highlights the need for researchers to have a clear view on how we choose to define a smallholder.

## 2.3 Biosecurity research

### 2.3.1 Overseas

The smallholder research situation overseas is similar to that of Australia with limited literature available in the area of smallholders and biosecurity. In the USA, Garber et al. (2007) looked at the non-commercial poulty industry, so called backyard flocks. This group was defined as having less than 1000 birds. A questionnaire was sent to commercial and non comercial breeders within a 1 mile radius of a commercial operation with the results showing that whilst the non commercial breeders reported poorer biosecurity practices they also reported less bird movement. The researchers suggested that efforts to control disease spread should focus on biosecurity education for non commercial breeders and issues related to movement and exposure of birds to other birds for commercial breeders.

### 2.3.2 Australian studies with national scope

Concern continues to be raised about the potential biosecurity risks associated with smallholders. Beale et al. (2008) considered this to be an "emerging risk factor". Some suggest that while considerable biosecurity research has been based on the disease itself, the implication of changes in land use patterns in relation to biosecurity risk have not been fully investigated (Aslin and Mazur, 2005). Maller et al. (2007) state that "There are few studies (in Australia or internationally) on farmers and biosecurity awareness, and fewer still that focus specifically on small lifestyle landholders and biosecurity" (p.20). This view is echoed by Hollier et al. (2008). There is a lack of

available data on the location and practices of smallholders owning livestock (Martin et al., 2012). Current national systems of livestock identification namely Property Identification Codes, National Livestock Identification Scheme and PigPass are means by which livestock movement and ownership can be traced. Compliance with these schemes may be an issue for smallholders who, in addition to the regulated systems, may also operate outside this scope (Hernández-Jover et al., 2009b; Schembri et al., 2010b). In 28 semi structured interviews with smallholders, Hollier et al. (2008) found a high level of complacency about livestock identification. Other biosecurity concerns related to smallholders are based on a perceived, but possibly overstated belief that they are unaware of the biosecurity risks that their on and off farm practices pose (Aslin and Mazur, 2005; Hollier et al., 2008; Martin et al., 2012).

Aslin and Mazur (2005) used a qualitative approach to investigate smallholders with a focus on biosecurity and reviewed previous work to conclude that while there have been numerous studies looking at land use practices, the focus was not biosecurity. Their study used a combination of data collection approaches including literature research, observational techniques and semi-structured interviews. The study focused on three case study areas - City of Swan and surrounds, WA; City of Greater Bendigo, Vic; Brisbane and Sunshine Coast Hinterland, Qld and involved "case experts" rather smallholders themselves (with the exception of stallholders selling produce at Farmers Markets). Based on their interviews, three areas of biosecurity concern were highlighted, two of which related directly to livestock. Concerns about risk related to poor animal husbandry and pasture/land management, and spread of disease such as foot and mouth were reported.

Barclay (2005) surveyed 3,000 livestock producers across NSW, Qld and Victoria about their knowledge of emergency animal diseases. Participants were selected from livestock producer listings in Telstra Yellow Pages. The herd size of respondents ranged from 2 to 50,000 head, hence not all would be considered smallholders using the current project definition. Including questions on Information, Biosecurity on farms, Perceptions of risk and Attitudes to biosecurity, they reported that pig producers were the most diligent in relation to biosecurity and dairy producers the least likely to practice safety and security measures. Somewhat concerning was their revelation that "...Australian farmers' attitudes to biosecurity reflect those of their English counterparts; that the responsibility for quarantine and biosecurity lies primarily with government." (p49).

Maller et al. (2007) used a qualitative interview approach in a study that aimed to:
1. Build on previous typologies of Australian landholders in peri-urban areas to categorise landholders who are potentially at risk of particular biosecurity threats;
2. Analyse and define biosecurity risks for industry groups and pertinent human, animal and plant health portfolios by investigating the practices, motivations, and values of peri-urban landholders.

Forty five individuals whose backgrounds included landholders (n=5), representatives from government, industry, special interest groups, researchers and rural merchants were questioned. Results from this research support the general opinion that peri-urban landholders source their livestock from both traditional and non traditional sources and that there is a range of knowledge and attitudes within the smallholder group with regards to biosecurity. While the results are relevant, they are again predominantly the views of case experts and as such may not necessarily reflect the reality of the practices of the smallholder group.

Wadsworth and Choy (2011) considered land use planning and the importance of addressing biosecurity issues within this context. Existing key stakeholders were identified as being peri-urban residents, community organisations, industry and government. Planning professionals were seen to be the missing link in the stakeholder networks with their role considered to be of benefit for both pre-emptive and post incursion response to a biosecurity threat.

Findings from risk assessments undertaken as part of a project looking at biosecurity risks associated with smallholders were presented at a stakeholder forum in 2010. Forum participants included producers from various industries, and representatives of national and state/territory government departments, Animal Health Australia, universities and livestock organisations. One of the key points arising from the forum was that animals owned by smallholders were more likely to be exposed to exotic disease due to their location, biosecurity practices and relative lack of QA programs (Perkins et al., 2010).

While there have been a number of studies that have a national focus with selected case study areas from multiple states, there has been no definitive national study on smallholders and biosecurity.

### 2.3.3 Australian studies with a state wide scope

***New South Wales***

Using both qualitative and quantitative methods and a mental model approach, Gilmour et al. (2007) conducted a study in the Yass region of NSW looking at stakeholder mapping and analysis for biosecurity risk communication. Semi-structured interviews were conducted with 33 stakeholders (landholders and representative groups) looking at biosecurity risks, awareness of vectors and pathways and practices. A stakeholder map was developed and modified as required throughout the study. In addition surveys were sent to a stratified sample of 930 with a 15% response rate. Participants were asked questions related to demographics and activities on the property. The study was not restricted to smallholders with holdings ranging from 0-2ha to >500ha. No correlation was found between property size and number of types of livestock, nor was any reported between property size and biosecurity familiarity and awareness. These results go some way to challenge the view that smallholders are ignorant of biosecurity issues and as such pose a greater risk. However when asked about specific animal disease, despite all landholders demonstrating varying levels of knowledge it was the smaller landholders who were the least knowledgeable.

A follow up paper by Gilmour et al. (2010) reflects upon the outcomes of the earlier research in an attempt to determine the role this may have in risk communication strategy. They found that for some research participants despite not necessarily articulating a sound understanding of biosecurity, on farm behaviour was often appropriate for risk management. On the whole however they report that those on smaller holdings knew significantly less about animal disease than those on larger holdings and that appropriate on farm practice is related to level of knowledge.

***Victoria and Western Australia***

Victoria and Western Australia are two states that have been the focus for a significant amount of Australian research into smallholders and biosecurity. Both of these states have had state government small farm information services.

Hollier et al. (2008) conducted 28 semi structured interviews in both states with smallholders identified as keeping farm animals. The main objective was to "heighten the awareness of the small lifestyle landholder profile as a potential risk to Australia's biosecurity, agriculture and market access" (p.3). Case study areas were selected in North Eastern Victoria and the City of Swan, Perth, Western Australia. It was found that all interviewees kept livestock with cattle being the most popular. A difference was found between those smallholders on less than 5 hectares and those on larger smallholdings. The owners of smaller properties tended to see their livestock more as pets with some larger holdings viewing their land management practices as being similar to commercial farming operations. Another reported finding was that swapping and bartering animals, thus circumventing the NLIS and PIC schemes, was taking place in this population.

***Victoria***

Hollier et al. (2004) conducted a study in the Honeysuckle Creek sub catchment area. The objectives of the study were to review and describe the Small Lifestyle Landowners (SLL) sector in the study area and to improve understanding of the drivers of land use change associated with SLL to inform policy and appropriate engagement strategies. The study incorporated workshops with stakeholders (n=32) on- farm interviews (n=24), two off-farm discussion groups with small landholders and data collated from two focus groups. The main drivers for rural land use are discussed and mapping of small holders in Victoria is presented. The focus of the study was not biosecurity and as such its findings are not of relevance to any discussions on smallholders and biosecurity.

In a later study questionnaire interviews were conducted at Small Farms Field Days with the focus being on land use activities and practices and biosecurity awareness. At the Lang Lang field days 73% of participants were unsure of how biosecurity might impact on their farm (Hollier et al., 2006). Reporting further on the Small Farms Field Days, Hollier et al. (2008) conclude that the small landholder population was highly mobile, had limited farming history and a lack of awareness of biosecurity. They also report that less than 5% of respondents would utilise government agencies as sources of information. At the Seymour Alternative Farms Expo, it was similarly reported that some interviewees were not aware of biosecurity measures that were designed to protect their properties from disease despite the finding that 69% had some agricultural commercial activity on their property (Hollier et al., 2008). It should be noted that this includes horticultural and livestock activity. They also report that 28% of respondents considered their operation to be a "hobby".

Utilising a combination of quantitative (mapping and questionnaires) and qualitative (focus groups, semi- structured interviews, workshops, photographic recordings, secondary analysis and synthesis of key documents) methods, Hollier and Reid (2007) undertook a study of smallholders in North-East Victoria. The broad aims of the study were to look at the location and characteristics of small lifestyle farms; the views and values of small lifestyle farmers and the influence of these on management decisions and participation in extension activities and finally training needs, information sources and ways to improve service delivery mechanisms. Biosecurity risk and its associated practices were not addressed in any detail in the questionnaires or interviews. The findings from this study related to location and characteristics of smallholders have been discussed previously in this review. It was reported that participatory-based approaches whereby smallholders were involved in both the definition and the solution of a problem was favoured, along with the notion that any extension needs to recognise and value to diversity of the group.

## 2.4 Studies from a sociological perspective

Aslin et al. (2004) completed a scoping study that focused on three main questions; who, where and what are the motivations of smallholders in Australia. They reviewed previous studies and existing data, reviewed land mapping and finally developed three geographical case studies based on existing survey data and socio-demographic profiling. The three case study areas that were selected were - Brisbane Hinterland, Goulburn-Broken Catchment and Darwin Hinterland. Certain characteristics, such as education level, size of farm, EVAO, time spent on the property and age, were shown to distinguish non-farmer rural landholders from farmers. The study used the term peri-urban to describe smallholders who have purchased their properties for non-farming purposes and who may or may not engage in primary production. As has been stated previously, the diverse nature of the smallholders would mean that these findings cannot be generalised across the entire smallholder population.

Hollier and Reid (2007a) explored the contribution of small farms to healthy rural communities. The project incorporated a review of the literature related to smallholders; a review of the outputs of state and national small farms workshops with social researchers and extension providers; and narratives and surveys with small farmers. One of their key findings was that "There is considerable commentary on the value of small lifestyle farms to rural communities but little quantitative evidence."(p28).

## 2.5 Studies from an epidemiological perspective

From 2005 to 2008, a research group from the University of Sydney with funding from the Australian Biosecurity Corporate Research Centre (ABCRC) conducted the study "Peri-urban regional surveillance for biosecurity for the pig industry in eastern Australia". This project focused on gaining a better understanding on demographics, biosecurity, traceability, health and management and communication practices of pig producers located in peri-urban areas in eastern Australia, as well as investigating surveillance systems for monitoring pigs post-farm-gate. Most of producers participating in this project had less than 100 sows on the farm, since producers trading through saleyards were the study target population. Several studies have been published from this project, including a PhD thesis (Schembri et al., 2007; Hernández-Jover et al., 2008a; Hernández-Jover et al., 2008b; Hernández-Jover et al., 2009b; Schembri, 2009; Schembri et al., 2010a; Hernández-Jover et al., 2011; Hernández-Jover et al., 2012a). This project identified key risk areas for emergency animal disease introduction and spread among all producers (smallholders and commercial), these being lack of veterinary contact, motivations for keeping pigs such as for personal use (home consumption) or as a hobby, marketing pigs privately with no formal transaction documentation and the co-production of pigs with ruminant and domestic bird species that could be involved in cross-species disease spread. In addition, commercial producers used greater number of on-farm biosecurity practices (e.g. footwear precautions, provision of overalls to visitors and shower facilities) than small-scale producers, and were more likely to keep health records and to have contacted a veterinarian in the previous 12 months. Attitudes towards disease reporting differed according to herd size and the severity of perceived impact of the disease. Regarding communication networks, producers identified other producers, their veterinarian and family and friends as their first point of contact, instead of government authorities and the pig industry organisation (Schembri, 2009).

A more recent project funded by ABCRC, investigated the biosecurity risks posed by small landholders to the Australian livestock production (Martin et al., 2012). The project quantified these risks and compared them with those posed by commercial (large) livestock producers, using several individual risk assessments focusing in different livestock species. Definition of smallholders was based on number of animals kept according to the livestock species. The risk assessments included an exposure and a partial consequence assessment, which investigate the probability of a previously identified hazard to be introduced into a property (small and large) and the probability of this hazard spreading from this property. The project concluded that in general: 1. Introduction of exotic diseases and residues is at least as likely for smallholders as for commercial producers; 2. Livestock kept by smallholders are less likely to spread diseases or residues than that kept by commercial operations, and subsequently, less likely to initiate a damaging outbreak; and, 3. Commercial livestock producers pose a greater biosecurity risk than smallholder producers, mainly due to the higher number of animals kept.

One of the risk assessments of this project investigated the risk of introduction and spread of Screw Worm Fly in smallholders (50 or fewer cattle) and commercial producers (1000 cattle or more) in shires within 100km of coastal tropical Queensland from Rockhampton to the Northern Territory Border. Information required for this assessment was gathered through a phone questionnaire among 243 beef cattle producers, 51 were smallholders and 86 commercial producers (the rest of properties kept between 51 and 999 cattle). This assessment concluded that coastal smallholders are more likely to be exposed than coastal commercial producers; however, spread is more likely from commercial producers than from smallholders. When the exposure and spread likelihoods were combined, the likelihood of a property being exposed, infection established and spread was estimated to be higher for smallholders than for commercial producers. This study recommended targeting extension activities towards all producers near port areas (where Screw Worm Fly is likely to be introduced into the country). In addition, reducing susceptible animals on farm (e.g. those with wounds, and time of wounds without treatment) was an on-farm recommendation.

Another of the risk assessments within the Martin et al. (2012) project investigated the biosecurity risks associated with small scale pig producers (Hernández-Jover et al., 2012b) using a foot and mouth disease (FMD) case study. The comparative risk for smallholders and large scale piggeries was investigated in addition to the method of sale i.e. formal and informal, within the smallholders group. This assessment used results from the previous ABCRC project on peri-urban pig producers (Schembri, 2009), study focused on small-scale producers selling through informal means (Schembri et al., 2010b) and questionnaires with specific groups of pig producers. This assessment estimated that the likelihood of exposure of a piggery to the FMD virus was extremely low and similar for all groups of pig producers. However, the likelihood of spread was more likely to occur from a small-scale piggery selling at sale yards and abattoirs than other small-scale piggeries and commercial operations. The issue of non traceable movement of pigs through informal sales was highlighted as an area of concern as this may increase the magnitude of an outbreak should one occur. Given that large scale producers do not sell informally, it is the smallholders whose behaviour relates directly to this observation. This study highlighted the need for an increased extension on the risks of swill feeding, disease detection and biosecurity among all pig producers, traceability requirements among small-scale pig producers selling informally and disease detection at agricultural shows, saleyards and abattoirs.

Supporting previous studies, a qualitative study among thirteen pig producers who sold their pigs through informal methods (Schembri et al., 2010b) found that while the biosecurity, feeding and herd health were of a comparatively high standard, delays in detection and reporting of an unusual disease combined with traceability difficulties may adversely affect the control of any disease outbreak.

To further investigate the issue of biosecurity and small scale pig producers, Hernández-Jover et al. (2012a) applied a stakeholder mapping framework to investigate key stakeholders influence and interest in the area of biosecurity and small-scale pig producers. The process included stakeholder identification, their issues of concern regarding small scale pig producers and biosecurity, and their perceived influence and interested in each of these issues. The stakeholder responses on their perceived influence and interest were then compared to the perspective from the small scale producers. Stakeholders were categorised as industry organisations, government agencies, research organisations, private organisations and private individuals. This study identified the capacity of various stakeholders to influence the outcomes and to which extent they have been successful or not in achieving these outcomes. The study confirms that there is a disconnection on the perceived influence and interests between stakeholders and producers, indicating that government and industry, which producers do not consider to be very influential, should liaise with those stakeholders with the capacity to influence them, such as veterinarians, other producers and livestock agents.

During 2008, a qualitative study investigating the potential biosecurity risks associated with bird sales in Australia and the practices of poultry producers who trade birds through these venues was conducted (Hernández-Jover et al., 2009a). Three case studies of bird sales were conducted and a total of 40 producers trading through these locations were interviewed to collect information on husbandry, health management and biosecurity practices. The sale managers or auctioneers were also interviewed to investigate general and biosecurity characteristics of the sales. Some practices at live bird sales were identified as posing a potential risk for disease spread, these being the inadequate dead bird disposal, non-use of disinfectant for cleaning cages and maintaining different bird species and other animal species in close contact. In addition, the study reported a poor understanding of biosecurity and limited application of on-farm biosecurity practices among small poultry keepers interviewed.

Two recent studies on poultry exhibition in Australia (Dusan et al., 2010; Hernández-Jover et al., 2013) suggest that although these poultry keepers' knowledge of biosecurity practices was moderate to good and they are very committed to the health of their birds, some practices undertaken by this sector of the industry might pose a risk for disease introduction and spread. Most poultry exhibitors keep the birds with outdoor access and with potential contact with wild birds, attend a high number of shows every year with travel over long distances, have low contact with veterinarians and some used live bird sales to trade birds.

## 2.6 Extension and Industry based research

A number of forums have been convened focusing on issues related to smallholders and biosecurity (Hollier et al., 2006; RIRDC, 2007; Department of Agriculture and Food, 2008; Perkins et al., 2010). In 2005 a forum, Rural Lifestyle and Landscape Change: Emerging Challenges for Extension was held

bringing together researchers and service delivery organisations with the aim of gaining new knowledge on the smallholder sector and to consider engagement and capacity building opportunities. Some of the resulting messages from the forum were that the social landscape of Australia is changing, smallholders are a diverse group and that all tiers of government must define their position with respect to smallholders.

The Small Lifestyle Farms and Biosecurity forum in 2006 involved 32 case expert participants who discussed the major issues related to smallholders and biosecurity. While the biosecurity risk posed by smallholders was the focus of the forum they also acknowledged that "Current evidence is anecdotal and there is a need to predicate the unpredictability through the collection of some hard data. This data collection can be further complimented by understanding what the sector perceive are potential biosecurity risks on their property." (Hollier et al., 2006p10)

In 2008 the inaugural Small Landholders Extension Practitioners Network practitioner's forum was held. One of the purposes of the forum was to bring together delegates to determine whether the creation of a national forum would result in more effective service provision to small landholders. It was unanimously agreed that the network be established. At the present date the network is not operational.

## 2.7 Limitations of previous research

The use of case experts in previous research has resulted in an increase in understanding of the smallholder population. One limitation with the use of case experts is that their views may be biased depending on their experiences. Gilmour et al. (2010) citing Morgan et al. (2002) suggest that while "…non-expert stakeholders may lack knowledge about a specific risk, experts' assumptions of non-expert stakeholders' knowledge were often incomplete and inaccurate…." (p.6). To address this, studies have used a combination of case experts and smallholders , however a suggestion could be made that those smallholders who participate in research are already engaged and may not be truly representative of the smallholder group.

The lack of information on particular sub-groups within the smallholder group is a concern. People from culturally and linguistically diverse backgrounds (CALD) (Aslin and Mazur, 2005) and also those with a general mistrust of authority (Hollier et al., 2008) may not be included in research. These groups are less likely to engage in extension work and as such research that relies on case experts may exclude these groups. Gilmour et al. (2007) acknowledge that in their research the study area (Yass LGA) has a high percentage of people with English as a first language and thus may not be applicable to other peri-urban areas. While acknowledging that the geographical distribution, diverse nature, large numbers and at times transitory nature of the smallholder group, makes research challenging, future research should include strategies to engage all sub- groups of the smallholder group.

Other limitations include the lack of specific information about the on farm practices of smallholders with regards to the livestock kept and biosecurity practices. Studies mentioned previously have shown that the biosecurity practices are influenced by the number of livestock held rather than simply the size of the land; however many studies looking at smallholders and biosecurity continue to use land size as a parameter for inclusion.

## 2.8 Recommendations from previous research

Changes in government focus and competing priorities has resulted in a sense of inertia in the area of national smallholder research and to a lesser extent service provision. Recommendations related to biosecurity plans have been addressed in the area of pig production, through the work of Australian Pork Limited, however some pig related concerns particularly those related to swill feeding have not been resolved. Further improvements in livestock identification are anticipated as the changes to the Property Identification Codes brought in September 2012, should result in more transparency in livestock ownership. The limitations of this scheme have been discussed; however, any expansion in requirements should be considered a positive for biosecurity.

Previous research has identified that a national quantitative survey of smallholders needs to be undertaken (Hollier et al., 2008). Such a study would provide baseline data and also information on actual rather than perceived biosecurity risks associated with smallholders. The current research involves a quantitative national study with the aim of establishing a broad understanding of the smallholder population, from which further research questions can be developed.

# 3. Materials and Methods

## 3.1 Human Research Ethics approval

The study proposal, information statement and questionnaire were submitted to the Human Research Ethics Committee at Charles Sturt University with the research title '"Characterization of smallholder livestock production in Australia"**.** This research proposal was approved on the 20th May 2013 (protocol number 416/2013/05).

## 3.2 Stakeholder identification and consultation process

The initial method for consulting stakeholders was to identify the relevant stakeholders with an interest in smallholders. This was achieved through existing knowledge of the sector from previous research and online searches. State based government departments/authorities, Natural Resource Management (NRM), Catchment Management Authorities (CMA), Landcare Networks and special interest, industry and community groups were contacted. The decision was taken that the Northern Territory would be excluded due to the low number of smallholders (Animal Health Australia, 2003). Figure 1 represents a basic stakeholder map based on the initial identification of stakeholders involved with smallholders.

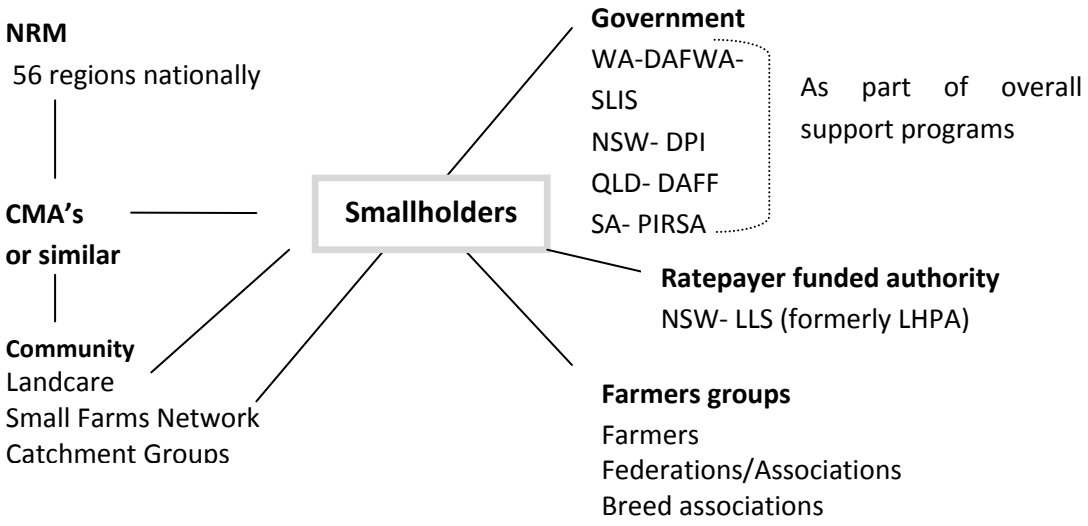


Figure 1. Mapping of stakeholders with identified link to smallholders

Initial contact was made through telephone calls and/or email. After contact had been established, interested groups were sent a set of questions (Appendix D) related to their involvement with smallholders and given the option to be contacted for follow up at a convenient time by telephone or if preferred, to provide responses via email. At this next contact, stakeholders were asked if they would be interested in assisting with the distribution of the questionnaire. A list of stakeholders included in the initial phase of consultation is shown in Table 4.

Table 4. List of stakeholders included in the initial phase of consultation.

| | Name | Category |
|---|---|---|
| **Smallholders -Pig** | Australian Pork Limited | Industry |
| **National** | Sheep Meat Council | Industry |
| | Australian Lowline Cattle Association | Farmers |
| **Western Australia** | Department of Agriculture and Food -Small Landholder Information Service | Government |
| | South Coast NRM/Torbay Catchment Group | Government |
| | Blackwood Valley Small Landholders | Community |
| | South West Catchment Council | Government |
| | Esperance Small Landholders | Community |
| | Western Australian Farmers Federation | Farmers |
| **Victoria** | Department of Primary Industries-- Small Landholders Information Service | Government |
| | North East Catchment Management Authority | Government |
| | Victorian Farmers Federation | Farmers |
| | West Gippland CMA | Government |
| | Goulburn Broken CMA | Government |
| | Mornington Peninsula Shire | Government |
| | Baw Baw Council | Government |
| | North Central CMA | Government |
| | Corangamite Catchment Management Authority | Government |
| | Wimmera Catchment Management Authority | Government |
| | Port Philip and Western Post Catchment Management Authority | Government |
| | East Gippsland CMA | Government |
| **Queensland** | DAFF Biosecurity | Government |
| | Fitzroy River and Coastal Catchments | Community |
| **South Australia** | Department of Primary Industries and Resources | Government |
| | The Fleurieu Small Land Holders Group | Community |
| **NSW/ACT** | Small Farms Network | Community/CMA funded |
| | Molonglo Catchment Group | Community |
| | Bellinger Landcare | Community |
| | Upper Murrumbidgee Catchment Coordinating Committee | Community |
| | Hastings Landcare Inc | Community |
| | Department of Primary Industries | Government |
| | Graham Centre for Agricultural Innovation | Government |
| | Livestock Health and Pest Authority | Authority |
| **Tasmania** | Department of Primary Industries, Parks, Water and Environment | Government |
| | NRM North | Government |
| | Tasmanian Farmers' & Graziers Association | Farmers |
| | NRM Cradle Coast | Government |
| | NRM South | Government |

## 3.3 Cross-sectional study on smallholder producers in Australia

### 3.3.1 Development of the questionnaire

A questionnaire (general) targeting smallholders keeping less than 50 cattle and/or 50 sheep and a questionnaire (pigs) targeting smallholders keeping less than or equal to 50 sows were developed. These questionnaires were constructed to gather information on characteristics related to demographics, on farm practices, biosecurity and communication networks of smallholders and small scale pig producers. The decision was taken to develop a separate questionnaire for pig producers so that specific questions related to small scale pig production could be included.

Both questionnaires consisted of 5 sections with 35 questions in total (Appendix E and F). The questionnaires contained 32 common questions. The 5 sections in the questionnaires were: demographics and general husbandry, animal movements, biosecurity, herd/flock and health management, and communication. The questionnaires comprised short closed, semi-closed and open questions in a simple, clear format to minimise confusion and maximise response accuracy (Dillman, 2000). The questionnaires were developed for both postal and electronic administration. The electronic versions of the questionnaire were developed and administered using the online survey tool, SurveyMonkey®.

### 3.3.2 Questionnaire review

***Questionnaire- Smallholders (general)***
The initial draft questionnaire was provided to Rachel Wicks from DAFF for comment with suggestions duly considered and incorporated where appropriate. The questionnaire was also provided to Craig Carter, project officer South Coast NRM and David Pitt, Senior Veterinarian Biosecurity Qld DAFF, for review.

In addition, the questionnaire was piloted with three smallholders residing in a semi-rural location within the Wagga Wagga LGA who were identified as keeping less than 50 cattle and/or sheep. Suggestions were duly considered and incorporated where appropriate.

***Questionnaire- Smallholders (pigs)***
The initial draft questionnaire was sent to Kathleen Plowman, General Manager Policy, Australian Pork Limited for comment with suggestions duly considered and incorporated where appropriate.

## 3.4 Questionnaire distribution

Stakeholders who agreed to assist with the distribution of the questionnaire on behalf of the researchers were contacted to discuss the best way of facilitating this. It was identified that there were differences between states with regards to both the availability and type of contact details for smallholders and the level of assistance and information that could be provided. It was not possible to administer the smallholders (general) questionnaire at a national level using a standard approach, resulting in the development of a tailored method of distribution for each state. The questionnaire (pigs) was able to be primarily administered through a national database (APL Pig Pass).

The criterion for inclusion was those smallholders keeping < 50 cattle and/or < 50 sheep for the smallholder (general) questionnaire, and ≤ 50 sows for the smallholder (pigs) questionnaire.

A summary of the selection method used in each state is provided in Tables 5 and 6. A census approach was used for the distribution of the online questionnaire among smallholders with available email registered in Western Australia and NSW. The postal survey was distributed among a randomly selected sample of smallholders from the State governments' available registers in Queensland, South Australia, Tasmania and Victoria. The sample size required in each state was calculated accounting for an infinite population (>1,000 smallholders), 95% confidence level and 5% precision, and assuming that approximately 20% of smallholders would conduct a specific practice. According to the sample size formula to estimate proportions (Dohoo et al., 2009)) approximately 245 responses were needed for each state. A sample size of 700 smallholders was targeted in each state assuming a response rate between 30 and 35% and according to resources available. In Queensland and Victoria, selection of producers was stratified and proportional by animal species (cattle and sheep) due to availability of information. A similar approach was used for the distribution of the questionnaire (pigs). Among pig producers with an available email address (n = 1,207) within the PigPass database (n = 1,572), a sample of 750 producers were selected (the resend of the questionnaire was done online). In addition, a census of the total 147 pig producers with ≤50 sows present in the Tasmanian government register was included for the distribution of the questionnaire (pigs) as Tasmanian producers were not represented in the PigPass database.

Two mail-outs /electronic contacts were used for the distribution of the questionnaire. The aim was to resend the questionnaire to non-respondents 3 to 4 weeks after the initial distribution to increase response rate. Due to the reliance on third parties to distribute the questionnaire, this 3-4 week timeframe was not achieved for all states (Table 5;

Table 6). For the postal questionnaire, the questionnaire and participant information sheet were posted to the selected smallholders with an addressed, reply paid return envelope. The electronic version was sent directly from the assisting organisations in an email containing an introduction to the project and a link to the full information statement and online questionnaire. The smallholder (general) questionnaire was also distributed once to participants at the Fitzroy and Coastal Catchments, Rockhampton, Qld, Small Landholders Day event. To encourage participation and to reduce potential for non-response bias, an incentive of entry into a lucky draw for five gift vouchers per questionnaire group (each of AU $50) was offered.

Table 5. Summary of the distribution of the postal and electronic questionnaires among smallholders (general) in Australia in 2013, including information on the method of distribution, the number of questionnaires distributed and the date of distribution.

| Organisation assisting | Information source | Selection method | Number of questionnaires | Date and mode |
|---|---|---|---|---|
| **Tasmania -** Department of Primary Industries, Parks Water, and Environment | Tasmanian Agricultural Property Database | 1. Select those keeping < 50 cattle, sheep and cattle/sheep n = 4017<br>2. Order by surname.<br>3. Generate random numbers n=700<br>4. Select 700 corresponding records<br>5. Send to display name | 696* | 1st - Postal- 16/07/13<br>2nd- Postal- 13/08/13 |
| **Queensland** | | | 700 | 1st - Postal- 24/07/13<br>2nd- Postal- 06/09/13 |
| Department of Agriculture Forestry and Fisheries | Agricultural Property System | 1.Select those registered or with updated information from 2005<br>2. Proportional number of questionnaires to be sent to cattle producers 625/28006 and sheep producers 75/3049<br>3. Select 700 records following a systematic random selection method –sampling proportional to shire size in terms of number of properties.<br>4. Send to display name | | |
| Fitzroy Coastal Catchment | Participants | Distribute questionnaire at Small Landholders Day – 50 -100 questionnaires available. | 50 | Available 17/08/13 |
| **Victoria** - Department of Environment and Primary Industries | Property Identification Codes | 1. Select active PICs that have<br>- < 50 sheep or cattle but at least one sheep or cow when last registered<br>- not ordered more than 30 tags a year in the last 5 years<br>- do not have more than 100 other animals (pigs, chickens, horses etc) registered.<br>2. Proportional number of questionnaires to be sent to cattle producers 468/4736, sheep producers 77/777 and cattle/sheep producers 155/1571.<br>2. Random selection of 700. | 699** | 1st - Postal- 16/07/13<br>2nd- Postal- 13/08/13 |
| **South Australia** –Primary Industries and Regions SA | Primary Industries Information Management System | 1. Active PICs that have < 50 sheep or cattle n=7387<br>2. Generate a random number list in Excel.<br>3. Associated the random numbers with each individual registration and then sorted by the random number.<br>4. Select the first 700 | 700 | 1st - Postal- 30/07/13<br>2nd- Postal- 25/09/13 |

| | | | | |
|---|---|---|---|---|
| **Western Australia** | | | | |
| Torbay Catchment Group | Membership database | Mailing list with exclusion of known urban properties- n=300 | 300 | 1st - Postal-15/08/13<br>2nd- not sent |
| Small Landholders Information Service, DAFF | Brands data base | 1. Registered for brands.<br>2. Email contact details provided.<br>3. Indicated that they will have less than 100 combined numbers of livestock n=780 | 780 | 1st - Electronic- 08/07/13<br>2nd- Electronic- 05/08/13 |
| **NSW/ACT** | | | | |
| Molonglo Catchment Group | Membership database | All members with email contact n=374 | 374 | 1st - Electronic- 26/06/13<br>2nd- Electronic- 11/07/13 |
| Small Farms Network | Membership database | All members with email contact n=565 | 565 | 1st - Electronic- 26/06/13<br>2nd- Electronic- 25/07/13 |
| Bellinger Landcare | Membership database | All members on contact list n= 300 | 300 | 1st - Electronic/Postal- 24/07/13<br>2ndnot sent*** |
| | | **TOTAL PARTICIPANTS** | **Postal 3095**<br>**Electronic 2019**<br>**Other 50**<br>**Combined 5164** | |

** Removed 4 names- Tasmania as record indicated a school, company name or duplication*

*** 1 name -Victoria from mailing list as record indicated a school, company name or duplication*

**** Poor response rate from initial mail out.*

Table 6. Summary of the distribution of the postal and electronic questionnaires among smallholders (pigs) in Australia, including information on the method of distribution, the number of questionnaires distributed and the date of distribution.

| Organisation assisting | Information source | Selection method | Number of questionnaires | Date and mode |
|---|---|---|---|---|
| **National -** Australian Pork Limited | Pig pass database | 1. Select those ≤ 50 sows. (n=1572)<br>2. Select records containing email addresses n=1207/1572<br>2. Sort by registered user name.<br>3. Generate random numbers n=750<br>4. Select 750 corresponding records<br>5. Send to Primary Authorised rep | 750 | 1st - Postal- 03/07/13<br>2nd- Email- 06/08/13 |
| **Tasmania -** Department of Primary Industries, Parks Water, and Environment | Tasmanian Agricultural Property Database | 1. Select those ≤ 50 sows. (n=147)<br>2. Send to display name | 147 | 1st - Postal- 03/07/13<br>2nd- Postal- 05/08/13 |
| | | **TOTAL PARTICIPANTS** | **897** | |

## 3.5 Data analysis

Data from the returned postal questionnaires were entered in Excel (PC/Windows XP, 2007) and checked for data entry errors. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. was used for the descriptive statistical analysis. Statistical analysis was conducted using GenStat software (© 2000-2012 VSN International Ltd, Hemel Hempstead, UK). The outcome variables considered in this analysis were classified in the following categories:

1. Self-definition and motivations
2. Biosecurity practices
3. Livestock movement practices
4. Herd/flock health and management practices
5. Communication networks and behaviour

All outcome variables were binary. Those variables with more than two outcomes were recoded to create a binary outcome. Univariable logistic regression analysis was conducted to investigate preliminary associations of the outcome variables with a group of explanatory variables. The explanatory variables considered were: Age, gender, state, property size (hectares), years owning livestock, species kept (ruminants and/or pigs), number of cattle, sheep and sows kept, keeping horses, keeping poultry and the ethnic background of the respondent. Correlation between explanatory variables were tested by a chi-square test and only one of the variables of a pair of highly correlate variables was included in the model. Variables with $P < 0.2$ in the univariable analysis were investigated further in a multivariable logistic regression model. Age and gender were forced into the multivariable models as potential confounders. Only those variables with a P-value $<0.05$ in the multivariable model were kept in the final model.

Biosecurity knowledge was qualitatively analysed using content analysis to identify thematic categories and subsequently an interpretive coding was used. Four categories were created: 0. No knowledge (I don't know / incorrect reference to introduction and spread of diseases); 1. Low level of understanding of biosecurity (general mention of disease prevention but no reference to introduction and/or spread); 2. Moderate level of understanding of biosecurity (correct reference to practices preventing the introduction or the spread); 3. High level of understanding of biosecurity (correct reference to practices preventing the introduction and spread of disease).

For the smallholder (general) study group, the geographic location of participants in the study (respondents to the survey) according to species kept was mapped by postcode using ArcGISTM 9.3 (ESRI Inc., Redland, CA, USA). The geographical location of distributed questionnaires and respondents among smallholders in Victoria and Tasmania was also mapped by postcode. In addition, for the smallholder (pig) study group, the geographical location of distributed questionnaires and respondents was also mapped by postcode.

# 4. Results

## 4.1 Consultation with stakeholders

Attempts were made to contact thirty eight identified stakeholder organisations. Of these, eighteen provided information and/or agreed to assist with the distribution of the questionnaire; ten provided limited information and ten were not successfully contacted (Table 7 and Table 8) (Appendix G). It is noted that the decision to not follow up on organisations that were initially not successfully contacted was based on the researchers being satisfied with the information provided by other stakeholder in that state. It cannot be assumed that these organisations would not have participated had further follow up occurred, however their non inclusion is not considered to have resulted in selection bias.

Variations in both knowledge of the sector and the level of direct association with smallholders was evident nationally, with only Western Australia currently providing a state government standalone support service to smallholders. In general, state government departments support smallholders as part of broader agricultural and biosecurity services and as such do not provide tailored support services.

The Small Farms Network is a smallholder information/support group (Appendix G). It covers the geographical region of the south coast and southern highlands of NSW, however due to demand they also provide some service/information to smallholders from outside this area.

Nationally, consultation with NRM's yielded varying results with some regions being directly responsible for the delivery of relevant programs to smallholders and other regions having this function managed by CMA's. It was also found that some CMA's delivered programs directly to smallholders and others provided a conduit to NRM funding for local Landcare offices and networks. Through discussion with these groups it was identified that while smallholder biosecurity issues are of interest and relevance, they form only one part of a bigger resource management objective. Of the groups consulted, the majority did not have identified staff tasked with supporting smallholders.

There is no national register of smallholders. State managed agricultural databases contain contacts for smallholders that have registered for PIC's but for non-government organisations details on livestock ownership were generally anecdotal. Maintaining the currency of contact information for smallholders was identified as a challenge due to the relatively high turnover of property ownership within this group.

Stakeholders in general, were unable to provide new literature. Any literature that was forwarded referred to the previously reviewed work from five to ten years ago, highlighting the need for current research.

The location of the stakeholders consulted was consistent with the areas identified in previous studies as having a higher concentration of smallholders (Hollier et al., 2008).

Table 7. List of stakeholders providing information on smallholders during the consultation process.

| | **Name** | **Category** |
|---|---|---|
| Pig Smallholders | Australian Pork Limited | Industry |
| Western Australia | DAFF- Small Landholder Information Service | Government |
| | South Coast NRM/Torbay Catchment Group | Government |
| | Blackwood Valley Small Landholders | Community |
| Victoria | Department of Primary Industries | Government |
| | North East Catchment Management Authority | Government |
| | Victorian Farmers Federation | Farmers |
| Queensland | Department of Agriculture Fisheries and Forestry | Government |
| | Fitzroy River and Coastal Catchments | Community |
| South Australia | Department of Primary Industries and Resources | Government |
| NSW/ACT | Small Farms Network | Community CMA funded |
| | Livestock Health and Pest Authorities | Authority |
| | Molonglo Catchment Group | Community |
| | Bellinger Landcare | Community |
| | Hastings Landcare | Community |
| Tasmania | Department of Primary Industries, Parks, Water and Environment | Government |
| | NRM North | Government |
| | NRM South | Government |

Table 8. List of stakeholders providing limited information on smallholders or unable to assist during the consultation process**.**

| | **Name** | **Category** |
|---|---|---|
| Victoria | West Gippland CMA | Government |
| | Goulburn Broken CMA | Government |
| | East Gippsland CMA | Government |
| | North Central CMA | Government |
| | Wimmera Catchment Management Authority | Government |
| NSW/ACT | Department of Primary Industries | Government |
| | Graham Centre for Agricultural Innovation | Government |
| | Tasmanian Farmers' & Graziers Association | Farmers |
| | Upper Murrumbidgee Catchment Coordinating Committee | Community |
| Tasmania | NRM Cradle Coast | Government |

## 4.2 Description of the characteristics of smallholders

### 4.2.1 Response rate

A total of 971 completed responses were received from smallholders (general) and 226 completed responses from smallholders (pigs). Respondents that did not provide information on number of animals kept, kept no livestock, indicated higher than 50 animals in any of the livestock categories or were otherwise not in the target population, or for electronic survey did not indicate consent to participate by full completion of the online survey have been excluded. This has resulted in the exclusion of 221 general smallholder respondents (postal n=119, electronic n=102) and 32 pig smallholder respondents (postal n=25, electronic n=7).

Thus, the number of responses was 750 from smallholders (general) and 194 from smallholders (pigs), representing a response rate of 14.5% and 21.6%, respectively.

In addition, of the questionnaires distributed by post, 117 smallholders (general) postal questionnaires and 13 smallholders (pigs) were returned to sender. If these non-received questionnaires are subtracted from the total distributed then the response rates were 14.7% for smallholders (general) and 21.9% for smallholders (pigs).

It was identified that 4 smallholders (general) reported that they kept only pigs ie no cattle and/or sheep. For the purposes of analysis these respondents were removed from the smallholders (general) database and added to the smallholders (pigs) database. This resulted in the final numbers for analysis being 746 smallholders (general) and 198 smallholders (pigs).

### 4.2.2 Smallholders (general)

#### 4.2.2.1 General demographics and husbandry practices

Table 9 shows respondents from each state as a percentage of the total responses, ranging from 12.9% (Western Australia) to 20.2% (South Australia).

Location by postcode of the distribution of smallholders responding to the survey, according to species kept, is shown in

Figure 2. Figure 3 and Figure 4 show the location by postcode of the distribution and receipt of questionnaires from Tasmanian and Victorian smallholders participating in the study. Return to senders and those respondents identified as being not in the target population were not included in the mapping data. It should also be noted that in some instances the postal address of the smallholder differed from the property location.

Table 9. Number of smallholders (general) by state[a] among 746 smallholders participating in an epidemiological study in Australia in 2013.

| State | Response, n(%) |
|---|---|
| New South Wales/ACT | 125 (16.8) |
| Victoria | 148 (19.8) |
| Tasmania | 126 (16.9) |
| South Australia | 151 (20.2) |
| Western Australia | 96 (12.9) |
| Queensland | 100 (13.4) |
| **Total** | **746** |

[a] Northern Territory not included in study due to reported low numbers of potential respondents

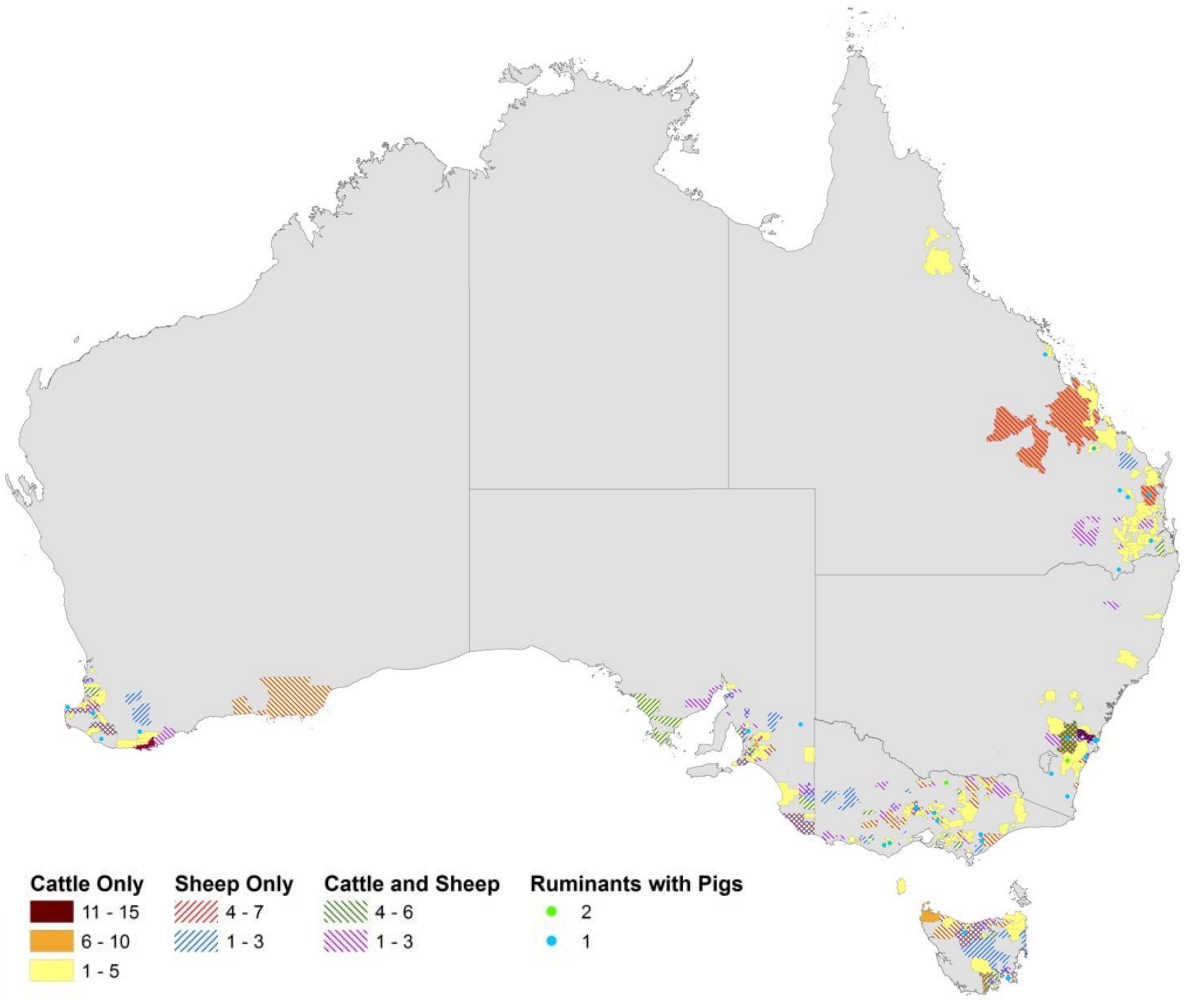


Figure 2. Distribution of smallholders (n = 746) participating in a survey during 2013 by postcode and according to the species kept.

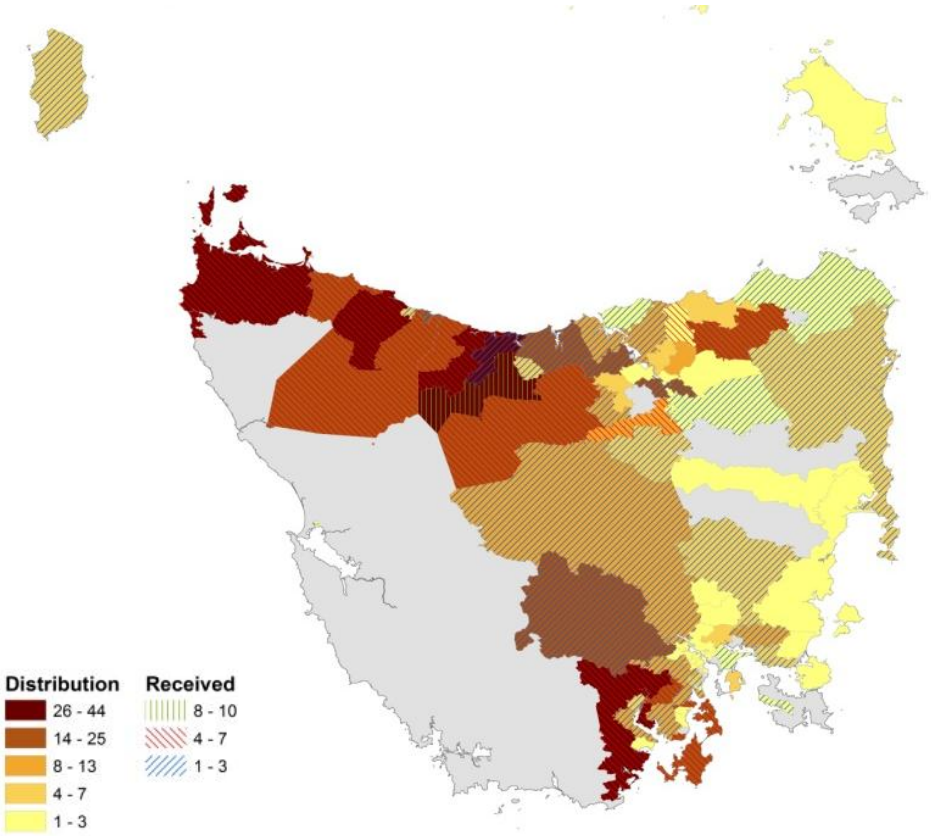


Figure 3. Location by postcode of the distribution (n = 636) and receipt (n = 126) of questionnaires for Tasmanian smallholders participating in the study.

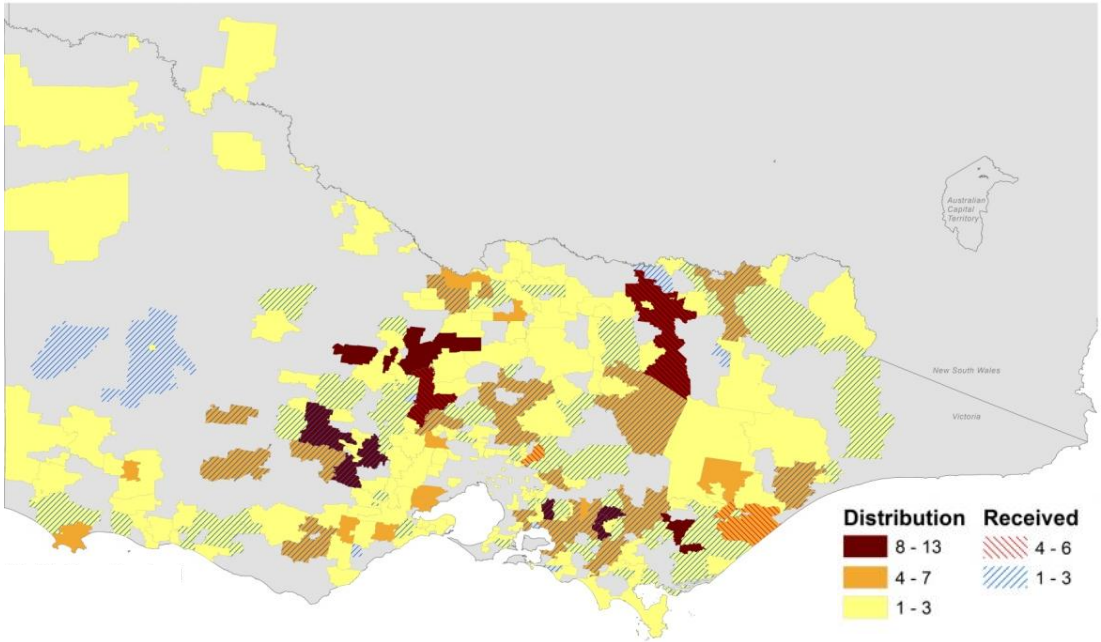


Figure 4. Location by postcode of the distribution (n=654) and receipt (n=148) of questionnaires for Victorian smallholders participating in the study.

The main demographic characteristics of the smallholders participating in the study are described in Table 10. The majority of respondents were male (67.5%), and over 45 years old, with the 55-64yr age group the most frequently observed (32.5%). The majority of respondents (78.7%) reported being from an Australian background.

Table 10. Demographic characteristics of 746 smallholders participating in an epidemiological study in Australia in 2013.

| **Characteristic** | **n(%) respondents** |
|---|---|
| *Age* | |
| 18-24y | 1(0.1) |
| 25-34y | 17(2.3) |
| 35-44y | 110(15.0) |
| 45-54y | 199(27.1) |
| 55-64y | 238(32.5) |
| +65y | 168(22.9) |
| *Sex* | |
| Male | 486(67.5) |
| Female | 234(32.5) |
| *Ethnic background* | |
| Australian | 541(78.7) |
| United Kingdom / Irish | 69(10.0) |
| Asian | 1(0.1) |
| European | 56(8.2) |
| Other | 20(2.9) |
| Size of property (hectares) | |
| <10 | 223(30.6) |
| 10 - 29 | 226(31.0) |
| 30 - 79 | 224(30.7) |
| >80 | 56(7.7) |
| *Undertake other agricultural/horticultural activities on property* | |
| Yes | 324(43.4) |
| *Involved in environmental activities on property* | |
| Yes | 329(44.1) |
| *How would you define your livestock operation* | |
| Self sufficiency | 126(16.9) |
| Hobby farmer | 453(60.7) |
| Lifestyle | 229(30.7) |
| Exhibition or rare breeds | 28(3.8) |
| Other | 78(10.5) |

Information received on the size of the property (in hectares) was categorised into four groups. The percentage of smallholders in each category was; less than 10 ha (30.6%); between 10 and 29 ha (31.0%); between 30 and 79 ha (30.7%) and more than 80 ha (7.7%). As expected, the property size was positively correlated with the number of cattle (Spearman's rank correlation, 0.676; $P< 0.001$) and sheep (Spearman's rank correlation, 0.354; $P< 0.001$) kept in the property.

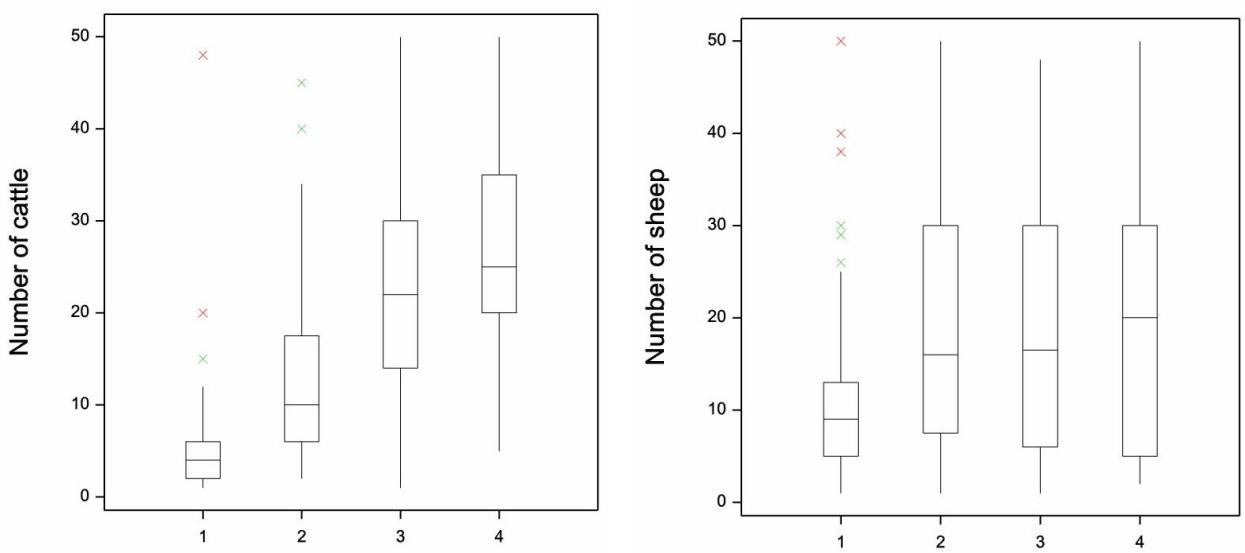


Figure 5. Boxplot representing the association between property size in hectares (X axis) and the number of cattle and sheep kept in the property (Y axis). Property size is categorized as follows: 1 <10ha; 2 = 10-29ha; 3= 30-79ha; 4 > 80ha. (Spearman's rank correlation = 0.676, number of cattle; 0.354, number of sheep; P<0.001).

Other agricultural/horticultural activities were undertaken by 43.4% of smallholders and 44.1% indicated that they were involved in biodiversity/conservation/environmental activities on the property. The majority of respondents, when asked to define their operation, selected hobby farmer as the definition (60.7%).

Information on the species of livestock kept and general husbandry of the smallholders participating in the study is presented in Table 11. The number of years involved with livestock ranged from 1 month to 80 years, with the average number of years involved being approximately 24 years. When categorised, 37.8% of respondents have been involved with livestock for over 30 years. The years involved with livestock was moderately correlated (Spearman's rank correlation, 0.401; P< 0.001) with the age of the producer (

Figure 6).

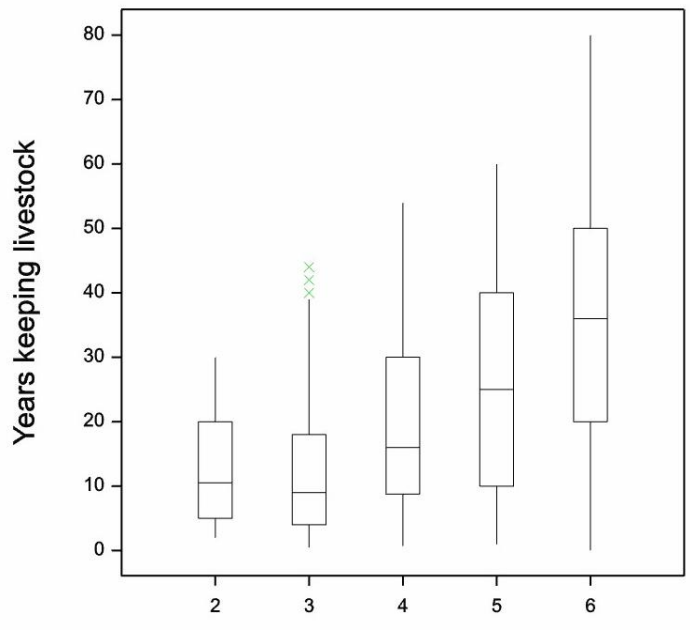

Figure 6. Boxplot representing the association between age of the producer (X axis) and the years keeping livestock (Y axis). Age is categorized as follows: 2 = 18–34y; 3 = 35-44y; 4=45-54y; 5=55-64y; 6≥65y. (Spearman's rank correlation = 0.401; P<0.001)

Cattle were the most commonly kept species (83.2%), followed by sheep (38.0%), with 4.7% of respondents keeping pigs. When further categorised, 60.6% of respondents reported keeping only cattle as compared to 17.0% keeping only sheep. As was expected due the parameters of the study, the number of cattle and sheep kept ranged from 1 to 50 head. The average number of animals kept was 15.8 for cattle and 15.4 for sheep. In addition to keeping cattle, sheep and/or pigs, 63.4% responded that they kept other animals on the property, with 31.3% keeping poultry and 31.8% keeping horses.

Figure 2 illustrates the survey respondents by postcode according to species kept.

Participants were asked the reasons for keeping livestock and were able to select more than one option. For those keeping cattle, extra income was the main reason (62.2%), whilst for those keeping sheep and pigs, home consumption was the most commonly selected reason (60.8% and 79.4%, respectively).

Table 12 shows the outcome of the multivariable logistic regression model investigating potential associations of the explanatory variables with how the smallholder defines their own operation.

Older producers (>55y old) were less likely (P=0.021) to define themselves as hobby farmers than younger producers. Those producers keeping between 6 and 15 cattle were more likely to choose this definition than other producers with less or more cattle. Regarding self-sufficiency, producers keeping cattle were less likely (P=0.006) to consider themselves a self-sufficient operation than those keeping cattle and sheep and/or pigs. The highest proportion of producers defining their operation as self-sufficient was among those keeping cattle, sheep and pigs (41.2%). In addition, those producers keeping poultry were also more likely (P<0.001) to consider themselves as self-sufficient.

Table 11. General husbandry description of 746 smallholders participating in an epidemiological study in Australia in 2013.

| | n(%) respondents | Min. | Max. | Mean | SD |
|---|---|---|---|---|---|
| Years *involved with livestock* | | .08 | 80.00 | 23.89 | 17.74 |
| 1-5y | 118(16.3) | | | | |
| 6-15y | 189(26.1) | | | | |
| 16 – 29y | 144(19.9) | | | | |
| >30 | 274(37.8) | | | | |
| *Species kept* | | | | | |
| Only Cattle | 452(60.6) | | | | |
| Only Sheep | 127(17.0) | | | | |
| Cattle and sheep | 133(17.8) | | | | |
| Ruminants and pigs | 34(4.6) | | | | |
| *Other species kept* | | | | | |
| Yes | 473(63.4) | | | | |
| Horses | 237(31.8) | | | | |
| Poultry | 233(31.3) | | | | |
| *Keep cattle on property* | | | | | |
| No | 124(16.8) | | | | |
| Yes | 614(83.2) | | | | |
| *No of cattle kept* | | 1 | 50 | 15.76 | 12.58 |
| 1 - 5 | 152(24.8) | | | | |
| 6 - 15 | 217(35.3) | | | | |
| 16 - 29 | 134(21.8) | | | | |
| >30 | 111(18.1) | | | | |
| *Reason for keeping cattle* | | | | | |
| Primary income | 27(4.4) | | | | |
| Extra income | 382(62.2) | | | | |
| Family tradition | 90(14.7) | | | | |
| Home consumption | 187(30.5) | | | | |
| Pet | 59(9.6) | | | | |
| *Keep sheep on property* | | | | | |
| No | 453(62.0) | | | | |
| Yes | 278(38.0) | | | | |
| *No of sheep kept* | | 1 | 50 | 15.36 | 12.47 |
| 1 - 5 | 68(24.5) | | | | |
| 6 - 15 | 109(39.2) | | | | |
| 16 - 29 | 49(17.6) | | | | |
| >30 | 52(18.7) | | | | |
| *Reason for keeping sheep* | | | | | |
| Primary income | 7(2.5) | | | | |
| Extra income | 79(28.4) | | | | |
| Family tradition | 16(5.8) | | | | |
| Home consumption | 169(60.8) | | | | |
| Pet | 47(16.9) | | | | |
| *Keep pigs on property* | | | | | |
| No | 695(95.4) | | | | |
| Yes | 34(4.7) | | | | |
| *No of sows kept* | | | | | |
| *0* | 11(32.4) | | | | |
| *1-10* | 22(64.7) | | | | |
| *>10* | 1(2.9) | | | | |
| *No of growers kept* | | | | | |
| *0* | 9(26.5) | | | | |
| *1-10* | 20(58.8) | | | | |
| *>10* | 5(14.7) | | | | |
| *Reason for keeping pigs* | | | | | |
| Primary income | 0(0) | | | | |
| Extra income | 11(32.4) | | | | |
| Family tradition | 3(8.8) | | | | |
| Home consumption | 27(79.4) | | | | |
| Pet | 7(20.6) | | | | |

Table 12. Multivariable logistic regression analysis of definition of livestock operation of 746 smallholders participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *How would you define your livestock operation? Hobby farmer* | | | | | | |
| Age | | | | | | 0.021 |
| 18-34 | 11(64.7) | -0.48 | 0.62 | 0.62 | (0.2-2.1) | |
| 35-44 | 77(70.0) | 0 | . | 1.00 | . | |
| 45-54 | 126(63.3) | -0.25 | 0.29 | 0.78 | (0.4–1.4) | |
| 55-64 | 131(55.0) | -0.81 | 0.28 | 0.45 | (0.3–0.8) | |
| >65 | 100(59.5) | -0.67 | 0.30 | 0.51 | (0.3–0.9) | |
| Number of cattle | | | | | | 0.011 |
| 1 – 5 | 86(56.6) | 0.09 | 0.26 | 1.10 | (0.7-1.8) | |
| 6 – 15 | 150(69.1) | 0.72 | 0.25 | 2.05 | (1.3-3.3) | |
| 16 – 29 | 85(63.4) | 0.39 | 0.27 | 1.47 | (0.9-2.5) | |
| 30 – 50 | 61(55.0) | 0 | . | 1.00 | . | |
| Gender | | | | | | 0.812 |
| *How would you define your livestock operation? Lifestyler* | | | | | | |
| Gender | | | | | | 0.037 |
| Male | 138(28.4) | 0 | . | 1.00 | . | |
| Female | 87(37.2) | 0.37 | 0.18 | 1.44 | (1.0–2.0) | |
| State | | | | | | 0.017 |
| NSW | 50(40.0) | 0 | . | 1.00 | . | |
| QLD | 31(31.0) | -0.31 | 0.30 | 0.73 | (0.4–1.3) | |
| SA | 40(26.5) | -0.63 | 0.27 | 0.53 | (0.3–0.9) | |
| TAS | 28(22.2) | -0.85 | 0.29 | 0.43 | (0.2–0.8) | |
| VIC | 43(29.1) | -0.55 | 0.27 | 0.57 | (0.3–1.0) | |
| WA | 37(38.5) | -0.05 | 0.29 | 0.95 | (0.5–1.7) | |
| Age | | | | | | 0.095 |
| *How would you define your livestock operation? Self sufficiency* | | | | | | |
| Species kept | | | | | | 0.006 |
| Sheep | 22(17.3) | 0.25 | 0.28 | 1.29 | (0.7–2.2) | |
| Cattle | 56(12.4) | 0 | . | 1.00 | . | |
| Cattle and sheep | 34(25.6) | 0.75 | 0.26 | 2.12 | (1.3–3.5) | |
| Cattle, sheep and pigs | 14(41.2) | 1.09 | 0.41 | 2.98 | (1.3–6.7) | |
| Poultry | | | | | | |
| No | 65 (12.7) | 0 | . | 1.00 | . | <0.001 |
| Yes | 61(26.2) | 0.83 | 0.22 | 2.30 | (1.5–3.5) | |
| Gender | | | | | | 0.185 |
| Age | | | | | | 0.566 |

#### 4.2.2.2 Animal movements

A description of practices of smallholders in relation to animal movements is shown in Table 13. With regards to animal movements within the previous 12 months, movements off the property (67.6%) were reported to occur more than introductions to the property (48.7%). For those smallholders reporting introductions, other farms were the most common source.

Most exits from the property were to saleyards. Whilst exit to an abattoir was not a set response option, 69.0% of respondents reporting an "other" destination identified this as being an abattoir. Keeping records of animal movements was reported by 83.4% of respondents, with a paper based method being the most commonly used (68.2%). Most respondents reported having a Property Identification Code (PIC) (96.2%); however caution must be exercised in interpreting this high affirmative response as the majority of participants were selected based on the livestock numbers associated with their PIC.

Producers from Queensland (11.8%) and Victoria (8.3%) were less likely (P=0.004) to have moved animals directly to an abattoir than producers from other states (21.8 to 26.8%). Movements of animals off the property to another farm were significantly associated with the number of sheep kept in the property and the years owning livestock. A lower proportion of producers with 30 to 50 sheep than the proportion among producers with less than 30 sheep did move animals to another farm; however, results should be interpreted with caution because only a low number of producers moved animals to another farm (Table 15).

Table 14 and

Table 15 show the outcome of the multivariable logistic regression models investigating associations of the livestock movement practices and the explanatory variables considered in this study. The proportion of producers introducing new animals in the last year differed according to the species kept (P<0.001). A lower proportion of producers keeping only sheep reported having introduced animals than producers keeping other animal species (cattle, cattle and sheep or cattle, sheep and pigs). The majority of producers keeping pigs in addition to ruminants (73.5%) introduced animals in the previous 12 months. Similarly, introductions from saleyards were less likely among producers keeping only sheep (P=0.002). In contrast, producers keeping only sheep were more likely to introduce animals from another farm (P<0.001) than producers keeping only cattle (OR, 0.13; 0.0 – 0.4). However, no significant difference was identified among producers keeping sheep with or without cattle and/or pigs.

Interestingly, a lower proportion of producers from South Australia reported introducing animals than producers from other states (P =0.001). In addition, knowledge on biosecurity was also associated with the practice of introducing animals in the previous 12 months (P=0.037) (*see section 4.2.2.3 for biosecurity knowledge*). Fewer producers with better knowledge introduced animals than among producers with poorer knowledge (P=0.037). The property size was also associated (P=0.008) with the introduction of animals from saleyards, with those producers with properties between 10 and 79 ha being more likely to introduce animals from this source than producers with smaller or larger properties.

Species kept, the years owning livestock and the property size were significantly associated with having moved livestock off the property in the last 12 months (Table 15). Similar to the introductions, fewer (P<0.001) producers keeping only sheep (42.7%) moved animals off the property than producers keeping other species (67.6% – 74.0%). The same was observed regarding moving animals to saleyards. Data suggest that the more years a producer has been owning livestock the more likely animals are moved off the property (P<0.001); with almost 80% of producers who have owned livestock for over 30 years having moved animals off the property in the past year compared to only 53.0% among producers who have only owned livestock for 5 years or less. In addition, movement of animals off the property increased with property size (P=0.005).

Table 13. Practices in relation to animal movements of 746 smallholders participating in an epidemiological study in Australia in 2013.

| Practice | n(%) respondents |
|---|---|
| *Did you introduce livestock in the last 12 months?* | |
| No | 377(51.2) |
| Yes | 359(48.7) |
| *Did you introduce livestock from the saleyard?* | |
| No | 191(53.2) |
| Yes | 168(46.8) |
| *Did you introduce livestock from another farm?* | |
| No | 144(40.1) |
| Yes | 215(59.9) |
| *Did you introduce livestock from another source?* | 42(9.9) |
| *Did you move livestock off your property in the last 12 months?* | |
| No | 237(32.4) |
| Yes | 494(67.6) |
| *Did you move livestock to a saleyard?* | |
| No | 155(31.4) |
| Yes | 339(68.6) |
| *Did you move livestock to another farm?* | |
| No | 367(74.3) |
| Yes | 127(25.7) |
| *Did you move livestock to another destination?* | |
| Abattoir/slaughter | 107(69.0) |
| Saleyard /feedlot; | 10(6.5) |
| Other property | 19(12.3) |
| Undefined | 19(12.3) |
| *Do you keep records of movements?* | |
| No | 118(16.6) |
| Yes | 594(83.4) |
| *Method of recording movements* | |
| Paper | 405(68.2) |
| Computer | 150(25.3) |
| Whiteboard | 4(0.7) |
| *Does your property have a Property Identification Code?* | |
| No | 14(1.9) |
| Yes | 703(96.2) |
| Don't know | 14(1.9) |

Producers from Queensland (11.8%) and Victoria (8.3%) were less likely (P=0.004) to have moved animals directly to an abattoir than producers from other states (21.8 to 26.8%). Movements of animals off the property to another farm were significantly associated with the number of sheep kept in the property and the years owning livestock. A lower proportion of producers with 30 to 50 sheep than the proportion among producers with less than 30 sheep did move animals to another farm; however, results should be interpreted with caution because only a low number of producers moved animals to another farm (Table 15).

Table 14. Multivariable logistic regression analysis of practices related to the introduction of animals of 746 smallholders participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Did you introduce new animals onto your property in the previous 12 months?* | | | | | | |
| Species kept | | | | | | |
| Sheep | 34(27.9) | -0.73 | 0.27 | 0.48 | (0.3 –0.8) | <0.001 |
| Cattle | 224(49.9) | 0 | . | 1.00 | . | |
| Cattle and sheep | 76(58.0) | 0.48 | 0.25 | 1.61 | (1.0 –2.6) | |
| Cattle, sheep and pigs | 25(73.5) | 0.85 | 0.50 | 2.35 | (0.9 –6.2) | |
| State | | | | | . | 0.011 |
| NSW | 74(59.2) | 0.04 | 0.31 | 1.04 | (0.6 –1.9) | |
| QLD | 57(57.6) | -0.03 | 0.36 | 0.97 | (0.5 –2.0) | |
| SA | 47(31.8) | -0.99 | 0.33 | 0.37 | (0.2 –0.7) | |
| TAS | 59(47.2) | -0.21 | 0.32 | 0.81 | (0.4 –1.5) | |
| VIC | 75(51.7) | -0.03 | 0.32 | 0.97 | (0.5 –1.8) | |
| WA | 47(50.0) | 0 | . | 1.00 | . | |
| Define biosecurity | | | | | | |
| No-poor | 151 (53.0) | 0 | . | 1.00 | . | 0.037 |
| Mod-High | 125(47.9) | -0.39 | 0.19 | 0.68 | (0.5 –0.9) | |
| Age | | | | | | 0.110 |
| Gender | | | | | | 0.407 |
| *Did you introduce animals from a saleyard?* | | | | | | |
| Gender | | | | | | 0.014 |
| Male | 116(50.4) | 0 | . | 1.00 | . | |
| Female | 43(36.4) | -0.62 | 0.25 | 0.54 | (0.3 – 0.9) | |
| Species kept | | | | | | 0.002 |
| Sheep | 5(14.7) | 0 | . | 1.00 | . | |
| Cattle | 123(54.9) | 1.67 | 0.53 | 5.29 | (1.9 – 14.8) | |
| Cattle and sheep | 30(39.5) | 1.09 | 0.56 | 2.98 | (1.0 – 9.0) | |
| Cattle, sheep and pigs | 10(40.0) | 0.64 | 0.69 | 1.91 | (0.5 – 7.4) | |
| Property hectares | | | | | | 0.008 |
| < 10 | 30(31.2) | 0 | . | 1.00 | . | |
| 10 – 29 | 59(56.7) | 0.90 | 0.32 | 2.45 | (1.3 – 4.6) | |
| 30 – 79 | 65(53.3) | 0.66 | 0.31 | 1.93 | (1.1 – 3.5) | |
| ≥ 80 | 12(37.5) | -0.19 | 0.46 | 0.82 | (0.3 – 2.0) | |
| Age | | | | | | 0.375 |
| *Did you introduce animals from another farm?* | | | | | | |
| Species kept | | | | | | <0.001 |
| Sheep | 30(88.2) | 0 | . | 1.00 | . | |
| Cattle | 112(50.0) | -2.03 | 0.56 | 0.13 | (0.0 – 0.4) | |
| Cattle and sheep | 55(72.4) | -1.14 | 0.60 | 0.32 | (0.1 – 1.0) | |
| Cattle, sheep and pigs | 18(72.0) | -0.88 | 0.72 | 0.41 | (0.1 – 1.7) | |
| Age | | | | | | 0.193 |
| Gender | | | | | | 0.066 |

Table 15. Multivariable logistic regression analysis of practices related to the movement of animals off the property of 746 smallholders participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Did you move any animals off your property in the previous 12 months?* | | | | | | |
| Species kept | | | | | | |
| Sheep | 53(42.7) | 0 | . | 1.00 | . | <0.001 |
| Cattle | 321(72.6) | 0.93 | 0.24 | 2.53 | (1.6 – 4.0) | |
| Cattle and sheep | 97(74.0) | 1.12 | 0.31 | 3.06 | (1.7 – 5.6) | |
| Cattle, sheep and pigs | 23(67.6) | 0.80 | 0.46 | 2.23 | (0.9 – 5.5) | |
| Years owning livestock | | | | | | <0.001 |
| 1 – 5 | 61(53.0) | 0 | . | 1.00 | . | |
| 6 – 15 | 118(63.1) | 0.23 | 0.26 | 1.26 | (0.8 – 2.1) | |
| 16 – 29 | 96(67.1) | 0.66 | 0.29 | 1.94 | (1.1 – 3.4) | |
| ≥ 30 | 209(78.9) | 1.25 | 0.28 | 3.49 | (2.0 – 6.0) | |
| Property hectares | | | | | | |
| < 10 | 121(55.0) | 0 | . | 1.00 | . | 0.005 |
| 10 – 29 | 156(69.6) | 0.52 | 0.22 | 1.68 | (1.1 – 2.6) | |
| 30 – 79 | 169(78.2) | 0.83 | 0.24 | 2.29 | (1.4 – 3.7) | |
| ≥ 80 | 43(78.2) | 0.63 | 0.38 | 1.87 | (0.9 – 3.9) | |
| Age | | | | | | 0.087 |
| Gender | | | | | | 0.767 |
| *Did you move animals to a saleyard?* | | | | | | |
| Species kept | | | | | | 0.039 |
| Sheep | 26(49.1) | 0 | . | 1.00 | . | |
| Cattle | 231(72.0) | 0.87 | 0.31 | 2.40 | (1.3 – 4.4) | |
| Cattle and sheep | 66(68.0) | 0.74 | 0.36 | 2.10 | (1.0 – 4.3) | |
| Cattle, sheep and pigs | 16(69.6) | 1.04 | 0.56 | 2.82 | (0.9 – 8.5) | |
| Age | | | | | | 0.512 |
| Gender | | | | | | 0.167 |
| *Did you move animals to an abattoir?* | | | | | | |
| State | | | | | | 0.004 |
| NSW | 22(26.8) | 0 | . | 1.00 | . | |
| QLD | 10(11.8) | -1.08 | 0.44 | 0.34 | (0.1-0.8) | |
| SA | 27(21.8) | -0.18 | 0.34 | 0.84 | (0.4-1.6) | |
| TAS | 23(22.3) | -0.28 | 0.36 | 0.75 | (0.4-1.5) | |
| VIC | 10(8.3) | -1.47 | 0.44 | 0.23 | (0.1-0.5) | |
| WA | 15(23.4) | -0.18 | 0.93 | 0.83 | (0.4-1.8) | |
| Age | | | | | | 0.542 |
| Gender | | | | | | 0.452 |
| *Did you move animals to another farm?* | | | | | | |
| Number of sheep | | | | | | 0.024 |
| 1 – 5 | 11(28.9) | 1.34 | 0.75 | 3.81 | (0.9 – 16.4) | |
| 6 – 15 | 21(36.8) | 1.68 | 0.70 | 5.37 | (1.4 – 21.3) | |
| 16 – 29 | 17(53.1) | 2.24 | 0.75 | 9.45 | (2.2 – 40.7) | |
| 30 - 50 | 4(11.8) | 0 | . | 1.00 | . | |
| Years owning livestock | | | | | | 0.027 |
| 1 – 5 | 22(36.1) | 0 | . | 1.00 | . | |
| 6 – 15 | 37(31.4) | -0.17 | 0.58 | 0.84 | (0.3 – 2.6) | |
| 16 – 29 | 20(20.8) | -1.14 | 0.68 | 0.32 | (0.1 – 1.2) | |
| ≥ 30 | 45(21.5) | -1.53 | 0.60 | 0.22 | (0.1- 0.7) | |
| Age | | | | | | 0.358 |
| Gender | | | | | | 0.375 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Do you keep records of animal movements?* | | | | | | |
| Species kept | | | | | | 0.022 |
| Sheep | 83(68.0) | 0 | . | 1.00 | . | |
| Cattle | 370(85.5) | 0.56 | 0.26 | 1.76 | (1.1 – 2.9) | |
| Cattle and sheep | 112(89.6) | 1.04 | 0.39 | 2.83 | (1.3 – 6.1) | |
| Cattle, sheep and pigs | 29(90.6) | 1.24 | 0.66 | 3.47 | (1.0 – 12.6) | |
| Property hectares | | | | | | <0.001 |
| < 10 | 148(70.5) | 0 | . | 1.00 | . | |
| 10 – 29 | 184(85.6) | 0.77 | 0.26 | 2.16 | (1.3 – 3.6) | |
| 30 – 79 | 201(92.2) | 1.41 | 0.32 | 4.10 | (2.2 – 7.6) | |
| ≥ 80 | 50(92.6) | 1.47 | 0.55 | 4.37 | (1.5 – 12.8) | |
| Age | | | | | | 0.528 |
| Gender | | | | | | 0.888 |
| *Do you keep records of animal movements in a computer?* | | | | | | |
| Species kept | | | | | | 0.014 |
| Sheep | 11(13.3) | 0 | . | 1.00 | . | |
| Cattle | 93(25.1) | 0.84 | 0.36 | 2.31 | (1.2 – 4.7) | |
| Cattle and sheep | 31(27.7) | 0.89 | 0.40 | 2.44 | (1.1 – 5.3) | |
| Cattle, sheep and pigs | 15(51.7) | 1.64 | 0.52 | 5.17 | (1.9 – 14.2) | |
| Years owning livestock | | | | | | |
| 1 – 5 | 35(38.0) | 0 | . | 1.00 | . | 0.02 |
| 6 – 15 | 44(28.8) | -0.47 | 0.30 | 0.62 | (0.3 – 1.1) | |
| 16 – 29 | 21(18.8) | -0.99 | 0.34 | 0.37 | (0.2 – 0.7) | |
| ≥ 30 | 46(20.6) | -0.76 | 0.30 | 0.47 | (0.3 – 0.8) | |
| Age | | | | | | 0.116 |
| Gender | | | | | | 0.421 |

Producers with only sheep and those with the smallest property size (<10 ha) were less likely to keep records of animals movements other producers. However, the majority of producers kept records of movements as previously stated. Keeping records of animal movements in a computer was more likely among producers keeping only cattle and cattle with pigs and/or sheep than among producers keeping only sheep (P=0.014). Moreover, those producers who have kept livestock for 5 or less years were more likely (P=0.02) to use a computer to record animal movements than producers with more years of experience.

#### 4.2.2.3 Biosecurity knowledge and practices

Biosecurity practices and knowledge of smallholders are shown in
Table 16 and the outcomes of the multivariable logistic regression analysis investigating potential associations of these practices and the explanatory variables are described in Table 17.

The level of understanding of the term biosecurity among smallholders was variable, with almost half of the responses defining the term biosecurity indicating at least a moderate level of understanding of the term. However, biosecurity practices related to animal handlers and visitors were generally inadequate, with most respondents not following correct protocols. The median of the average number of times per year that animal handlers with close contact with livestock visited the property was 2, with a 25-75 percentile between 1 and 3. Only 16.7% reported keeping visitor records, most would not provide overalls for visitors and over half of respondents would not require visitors to wash their hands when handling animals. Moreover, over 40% of producers reported not isolating incoming livestock, with the most frequently reported reason for not isolating being the perception

that there was no need on their property. Among those producers who reported isolating incoming animals, the average number of days of isolation was 14.2 days.

Table 16. Biosecurity practices and knowledge reported by 746 smallholders participating in an epidemiological study in Australia in 2013.

| **Biosecurity practice** | | | **n(%) respondents** |
|---|---|---|---|
| *Are animal handlers required to wash hands before and after handling livestock* | | | |
| No | | | 392(59.6) |
| Yes | | | 266(40.4) |
| *Number of animal handlers* | *Minimum* | *Average* | *Maximum* |
| Mean | 1.45 | 2.71 | 3.79 |
| Sd | 2.88 | 4.23 | 5.80 |
| Median | 1 | 2 | 2 |
| Min – Max | 0 – 40 | 0 – 45 | 0 – 52 |
| 25 – 75% | 0 - 2 | 1 - 3 | 1 - 4 |
| *Are visitors with contact with livestock provided with clothes/overalls?* | | | |
| No | | | 628(94.7) |
| Yes | | | 35(5.3) |
| *Do you keep records of visitors?* | | | |
| No | | | 559(83.3) |
| Yes | | | 112(16.7) |
| *Do you isolate incoming livestock?* | | | |
| No | | | 191(41.9) |
| Yes | | | 265(58.1) |
| Number of days isolated | | | |
| Mean | 14.2 | | |
| Sd | 20.1 | | |
| Min – Max | 1 - 183 | | |
| *Reasons for not isolating* | | | |
| Lack of time | | | 10(5.2) |
| Lack of space | | | 26(13.6) |
| Lack of money | | | 4(2.1) |
| No need on property | | | 108(56.5) |
| Unaware of reason | | | 30(15.7) |
| *How would you define biosecurity* | | | |
| No understanding | | | 129(23.5) |
| Low level of understanding | | | 156(28.4) |
| Moderate level of understanding | | | 225(40.9) |
| High level of understanding | | | 40(7.3) |

More females (56.7%) than males (44.1%) described the term biosecurity with a moderate to high understanding of the term (Table 17). Although property size was significantly associated with the biosecurity knowledge (P=0.011), interpretation of the outcomes of the logistic regression model is not straight forward. According to the model those producers with properties with 10 to 29 ha and those with more than 80 ha have better biosecurity knowledge than producers with less than 10 ha and those with 30 to 79 ha. Producers from Western Australia had a significantly better (P=0.012) knowledge of what biosecurity means than producers from other states (except NSW, which did not significantly differ; OR, 0.62; 0.4-1.1).

Table 17. Multivariable logistic regression analysis of biosecurity related practices of 746 smallholders participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Producer understanding of the term biosecurity – No and low understanding compared to moderate and high understanding* | | | | | | |
| Gender | | | | | | 0.007 |
| Male | 157(44.1) | 0 | . | 1.00 | . | |
| Female | 102(56.7) | 0.54 | 0.20 | 1.71 | (1.2 – 2.5) | |
| Property hectares | | | | | | 0.011 |
| < 10 | 59(39.3) | -0.73 | 0.24 | 0.48 | (0.3 – 0.8) | |
| 10 – 29 | 95(56.2) | 0 | . | 1.00 | . | |
| 30 – 79 | 87(47.0) | -0.52 | 0.23 | 0.59 | (0.4 – 0.9) | |
| ≥ 80 | 21(58.3) | -0.00 | 0.41 | 0.99 | (0.5 – 2.2) | |
| State | | | | | | 0.012 |
| NSW | 58(53.7) | -0.48 | 0.31 | 0.62 | (0.4 – 1.1) | |
| QLD | 28(40.0) | -1.08 | 0.37 | 0.34 | (0.2 – 0.7) | |
| SA | 39(39.4) | -1.11 | 0.33 | 0.33 | (0.2 – 0.6) | |
| TAS | 39(44.3) | -0.87 | 0.34 | 0.42 | (0.2 – 0.8) | |
| VIC | 49(48.0) | -0.62 | 0.33 | 0.54 | (0.3 – 1.0) | |
| WA | 52(62.7) | 0 | . | 1.00 | . | |
| Age | | | | | | 0.289 |
| *Do you require animal handlers to wash their hands before and after handling your animals?* | | | | | | |
| Number of cattle | | | | | | 0.011 |
| 1 – 5 | 56(42.7) | -0.07 | 0.24 | 0.93 | (0.6 – 1.5) | |
| 6 – 15 | 91(47.2) | 0 | . | 1.00 | . | |
| 16 – 29 | 38(31.9) | -0.82 | 0.26 | 0.44 | (0.3 – 0.7) | |
| 30 - 50 | 39(37.9) | -0.45 | 0.27 | 0.64 | (0.4 – 1.1) | |
| State | | | | | | 0.043 |
| NSW | 45(38.1) | -0.71 | 0.33 | 0.49 | (0.3 – 0.9) | |
| QLD | 46(56.8) | 0 | . | 1.00 | . | |
| SA | 47(38.2) | -0.92 | 0.35 | 0.40 | (0.2 – 0.8) | |
| TAS | 39(35.8) | -1.09 | 0.35 | 0.33 | (0.2 – 0.7) | |
| VIC | 57(40.4) | -0.89 | 0.33 | 0.41 | (0.2 – 0.8) | |
| WA | 32(37.2) | -0.70 | 0.36 | 0.50 | (0.2 – 1.0) | |
| Age | | | | | | 0.802 |
| Gender | | | | | | 0.104 |
| *Do you keep records of visitors?* | | | | | | |
| Property hectares | | | | | | 0.003 |
| < 10 | 22(10.9) | 0 | . | 1.00 | . | |
| 10 – 29 | 31(15.6) | 0.38 | 0.31 | 1.46 | (0.8 – 2.6) | |
| 30 – 79 | 43(20.5) | 0.76 | 0.29 | 2.14 | (1.2 – 3.8) | |
| ≥ 80 | 15(31.2) | 1.32 | 0.39 | 3.73 | (1.7 – 8.0) | |
| Gender | | | | | | 0.032 |
| Male | 63(14.4) | 0 | . | 1.00 | . | |
| Female | 45(20.8) | 0.48 | 0.23 | 1.62 | (1.1 – 2.5) | |
| Age | | | | | | 0.631 |
| *Do you isolate incoming animals upon arrival?* | | | | | | |
| Species kept | | | | | | 0.012 |
| Sheep | 20(37.0) | 0 | . | 1.00 | . | |
| Cattle | 172(61.9) | 1.03 | 0.32 | 2.81 | (1.5 – 5.2) | |
| Cattle and sheep | 56(58.3) | 0.90 | 0.36 | 2.46 | (1.2 – 5.0) | |
| Cattle, sheep and pigs | 17(60.7) | 1.09 | 0.50 | 2.98 | (1.1 – 8.0) | |
| Age | | | | | | 0.809 |
| Gender | | | | | | 0.195 |

| *Average number of animal handlers that have close contact with your livestock visit your property in 12 mnths** | | | | | |
|---|---|---|---|---|---|
| | **Mean (SD)** | ***B*** | **SE** | **95%CI estimate** | |
| Number of cattle | | | | | <0.001 |
| 1 – 5 | 1.79(2.34) | -3.07 | 0.70 | (-4.4, -1.7) | |
| 6 – 15 | 2.27(4.24) | -2.46 | 0.62 | (-3.7, -1.2) | |
| 16 – 29 | 2.74(2.79) | -1.88 | 0.66 | (-3.2, -0.6) | |
| 30 - 50 | 4.62(6.73) | 0 | . | . | |
| Gender | | | | | 0.015 |
| Male | 2.31(3.36) | 0 | . | . | |
| Female | 3.50(5.50) | 1.38 | 0.47 | (0.4, 2.3) | |
| Age | | | | | 0.429 |

*Linear regression

The average number of animal handlers per year with close contact with the livestock was significantly associated with the number of cattle kept in the property, with producers with 1 to 5 cattle having a lower average (1.79 animal handlers) than producers with more cattle (2.27 to 4.62).

The models suggest that producers with less number of cattle are more likely to require animal handlers to wash their hands when handling their livestock (P=0.011); with a higher proportion of producers with 6 to 15 cattle (47.2%) requiring this practice than this proportion among producers with 16 to 29 cattle (31.9%). However, no significant difference was observed between the proportion of producers requiring hands to be washed among producers keeping 30 to 50 cattle (37.9%) and among producers keeping 1 to 5 cattle (42.7%) and the reference category (16 to 29 cattle). More producers from Queensland (56.8%) reported requiring animal handlers to wash their hands than producers from other states (35.8 to 40.4%).

Although overall, most producers would not keep visitor records, the data suggest that females are more likely to keep a record of visitors than males (OR, 1.62; 1.1 – 2.5; P=0.032), and these records are less likely to be kept in the smallest properties (P=0.003).

#### 4.2.2.4 Health and management practices

A description of the herd/flock health management practices reported by the smallholders participating in the current study is shown in Table 18. Most smallholders would inspect their livestock daily or weekly and over half would record animal treatments, disease and deaths. With regards to contact with veterinarians, 35.2% reported that they had been in contact with a veterinarian in the last 12 months; however, of those who had not been in contact with a veterinarian, 27% reported that they had never contacted a vet regarding the health of their livestock.

Producers were asked what they would do if they saw symptoms of disease or unusual behaviour in their livestock and provided with several non-exclusive options (Table 18) with three frequency responses (always, sometimes or never). The majority of producers would treat themselves (22.9% always; 71.3% sometimes), call a neighbour/friend/other producer (24.1% always; 64.3% sometimes) and call a veterinarian (34.4% always; 61.1% sometimes). Almost half of producers would never call the State Department of Primary Industries or Agriculture and most (68.2%) would never call the exotic disease hotline. Of concern is the 33.3% and 2.7% of producers who reported that they would do nothing in the event of unusual symptoms, always or sometimes, respectively.

Table 18. Herd/Flock health and management behaviour reported by 746 smallholders participating in an epidemiological study in Australia in 2013.

| **Health management practice** | **n(%) respondents** | | |
|---|---|---|---|
| *How often do you inspect livestock?* | | | |
| *Cattle* | | | |
| Daily | 375(62.3) | | |
| Weekly | 200(33.2) | | |
| Fortnightly | 21(3.5) | | |
| Monthly | 6(1.0) | | |
| *Sheep* | | | |
| Daily | 184(66.9) | | |
| Weekly | 76(27.6) | | |
| Fortnightly | 6(2.2) | | |
| Monthly | 9(3.3) | | |
| *Pigs* | | | |
| Daily | 32(97.0) | | |
| Weekly | 1(3.0) | | |
| Fortnightly | 0 | | |
| Monthly | 0 | | |
| *Do you record the number of animals with disease?* | | | |
| No | 290(45.2) | | |
| Yes | 351(54.8) | | |
| *Do you record the number of animals that died or were euthanased?* | | | |
| No | 239(36.5) | | |
| Yes | 416(63.5) | | |
| *Do you record treatment routine* | | | |
| No | 216(33.7) | | |
| Yes | 425(66.3) | | |
| *Have you contacted a vet in the last 12mths[a]?* | | | |
| No | 474(64.8) | | |
| Yes | 257(35.2) | | |
| *If no, last time veterinarian contacted* | | | |
| Never | 116(27.0) | | |
| 1-2 yrs ago | 119(27.7) | | |
| 3-5yrs ago | 108(25.1) | | |
| >5yrs ago | 87(20.2) | | |
| *What would you do if you saw symptoms of disease or unusual behaviour in their livestock?* | | | |
| | Always | Sometimes | Never |
| Do nothing – it will get better with time | 14(2.7) | 170(33.3) | 327(64.0) |
| Treat myself | 134(22.9) | 417(71.3) | 34(5.8) |
| Call a neighbour / friend / other producer | 135(24.1) | 361(64.3) | 65(11.6) |
| Call a veterinarian | 237(34.4) | 421(61.1) | 31(4.5) |
| Call the livestock agent / sale yard | 27(5.3) | 130(25.4) | 355(69.3) |
| Call the Dept. of Primary Ind./Agriculture | 43(8.2) | 226(42.9) | 258(49.0) |
| Call the exotic disease hotline | 29(5.8) | 129(26.0) | 339(68.2) |

[a]4 additional smallholders indicated that they were veterinarians

Results of the multivariable logistic regression models investigating practices in relation to contact with the veterinarian and record keeping are detailed in Table 19. In addition, Table 20 shows results of the logistic regression analyses in relation to frequency of livestock inspection and communication practices and attitudes in the event of livestock disease or unusual behaviour.

Table 19. Multivariable logistic regression analysis of herd/flock and health management (veterinary contact and information recording) related practices of 746 smallholders participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Have you contacted a veterinarian in the last 12 months regarding the health of your livestock?* | | | | | | |
| Species kept | | | | | | 0.008 |
| Sheep | 37(29.8) | -0.62 | 0.25 | 0.54 | (0.3 – 0.9) | |
| Cattle | 154(34.6) | -0.35 | 0.33 | 0.70 | (0.4 – 1.4) | |
| Cattle and sheep | 60(46.2) | 0 | . | 1.00 | . | |
| Cattle, sheep and pigs | 6(18.8) | -1.84 | 0.61 | 0.16 | (0.1 – 0.5) | |
| Horses in the property | | | | | | |
| No | 144(28.3) | 0 | . | 1.00 | . | <0.001 |
| Yes | 113(49.1) | 0.90 | 0.21 | 2.45 | (1.6 – 3.7) | |
| Biosecurity knowledge | | | | | | |
| No-poor | 90 (31.5) | 0 | . | 1.00 | . | 0.006 |
| Mod-High | 117(45.2) | 0.54 | 0.20 | 1.72 | (1.2 – 2.5) | |
| Property hectares | | | | | | |
| < 10 | 70(31.8) | -0.39 | 0.26 | 0.67 | (0.4–1.1) | 0.012 |
| 10 – 29 | 68(30.8) | -0.71 | 0.24 | 0.49 | (0.3 – 0.8) | |
| 30 – 79 | 93(41.9) | 0 | . | 1.00 | . | |
| ≥ 80 | 20(38.5) | 0.28 | 0.41 | 1.32 | (0.6 – 3.0) | |
| Age | | | | | | 0.500 |
| Gender | | | | | | 0.141 |
| *Do you record the number of animals with disease?* | | | | | | |
| Gender | | | | | | 0.001 |
| Male | 219(51.0) | 0 | . | 1.00 | . | |
| Female | 123(63.1) | 0.63 | 0.19 | 1.87 | (1.3 – 2.7) | |
| Species kept | | | | | | 0.002 |
| Sheep | 39(35.5) | 0 | . | 1.00 | . | |
| Cattle | 239(60.7) | 0.89 | 0.24 | 2.43 | (1.5 – 3.9) | |
| Cattle and sheep | 59(53.6) | 0.63 | 0.29 | 1.89 | (1.1 – 3.3) | |
| Cattle, sheep and pigs | 14(51.9) | 0.42 | 0.48 | 1.53 | (0.6 – 3.9) | |
| State | | | | | | <0.001 |
| NSW | 84(76.4) | 0 | . | 1.00 | . | |
| QLD | 50(60.2) | -0.82 | 0.33 | 0.44 | (0.2 – 0.8) | |
| SA | 52(42.3) | -1.43 | 0.31 | 0.24 | (0.1 – 0.4) | |
| TAS | 57(49.1) | -1.18 | 0.31 | 0.31 | (0.2 – 0.6) | |
| VIC | 65(51.2) | -1.20 | 0.30 | 0.30 | (0.2 – 0.5) | |
| WA | 43(52.4) | -1.00 | 0.33 | 0.37 | (0.2 – 0.7) | |
| Age | | | | | | 0.734 |
| *Do you record the number of animals that died or were euthanased?* | | | | | | |
| Gender | | | | | | 0.002 |
| Male | 261(60.0) | 0 | . | 1.00 | . | |
| Female | 144(71.3) | 0.62 | 0.20 | 1.86 | (1.3 – 2.8) | |
| Species kept | | | | | | 0.027 |
| Sheep | 48(41.7) | 0 | . | 1.00 | . | |
| Cattle | 270(68.7) | 0.71 | 0.24 | 2.03 | (1.3 – 3.3) | |
| Cattle and sheep | 80(68.4) | 0.73 | 0.31 | 2.08 | (1.1 – 3.8) | |
| Cattle, sheep and pigs | 18(60.0) | 0.53 | 0.47 | 1.70 | (0.7 – 4.3) | |
| Property hectares | | | | | | <0.001 |
| < 10 | 86(45.3) | 0 | . | 1.00 | . | |
| 10 – 29 | 127(62.9) | 0.56 | 0.22 | 1.75 | (1.1 – 2.7) | |
| 30 – 79 | 156(77.6) | 1.20 | 0.24 | 3.33 | (2.1 – 5.4) | |
| ≥ 80 | 41(82.0) | 1.71 | 0.43 | 5.54 | (2.4 –12.7) | |
| Age | | | | | | 0.526 |
| *Do you record treatment routines?* | | | | | | |
| Biosecurity knowledge | | | | | | 0.016 |
| No-poor | 157(63.1) | 0 | . | 1.00 | . | |
| Mod-High | 176(75.5) | 0.51 | 0.21 | 1.67 | (1.1 – 2.5) | |
| Property hectares | | | | | | <0.001 |
| <10 | 104(55.6) | 0 | . | 1.00 | . | |
| 10 –29 | 133(65.8) | 0.48 | 0.26 | 1.62 | (1.0 – 2.7) | |
| 30 – 79 | 145(75.1) | 1.01 | 0.27 | 2.74 | (1.6 – 4.6) | |
| ≥ 80 | 37(80.4) | 1.50 | 0.56 | 4.49 | (1.5 – 13.6) | |
| Age | | | | | | 0.494 |
| Gender | | | | | | 0.142 |

Producers keeping cattle and sheep (46.2%) were more likely to have contacted a veterinarian than other producers (P=0.008), with the lowest proportion of producers having contact a veterinarian being reported among producers keeping cattle, sheep and pigs (18.8%). Producers keeping horses

were also more likely to have contacted a veterinarian in the past year than those producers without horses (OR, 2.45; 1.6 – 3.7; P<0.001). Interestingly, those producers who had a moderate to high understanding of biosecurity were also more likely to have contacted a veterinarian (OR, 1.72; 1.2 – 2.5: P=0.006). Records of animals with diseases and deaths were more likely among female than male producers, and less likely among those producers keeping only sheep than among other producers (Table 19). Interestingly, producers from NSW were more likely to keep records of disease than producers from other states (P<0.001). Smaller properties were less likely (P<0.001) to keep records of animal deaths and treatment routines than larger properties.

Female respondents were more likely (P=0.035) to inspect cattle daily (vs. weekly, fortnightly or monthly) than male respondents (Table 20). In addition and as expected, the bigger the property the less likely that inspection of cattle would occur daily (P<0.001). Daily inspection of cattle was more likely among producers with less years of experience raising livestock (P=0.011). Regarding inspection of sheep, producers keeping poultry were more likely to report inspecting their sheep daily than producers without poultry (P=0.005) and producers from Queensland were also more likely to inspect sheep daily than producers in other states (P=0.042).

Regarding the attitude of producers in the event of unusual symptoms of disease or behaviour, the models investigated the producers' selection of the option 'never' for contacting the State Department of Primary Industries/Agriculture and contacting the veterinarian. Results suggest that the larger the property the less likely a producer was to select 'never' contacting the State Department of Primary Industries/Agriculture (P=0.023); thus, being more likely to contact this government department in the event unusual symptoms of disease. The model also suggest that the more years of experience raising livestock the more likely a producer would contact this government department (P=0.016) (less likely to select the 'never' option). Regarding veterinarian contact, those producers keeping horses were less likely to select the 'never' option and as such, more likely to contact a veterinarian when faced with disease on the farm. In addition, those producers keeping only sheep were more likely to never contact a veterinarian than other producers (P=0.007). However, only a total of 31 producers selected the 'never' option for the veterinary contact, thus this results should be interpreted with caution.

Table 20. Multivariable logistic regression analysis of herd/flock and health management (frequency of inspection and attitudes towards disease) related practices of 746 smallholders participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *How often do you inspect your livestock? Cattle (Daily inspection vs. others (weekly, fortnightly, monthly))* | | | | | | |
| Gender | | | | | | 0.035 |
| Male | 235(59.2) | 0 | . | 1.00 | . | |
| Female | 130(70.3) | 0.45 | 0.22 | 1.57 | (1.1–2.4) | |
| Property hectares | | | | | | <0.001 |
| < 10 | 104(72.2) | 0 | . | 1.00 | . | |
| 10 – 29 | 128(66.7) | -0.23 | 0.26 | 0.80 | (0.5–1.3) | |
| 30 – 79 | 115(56.1) | -0.65 | 0.25 | 0.52 | (0.3–0.8) | |
| ≥ 80 | 20(40.8) | -1.45 | 0.36 | 0.23 | (0.1–0.5) | |
| Horses in the property | | | | | | |
| No | 401(78.9) | 0 | . | 1.00 | . | 0.038 |
| Yes | 143(60.3) | 0.44 | 0.21 | 1.55 | (1.0–2.4) | |
| Years owning livestock | | | | | | 0.011 |
| 1 – 5 | 41(48.8) | 0 | . | 1.00 | . | |
| 6 – 15 | 95(61.7) | 0.62 | 0.30 | 1.85 | (1.0–3.3) | |
| 16 – 29 | 69(59.5) | 0.54 | 0.32 | 1.71 | (0.9–3.2) | |
| ≥ 30 | 158(68.1) | 1.00 | 0.30 | 2.72 | (1.5–4.9) | 0.983 |
| Age | | | | | | |
| *How often do you inspect your livestock? Sheep (Daily inspection vs. others (weekly, fortnightly, monthly))* | | | | | | |
| Age | | | | | | 0.044 |
| 18-34 | 4(57.1) | -1.01 | 0.85 | 0.36 | (0.1–1.9) | |
| 35-44 | 21(56.8) | -1.29 | 0.50 | 0.28 | (0.1–0.7) | |
| 45-54 | 53(75.7) | -0.03 | 0.43 | 0.97 | (0.4 –2.3) | |
| 55-64 | 59(63.4) | -0.62 | 0.39 | 0.54 | (0.3–1.1) | |
| >65 | 46(70.8) | 0 | . | 1.00 | . | |
| Poultry | | | | | | |
| No | 94(18.4) | 0 | 0 | 1.00 | . | 0.005 |
| Yes | 90(38.6) | 0.87 | 0.31 | 2.38 | (1.3–4.4) | |
| State | | | | | | |
| NSW | 26(65.0) | -0.19 | 0.52 | 0.83 | (0.3–2.3) | 0.042 |
| QLD | 16(94.1) | 2.17 | 1.09 | 8.75 | (1.0–74.5) | |
| SA | 43(54.4) | -0.61 | 0.44 | 0.54 | (0.2–1.3) | |
| TAS | 34(70.8) | 0.08 | 0.50 | 1.09 | (0.4–2.9) | |
| VIC | 39(73.6) | 0.37 | 0.50 | 1.45 | (0.05–3.8) | |
| WA | 26(68.4) | 0 | . | 1.00 | . | |
| Gender | | | | | | 0.265 |
| *What would you do if you saw symptoms of disease or unusual behaviour in your livestock? Never contact- DPI* | | | | | | |
| Property hectares | | | | | | 0.023 |
| < 10 | 89(58.6) | 0 | . | 1.00 | . | |
| 10 – 29 | 82(48.8) | 0.35 | 0.23 | 1.42 | (0.9–2.2) | |
| 30 – 79 | 67(41.4) | 0.74 | 0.24 | 2.09 | (1.3–3.4) | |
| ≥ 80 | 15(40.5) | 0.52 | 0.39 | 1.69 | (0.8–3.6) | |
| Years owning livestock | | | | | | 0.016 |
| 1 – 5 | 40(47.1) | 0.67 | 0.29 | 1.95 | (1.1–3.5) | |
| 6 – 15 | 85(59.9) | 0 | . | 1.00 | . | |
| 16 – 29 | 45(43.7) | 0.62 | 0.27 | 1.85 | (1.1–3.2) | |
| ≥ 30 | 80(43.2) | 0.73 | 0.25 | 2.08 | (1.3–3.4) | |
| Age | | | | | | 0.900 |
| Gender | | | | | | 0.350 |
| *What would you do if you saw symptoms of disease or unusual behaviour in your livestock? Never (vs. always/sometimes) contact- Veterinarian* | | | | | | |
| Horses in the property | | | | | | 0.011 |
| No | 29(6.2) | 0 | . | 1.00 | . | |
| Yes | 2(0.9) | -1.89 | 0.74 | 0.15 | (0.0-0.7) | |
| Species kept | | | | | | 0.007 |
| Sheep | 13(11.8) | 0 | . | 1.00 | . | |
| Cattle | 12(2.8) | -1.46 | 0.44 | 0.23 | (0.1-0.5) | |
| Cattle and sheep | 5(4.0) | -1.12 | 0.56 | 0.32 | (0.1-0.9) | |
| Cattle, sheep and pigs | 1(3.6) | -1.41 | 1.09 | 0.24 | (0.0-2.1) | |
| Age | | | | | | 0.721 |
| Gender | | | | | | 0.158 |

#### 4.2.2.5 Communication networks and behaviour

A description of the smallholders' behaviours regarding communication networks is shown in Table 21. The majority of smallholders seek information on the health of their livestock (82.9%), with veterinarians considered as being the most useful information source, followed by the State Department of Primary Industries (or equivalent State department), rural suppliers and other smallholders. Newsletters, email and websites were selected by 22.7%, 20.9% and 20.2% of smallholders as the most useful methods of information delivery, respectively.

Table 21. Communication networks and behaviour reported by 746 smallholders participating in an epidemiological study in Australia in 2013.

| **Communication network practices** | **n(%) respondents** |
|---|---|
| *Do you seek information on management and health of livestock?* | |
| No | 123(17.1) |
| Yes | 597(82.9) |
| *If yes, which ones are the three most useful sources of information?* [a] | |
| DPI | 252(42.2) |
| Veterinarian | 402(67.3) |
| Rural supplier | 227(38.0) |
| Other smallholders | 206(34.5) |
| Large scale livestock producers | 149(25.0) |
| Government internet sites | 158(26.5) |
| Other internet sites | 183(30.7) |
| Small farms network | 54(9.0) |
| NRM/CMA/Landcare | 34(5.7) |
| LHPA[b] | 59(9.9) |
| Industry breed groups | 72(12.1) |
| Community based small farms groups | 33(5.5) |
| *Select the three most useful methods of information delivery* | |
| Newspaper | 296(14.0) |
| Newsletter/letter in the mail | 478(22.7) |
| Seminars/Workshops | 224(10.6) |
| Fax | 26(1.2) |
| Email | 441(20.9) |
| Telephone call | 218(10.3) |
| Website | 426(20.2) |

[a] Could select more than one
[b] Name changed to Local Land Services

Table 22 and

Table 23 show the outcomes of the multivariable logistic regression analysis investigating potential association of smallholders' communication networks and behaviours with the explanatory variables.

Table 22. Multivariable logistic regression analysis of communication networks of 746 smallholders participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Do you seek information on the management and health of your livestock?* | | | | | | |
| Gender | | | | | | 0.028 |
| Male | 376(79.8) | 0 | . | 1.00 | . | |
| Female | 206(98.0) | 0.57 | 0.26 | 1.77 | (1.1–2.9) | |
| Age | | | | | | |
| 18-34 | 15(88.2) | 1.74 | 1.04 | 5.71 | (0.7-44.2) | <0.001 |
| 35-44 | 101(92.7) | 1.51 | 0.41 | 4.54 | (2.0-10.1) | |
| 45-54 | 167(86.1) | 0.91 | 0.28 | 2.50 | (1.4-4.3) | |
| 55-64 | 201(86.6) | 1.04 | 0.27 | 2.82 | (1.7-4.7) | |
| >65 | 108(67.1) | 0 | . | 1.00 | . | |
| Poultry | | | | | | |
| No | 385 (78.4) | 0 | . | 1.00 | . | |
| Yes | 212(92.6) | 1.09 | 0.29 | 3.00 | (1.7 – 5.2) | <0.001 |
| *Most useful sources of information? Department of Primary Industries (or equivalent State government department)* | | | | | | |
| State | | | | | | <0.001 |
| NSW | 62(54.9) | 0 | . | 1.00 | . | |
| QLD | 35(43.2) | -0.46 | 0.31 | 0.63 | (0.3–1.1) | |
| SA | 34(30.1) | -1.06 | 0.28 | 0.35 | (0.2–0.6) | |
| TAS | 29(31.5) | -0.99 | 0.30 | 0.37 | (0.2–0.7) | |
| VIC | 45(37.8) | -0.72 | 0.27 | 0.49 | (0.3–0.8) | |
| WA | 47(59.5) | 0.15 | 0.30 | 1.17 | (0.6–2.1) | |
| Gender | | | | | | 0.861 |
| Age | | | | | | 0.389 |
| *Most useful sources of information? Veterinarians* | | | | | | |
| Horses in the property | | | | | | <0.001 |
| No | 241(61.0) | 0 | . | 1.00 | . | |
| Yes | 161(79.7) | 0.92 | 0.22 | 2.5 | (1.6–3.8) | |
| Species kept | | | | | | 0.006 |
| Sheep | 54(51.9) | 0 | . | 1.00 | . | |
| Cattle | 250(70.6) | 0.77 | 0.24 | 2.17 | (1.4-3.5) | |
| Cattle and sheep | 82(71.9) | 0.92 | 0.30 | 2.51 | (1.4-4.5) | |
| Cattle, sheep and pigs | 16(64.0) | 0.62 | 0.49 | 1.87 | (0.7-4.9) | |
| Gender | | | | | | 0.859 |
| Age | | | | | | 0.228 |
| *Most useful sources of information? Government internet sites* | | | | | | |
| Number of cattle | | | | | | 0.045 |
| 1 – 5 | 37(31.1) | 0 | . | 1.00 | . | |
| 6 – 15 | 44(26.0) | -0.29 | 0.27 | 0.75 | (0.4–1.3) | |
| 16 – 29 | 28(26.2) | -0.26 | 0.31 | 0.77 | (0.4–1.4) | |
| 30 - 50 | 14(14.9) | -1.03 | 0.37 | 0.36 | (0.2–0.7) | |
| Gender | | | | | | 0.236 |
| Age | | | | | | 0.405 |
| *Most useful sources of information? Other internet sites* | | | | | | |
| Age | | | | | | <0.001 |
| 18-34 | 7(46.7) | 0 | . | 1.00 | . | |
| 35-44 | 40(39.6) | -0.30 | 0.56 | 0.74 | (0.2–2.2) | |
| 45-54 | 60(35.9) | -0.41 | 0.54 | 0.66 | (0.2–1.9) | |
| 55-64 | 63(31.3) | -0.61 | 0.54 | 0.55 | (0.2–1.6) | |
| >65 | 13(12.0) | -1.80 | 0.60 | 0.17 | (0.1–0.5) | |
| Gender | | | | | | 0.688 |
| *Most useful sources of information? Other smallholders* | | | | | | |
| Age | | | | | | 0.001 |
| 18-34 | 8(53.3) | 0 | . | 1.00 | . | |
| 35-44 | 47(46.5) | -0.23 | 0.56 | 0.79 | (0.3–2.4) | |
| 45-54 | 67(40.1) | -0.55 | 0.54 | 0.58 | (0.2–1.7) | |
| 55-64 | 55(28.9) | -1.02 | 0.54 | 0.36 | (0.1–1.0) | |
| >65 | 25(23.1) | -1.27 | 0.57 | 0.28 | (0.1–0.8) | |
| Gender | | | | | | 0.595 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Most useful sources of information? Large scale livestock producer* | | | | | | |
| Number of cattle | | | | | | 0.045 |
| 1 – 5 | 20(16.8) | 0 | . | 1.00 | . | |
| 6 – 15 | 48(28.4) | 0.85 | 0.33 | 2.33 | (1.2–4.4) | |
| 16 – 29 | 27(25.2) | 0.68 | 0.38 | 1.98 | (0.9–4.1) | |
| 30 - 50 | 30(31.9) | 0.93 | 0.37 | 2.52 | (1.2–5.2) | |
| State | | | | | | 0.006 |
| NSW | 22(19.5) | 0 | . | 1.00 | . | |
| QLD | 17(21.0) | -0.02 | 0.41 | 0.98 | (0.4–2.2) | |
| SA | 19(16.8) | -0.25 | 0.43 | 0.78 | (0.3–1.8) | |
| TAS | 28(30.4) | 0.65 | 0.38 | 1.91 | (0.9–4.0) | |
| VIC | 34(28.6) | 0.79 | 0.36 | 2.19 | (1.1–4.4) | |
| WA | 29(36.7) | 1.02 | 0.38 | 2.76 | (1.3–5.8) | |
| Age | | | | | | 0.247 |
| Gender | | | | | | 0.466 |
| *Most useful sources of information? Livestock Health and Pest Authorities (currently Local Land Services)* | | | | | | |
| Age | | | | | | 0.037 |
| 18-34 | 0(0.0) | . | . | . | . | |
| 35-44 | 6(5.9) | -1.25 | 0.50 | 0.29 | (0.1 – 0.8) | |
| 45-54 | 15(9.0) | -0.90 | 0.39 | 0.41 | (0.2 –0.9) | |
| 55-64 | 18(9.0) | -0.86 | 0.36 | 0.42 | (0.2 –0.9) | |
| >65 | 20(18.5) | 0 | . | 1.00 | . | |
| Property hectares | | | | | | 0.005 |
| < 10 | 4(2.4) | 0 | . | 1.00 | . | |
| 10 – 29 | 22(11.8) | 1.72 | 0.56 | 5.57 | (1.9–16. 6) | |
| 30 – 79 | 25(13.7) | 1.94 | 0.55 | 6.96 | (2.4–20.6) | |
| ≥ 80 | 7(15.2) | 1.93 | 0.66 | 6.88 | (1.9–25.1) | |
| Gender | | | | | | 0.981 |

Although most producers reported seeking information on the management and health of their livestock, female and younger producers are more likely to do so than male (P=0.028) and older producers (P<0.001). Regarding usefulness of different sources of information, producers from NSW (54.9%) and Western Australia (59.5%) were more likely (P<0.001) to consider the State Department of Primary Industries/Agriculture as a useful source of information than producers from South Australia (30.1%), Tasmania (31.5%) and Victoria (37.8%). This proportion among producers from Queensland (43.2%) did not significantly differ from the NSW one. Regarding Livestock Health and Pest Authority (currently Local Land Services), older producers (P=0.037) and those with bigger properties (P=0.005) considered this organization as a useful source of information.

Results also suggest that those producers keeping sheep are less likely to find veterinarians a useful source of information than producers keeping cattle with/without sheep (P=0.006). In addition, producers keeping horses (79.7%) are more likely to consider veterinarians as a useful source of information (P<0.001) than those producers without horses (61.0%).

Producers with 30 to 50 cattle (14.9%) were less likely to select government internet sites as useful sources of information compared to those with only 1 to 5 cattle (31.1%). Moreover, as expected, older producers were less likely to consider other internet sites as useful sources of information (P<0.001). Regarding other producers as useful sources of information, the perception of smallholders being a useful source of information decreased with increased age (P=0.001) (e.g. 23.1% among producers over 65 y old compared to 53.3% among producers between 18 and 34 y old). In addition, large scale livestock producers were more likely to be considered a useful source of information when the number of cattle kept in the property increased (P=0.045).

Table 23. Multivariable logistic regression analysis of preferred methods of information delivery of 746 smallholders participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Most useful methods of information delivery? Email* | | | | | | |
| Age | | | | | | 0.033 |
| 18-34 | 15(88.2) | 0 | . | 1.00 | . | |
| 25-34 | 71(64.5) | -2.17 | 1.05 | 0.11 | (0.0–0.9) | |
| 35-44 | 132(67.0) | -2.09 | 1.04 | 0.12 | (0.0–0.9) | |
| 45-54 | 135(57.9) | -2.53 | 1.04 | 0.08 | (0.0–0.6) | |
| 55-64 | 83(55.0) | -2.59 | 1.04 | 0.07 | (0.0–0.6) | |
| >65 | | | | | | |
| State | | | | | | <0.001 |
| NSW | 93(75.6) | 0 | . | 1.00 | . | |
| QLD | 53(55.2) | -0.91 | 0.31 | 0.40 | (0.2–0.7) | |
| SA | 88(60.7) | -0.76 | 0.28 | 0.47 | (0.3–0.8) | |
| TAS | 52(44.8) | -1.30 | 0.29 | 0.27 | (0.2–0.5) | |
| VIC | 80(56.3) | -0.95 | 0.28 | 0.39 | (0.2–0.7) | |
| WA | 75(78.9) | 0.18 | 0.34 | 1.2 | (0.6–2.3) | |
| Gender | | | | | | 0.61 |
| *Most useful methods of information delivery? Newsletter/letter in the mail* | | | | | | |
| State | | | | | | <0.001 |
| NSW | 50(40.7) | 0 | . | 1.00 | . | |
| QLD | 62(64.6) | 0.89 | 0.30 | 2.44 | (1.4–4.4) | |
| SA | 110(75.9) | 1.48 | 0.28 | 4.38 | (2.5–7.6) | |
| TAS | 78(67.2) | 1.03 | 0.28 | 2.81 | (1.6–4.9) | |
| VIC | 111(78.2) | 1.63 | 0.29 | 5.08 | (2.9–8.9) | |
| WA | 67(70.5) | 1.23 | 0.30 | 3.42 | (1.9–6.2) | 0.012 |
| Years owning livestock | | | | | | |
| 1 – 5 | 60(52.2) | 0 | . | 1.00 | . | |
| 6 – 15 | 120(65.2) | 0.59 | 0.26 | 1.80 | (1.1–3.0) | |
| 16 – 29 | 101(73.2) | 0.92 | 0.29 | 2.51 | (1.4–4.4) | |
| ≥ 30 | 183(70.1) | 0.70 | 0.26 | 2.01 | (1.2–3.4) | |
| Age | | | | | | 0.470 |
| Gender | | | | | | 0.418 |
| *Most useful methods of information delivery? Newspaper* | | | | | | |
| State | | | | | | <0.001 |
| NSW | 30(24.4) | 0 | . | 1.00 | . | |
| QLD | 39(40.6) | 0.53 | 0.32 | 1.69 | (0.9–3.2) | |
| SA | 50(34.5) | 0.26 | 0.29 | 1.29 | (0.7–2.3) | |
| TAS | 75(64.7) | 1.56 | 0.30 | 4.75 | (2.6–8.5) | |
| VIC | 75(52.8) | 1.13 | 0.28 | 3.08 | (1.8–5.4) | |
| WA | 27(28.4) | 0.13 | 0.32 | 1.14 | (0.6–2.1) | <0.001 |
| Years owning livestock | | | | | | |
| 1 – 5 | 34(29.6) | 0 | . | 1.00 | . | |
| 6 – 15 | 58(31.5) | 0.05 | 0.27 | 1.05 | (0.6–1.8) | |
| 16 – 29 | 53(38.4) | 0.24 | 0.29 | 1.27 | (0.7–2.2) | |
| ≥ 30 | 139(53.3) | 0.87 | 0.27 | 2.40 | (1.4–4.0) | |
| Age | | | | | | 0.731 |
| Gender | | | | | | 0.427 |
| *Most useful methods of information delivery? Telephone* | | | | | | |
| Number of cattle | | | | | | 0.02 |
| 1 – 5 | 41(28.5) | 0 | . | 1.00 | . | |
| 6 – 15 | 72(34.8) | 0.24 | 0.25 | 1.27 | (0.8–2.1) | |
| 16 – 29 | 46(35.4) | 0.17 | 0.28 | 1.20 | (0.7–2.0) | |
| 30 - 50 | 22(20.0) | -0.66 | 0.32 | 0.52 | (0.3–1.0) | |
| Poultry | 55(24.2) | -0.45 | 0.22 | 0.64 | (0.4–1.0) | 0.038 |
| Age | | | | | | 0.369 |
| Gender | | | | | | 0.082 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Most useful methods of information delivery? Seminar* | | | | | | |
| State | | | | | | <0.001 |
| NSW | 89(72.4) | 0 | . | 1.00 | . | |
| QLD | 22(22.9) | -2.20 | 0.33 | 0.11 | (0.1–0.2) | |
| SA | 29(20.0) | -2.40 | 0.30 | 0.09 | (0.1–0.2) | |
| TAS | 21(18.1) | -2.53 | 0.32 | 0.08 | (0.0–0.2) | |
| VIC | 26(18.3) | -2.59 | 0.31 | 0.08 | (0.0–0.1) | |
| WA | 37(38.9) | -1.53 | 0.30 | 0.22 | (0.1–0.4) | |
| Age | | | | | | 0.597 |
| Gender | | | | | | 0.911 |
| *Most useful methods of information delivery? Website* | | | | | | |
| State | | | | | | <0.001 |
| NSW | 96(78.0) | 0 | . | 1.00 | . | |
| QLD | 59(61.5) | -0.70 | 0.33 | 0.50 | (0.3–1.0) | |
| SA | 72(49.7) | -1.11 | 0.30 | 0.33 | (0.2–0.6) | |
| TAS | 58(50.0) | -1.24 | 0.31 | 0.29 | (0.2–0.5) | |
| VIC | 76(53.5) | -1.15 | 0.30 | 0.32 | (0.2–0.6) | |
| WA | 65(68.4) | -0.46 | 0.33 | 0.63 | (0.3–1.2) | <0.001 |
| Years owning livestock | | | | | | |
| 1 – 5 | 93(80.9) | 0 | . | 1.00 | . | |
| 6 – 15 | 123(66.8) | -0.75 | 0.30 | 0.47 | (0.3–0.8) | |
| 16 – 29 | 84(60.9) | -0.78 | 0.31 | 0.46 | (0.3–0.8) | |
| ≥ 30 | 117(44.8) | -1.35 | 0.29 | 0.26 | (0.1–0.5) | |
| Age | | | | | | 0.004 |
| 18-34 | 10(55.6) | 0.04 | 0.59 | 1.04 | (0.3–3.3) | |
| 35-44 | 82(74.5) | 0.96 | 0.31 | 2.61 | (1.4–4.8) | |
| 45-54 | 130(66.0) | 0.85 | 0.25 | 2.34 | (1.4–3.8) | |
| 55-64 | 137(58.8) | 0.55 | 0.24 | 1.73 | (1.1–2.7) | |
| >65 | 63(41.7) | 0 | . | 1.00 | . | |
| Gender | | | | | | 0.980 |

Younger producers (P=0.033) and producers from NSW and Western Australia (P<0.001) were more likely to consider email as a useful method of information delivery than older producers and producers from other states. In addition, producers from NSW were also the most likely to consider websites and seminars as useful methods of information delivery compared to producers from other states. In agreement with this finding, producers from NSW were less likely to select newsletters and newspapers as useful methods than producers from most of the other states (Table 23). Furthermore, producers with less years of experience (correlated to the age) were more likely to prefer websites than newsletters and newspapers.

### 4.2.3 Smallholders pigs

#### 4.2.3.1 General demographics and husbandry practices

Table 24 shows respondents from each state as a percentage of the total responses ranged from 7.1% ( Western Australia) to 32.8% (New South Wales).

Table 24. Number of pig smallholders by state[a] among 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013.

| State | Response, n(%) |
|---|---|
| New South Wales/ACT | 65(32.8) |
| Victoria | 47(23.7) |
| Tasmania | 18(9.1) |
| South Australia | 16(8.1) |
| Western Australia | 14(7.1) |
| Queensland | 37(18.7) |
| No postcode | 1(0.5) |
| Total | **198** |

[a] Northern Territory not included in study due to reported low numbers of potential respondents

Location by postcode of the distribution and receipt of questionnaires from smallholders (pigs) participating in the study are shown in

Figure 7. Return to senders and those respondents identified as being not in the target population were not included in the mapping data. As for the smallholder general), in some instances the postal address of the smallholder differed from the property location.

Figure 8. Boxplot representing the association (P = 0.044) between the presence of cattle and sheep in the property (X axis; 1 = properties with cattle and sheep, 0 = properties without both, cattle and sheep) and property size in hectares (Y axis).

Table 25 describes the main demographic characteristics of the smallholders (pigs) participating in the study. Results are very similar to those reported by the smallholders (general), with the majority of respondents being male (68.1%) and over 45 years old. The most frequently reported age group was the 45-54yr (35.2%). The majority of respondents (85.3%) reported being from an Australian background. The percentage of smallholders in each property size category was 15.2% for those with less than 10 ha, 19.3% for those with properties between 10 and 29 ha, 17.8% for those with properties between 30 and 79 ha and 47.7% with properties with more than 80 ha. This property size distribution differed to the distribution among smallholder (general), with smallholders keeping pigs reporting bigger property sizes. This could be due to the fact that over 60% of these smallholders also kept cattle and/or sheep. When investigating the relationship of property size with the presence of cattle and/or sheep in the property, a significant association was found between keeping cattle and sheep and property size, with those properties keeping both, cattle and sheep (n = 83) having bigger property sizes (P= 0.044). Figure 8 shows the distribution of hectares according to the presence of cattle and sheep in the property.

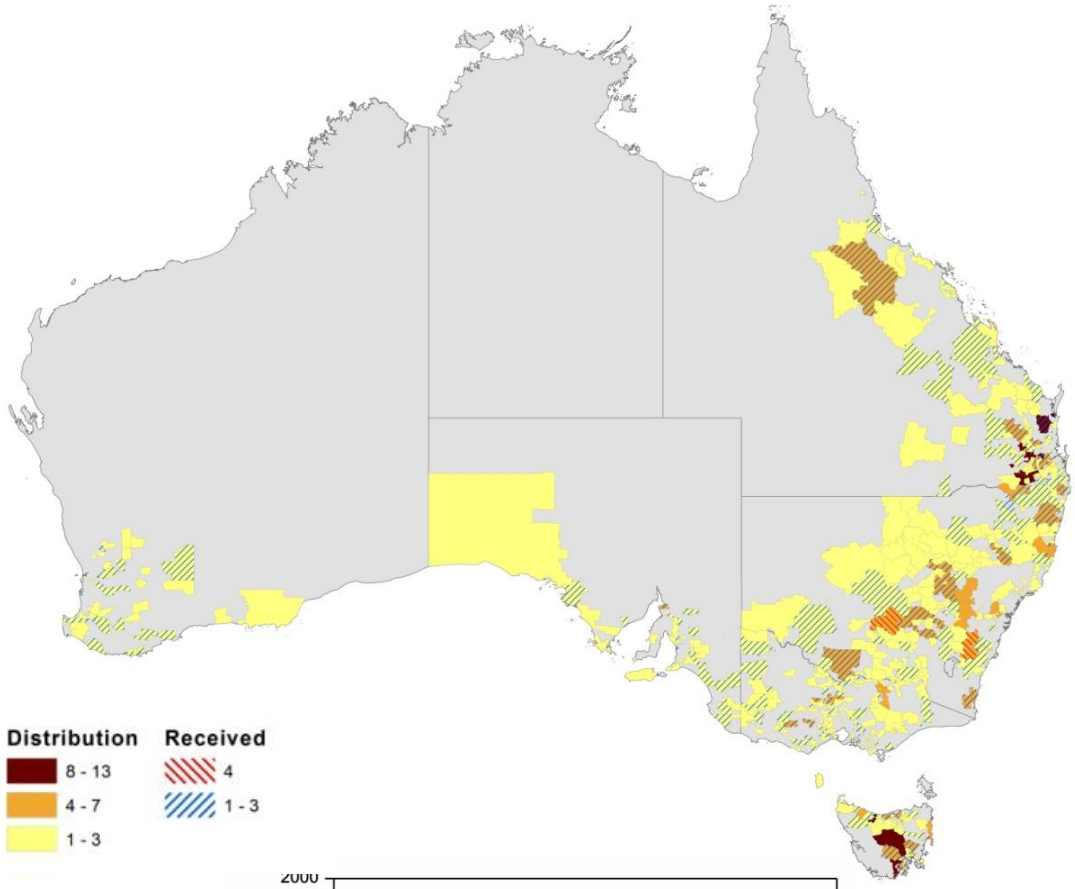


Figure 7. Location distribution (n=864) by postcode of the questionnaires for participating in the and receipt (n=198) of smallholders (pig) study.

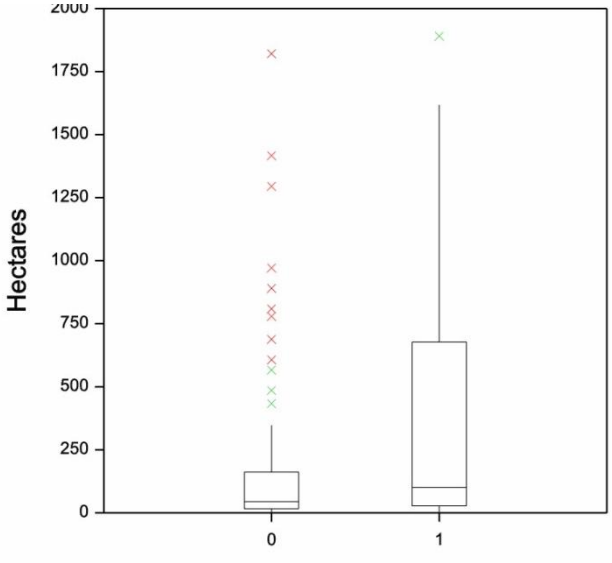

Figure 8. Boxplot representing the association (P = 0.044) between the presence of cattle and sheep in the property (X axis; 1 = properties with cattle and sheep, 0 = properties without both, cattle and sheep) and property size in hectares (Y axis).

Table 25. Demographic characteristics of 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013.

| Characteristic | n(%) respondents |
|---|---|
| *Age* | |
| 18-24y | 2(1.0) |
| 25-34y | 18(9.2) |
| 35-44y | 51(26.0) |
| 45-54y | 69(35.2) |
| 55-64y | 39(19.9) |
| +65y | 17(8.7) |
| *Sex* | |
| Male | 130(68.1) |
| Female | 61(31.9) |
| *Ethnic background* | |
| Australian | 151(85.3) |
| United Kingdom / Irish | 12(6.8) |
| Asian | 2(1.1) |
| European | 8(4.5) |
| Other | 4(2.3) |
| *Size of property (ha)* | |
| <10 | 30(15.2) |
| 10 - 29 | 38(19.3) |
| 30 - 79 | 35(17.8) |
| >80 | 94(47.7) |
| *How many commercial piggeries within 5km of property* | |
| 0 | 158(79.8) |
| 1 | 20(10.1) |
| 2 | 2(1.0) |
| 3 | 3(1.5) |
| Not known | 11(5.6) |
| *Undertake other agricultural/horticultural activities on property* | |
| Yes | 132(66.7) |
| *Involved in environmental activities on property* | |
| Yes | 84(42.4) |

The number of commercial piggeries within 5km of the property ranged from none to 3 with most respondents (79.8%) having no known commercial piggeries within 5km. Other agricultural/horticultural activity was undertaken by 66.7% of smallholders and 42.4% indicated that they were involved in biodiversity/conservation/ environmental activities on the property.

Information on general husbandry of the smallholders participating in the study is presented in

Table 26. The number of years involved with livestock ranged from 2 months to 70 years, with the average number of years involved being approximately 12.9 years. When categorised, half of respondents had kept pigs for between 1 and 5 years and 18.0% of respondents have kept pigs for over 30 years. There was an association between the age of the producer and the number of years keeping pigs (

Figure 9; Spearman's rank correlation = 0.414; P<0.001). The majority kept between 1 and 10 sows with a relatively even spread of numbers of growers kept across all categories. The median number of sows kept was 5; while the median number of growers kept was 10. The main reasons for keeping pigs were as a source of additional income and for home consumption (46.0% and 51.5%, respectively), noting that respondents were able to select more than one response to this question.

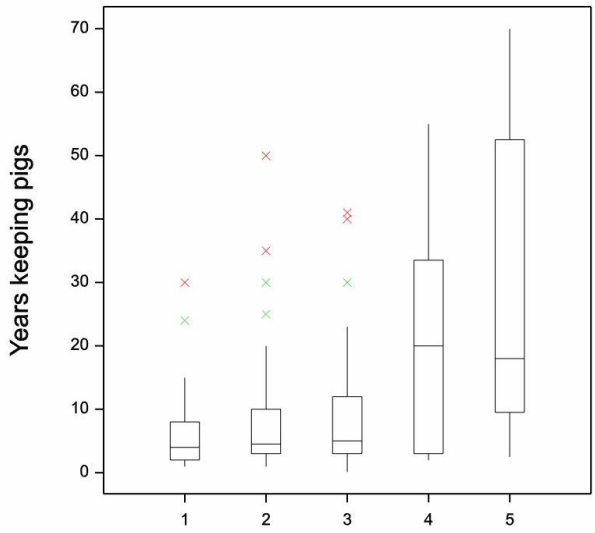


Figure 9. Boxplot representing the association between age of the producer (X axis) and the years keeping livestock (Y axis). Age is categorized as follows: 2 = 18–34y; 3 = 35-44y; 4=45-54y; 5=55-64y; 6≥65y. (Spearman's rank correlation = 0.401; P<0.001)

Associations of the motivations for keeping pigs and the explanatory variables were investigated and results from the multivariable logistic regression models are presented in Table 27. As expected, those producers keeping more than 10 sows were more likely to keep pigs as extra income than producers keeping less than 10 sows, who were more likely to keep pigs for home consumption or as hobby (P < 0.001). In addition, those producers with less than 10 sows (P=0.029) and those keeping poultry (P = 0.009) were also more likely to keep pigs as conservation of rare breeds than producers

with more than 10 sows or without poultry. Interestingly, those pig producers keeping cattle are more likely to have pigs for home consumption than other producers (P= 0.015).

Table 26. General husbandry description of 198 smallholders keeping pigs involved in an epidemiological study in Australia in 2013.

| Husbandry description | n(%) respondents | Min. | Max. | Mean | SD |
|---|---|---|---|---|---|
| Years *kept pigs* | | 0.16 | 70.0 | 12.92 | 15.04 |
| 1-5y | 97(50.0) | | | | |
| 6-15y | 47(24.2) | | | | |
| 16 – 29y | 15(7.7) | | | | |
| >30 | 35(18.0) | | | | |
| *No of sows kept* | | 0 | 50.0 | 10.9 | 12.9 |
| *0* | 2(1.0) | | | | |
| *1-10* | 134(67.7) | | | | |
| *>10* | 62(31.3) | | | | |
| *No of growers kept* | | 0 | 500.0 | 42.0 | 77.6 |
| *0* | 51(25.8) | | | | |
| *1-10* | 50(25.3) | | | | |
| *10-50* | 54(27.3) | | | | |
| *>50* | 43(21.7) | | | | |
| *Reason for keeping pigs* | | | | | |
| Primary income | 18(9.1) | | | | |
| Extra income | 91(46.0) | | | | |
| Family tradition | 24(12.1) | | | | |
| Home consumption | 102(51.5) | | | | |
| Pet | 15(7.6) | | | | |
| Rare breeds[a] | 46(23.7) | | | | |
| Hobby[a] | 71(36.6) | | | | |
| *Other species kept* | | | | | |
| Yes | 188(94.9) | | | | |
| Cattle | 130(65.7) | | | | |
| Sheep | 126(63.6) | | | | |
| Horses | 54(27.3) | | | | |

[a] 4 smallholders did not have this as a response option as they responded the smallholder (general) survey

Table 27. Multivariable logistic regression analysis of motivations for keeping pigs of 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Reason for keeping pigs- Extra income* | | | | | | |
| Sows | | | | | | <0.001 |
| 0-10 | 44(32.4) | 0 | . | 1.00 | . | |
| >10 | 47(75.8) | 2.12 | 0.39 | 8.32 | (3.9-17.9) | |
| Age | | | | | | 0.237 |
| Gender | | | | | | 0.879 |
| *Reason for keeping pigs- Home consumption* | | | | | | |
| Sows | | | | | | <0.001 |
| 0-10 | 88(64.7) | 0 | . | 1.00 | . | |
| >10 | 14(22.6) | -1.76 | 0.37 | 0.17 | (0.1-0.4) | |
| Cattle | | | | | | 0.015 |
| No | 26(38.2) | 0 | . | 1.00 | . | |
| Yes | 76(58.5) | 0.84 | 0.35 | 2.32 | (1.2-4.6) | |
| Age | | | | | | 0.143 |
| Gender | | | | | | 0.636 |
| *Reason for keeping pigs- Rare breeds* | | | | | | |
| Poultry | | | | | | 0.009 |
| No | 19(15.6) | 0 | . | 1.00 | . | |
| Yes | 27(37.5) | 1.01 | 0.38 | 2.74 | (1.3-5.8) | |
| Sows | | | | | | 0.029 |
| 0-10 | 39(29.5) | 0 | . | . | . | |
| >10 | 7(11.3) | -1.05 | 0.48 | 0.35 | (0.1-0.9) | |
| Age | | | | | | 0.173 |
| Gender | | | | | | 0.114 |
| *Reason for keeping pigs- Hobby* | | | | | | |
| Sows | | | | | | <0.001 |
| 0-10 | 64(48.5) | 0 | . | 1.00 | . | |
| >10 | 7(11.3) | -1.86 | 0.44 | 0.16 | (0.1-0.4) | |
| Age | | | | | | 0.725 |
| Gender | | | | | | 0.383 |

#### 4.2.3.2 Animal movements

Table 28 shows the reported practices of smallholders keeping pigs in relation to animal movements. In the previous 12 months, a high proportion of smallholders reported movements off the property (86.3%) and over 40% reported pigs being introduced. For those smallholders reporting introductions, introductions from another farm was the most common source.

Most exits from the property were to abattoirs (58.8%). Keeping records of animal movements was reported by 90.8% of respondents with the Pig Pass NVD being the most commonly reported method (80.6%). Most respondents reported having a PIC (97.9%); however, as for the smallholder (general), these results should be interpreted with caution as the participants were selected from the APL PigPass database with the associated requirement for obtaining a PigPass NVD being that the property has a current PIC.

Table 28. Practices in relation to animal movement of 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013

| **Practice** | **n(%) respondents** |
|---|---|
| *Did you introduce pigs in the last 12 months?* | |
| No | 110(55.6) |
| Yes | 88(44.4) |
| *Did you introduce pigs from the saleyard?* | |
| No | 68(77.3) |
| Yes | 20(22.7) |
| *Did you introduce pigs from another farm?* | |
| No | 17(19.3) |
| Yes | 71(80.7) |
| *Did you move pigs off your property in the last 12 months?* | |
| No | 27(13.7) |
| Yes | 170(86.3) |
| *Did you move pigs to a saleyard?* | |
| No | 104(61.2) |
| Yes | 66(35.3) |
| *Did you move pigs to another farm?* | |
| No | 120(70.6) |
| Yes | 50(29.4) |
| *Did you move pigs to an abattoir?* | |
| No | 70(41.2) |
| Yes | 100(58.8) |
| *Do you keep records of movements?* | |
| No | 18(9.2) |
| Yes | 177(90.8) |
| *Method of recording movements*[a] | |
| Paper | 39(22.3) |
| Computer | 27(15.4) |
| Whiteboard | 1(0.6) |
| PigPass NVD | 141(80.6) |
| Waybill | 17(9.7) |
| *Does your property have a Property Identification Code?* | |
| No | 2(1.0) |
| Yes | 190(97.9) |
| Don't know | 2(1.0) |

[a] 4 smallholders did not have this as a response option as they responded the smallholder (general) survey

Results from the logistic analysis investigating the association of movement practices and the explanatory variables are described in Table 29 and

Table 30. Producers with more than ten sows were more likely to have introduced pigs in the previous 12 months (P=0.002). Introduction of pigs from a saleyard was dependent on the number of years raising pigs, with those producers who have raised pigs for more than 15 years more likely to introduce animals from this source than other producers (P=0.011). However, only 20 producers reported introducing pigs from saleyards, so the sample size is likely to be too small to draw any conclusions. Introduction from another farm was more likely among producers with more than ten sows (P=0.007) and also those keeping poultry (P=0.014).

Table 29. Multivariable logistic regression analysis of practices related to the introduction of animals of 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | **Producers (%)** | ***B*** | **SE** | **Odds ratio** | **(95% CI)** | ***P*** |
|---|---|---|---|---|---|---|
| *Did you introduce new pigs onto your property in the previous 12mths?* | | | | | | |
| Sows | | | | | | 0.002 |
| 0-10 | 51(37.5) | 0 | . | 1.00 | . | |
| >10 | 37(59.7) | 1.05 | 0.34 | 2.87 | (1.5-5.6) | |
| Age | | | | | | 0.076 |
| Gender | | | | | | 0.971 |
| *Did you introduce pigs from a saleyard?* | | | | | | |
| Years keeping pigs | | | | | | 0.011 |
| 1-5 | 4(9.5) | 0 | . | 1.00 | . | |
| 6-15 | 9(37.5) | 1.67 | 0.74 | 5.29 | (1.2-22.6) | |
| 16-29 | 4(66.7) | 3.23 | 1.16 | 25.18 | (2.6-246.5) | |
| >30 | 3(20.0) | -0.06 | 1.07 | 0.94 | (0.1-7.6) | |
| Poultry | | | | | | 0.016 |
| No | 18(31.6) | 0 | . | 1.00 | . | |
| Yes | 2(6.5) | -2.13 | 0.88 | 0.12 | (0.0-0.7) | |
| Age | | | | | | 0.919 |
| Gender | | | | | | 0.918 |
| *Did you introduce pigs from another farm?* | | | | | | |
| Gender | | | | | | 0.047 |
| Male | 49(86.0) | 0 | . | 1.00 | . | |
| Female | 21(72.4) | -1.43 | 0.72 | 0.24 | (0.1-1.0) | |
| Poultry | | | | | | 0.014 |
| No | 43(75.4) | 0 | . | 1.00 | . | |
| Yes | 28(90.3) | 1.98 | 0.81 | 7.22 | (1.5-35.1) | |
| Sows | | | | | | 0.007 |
| 0-10 | 38(74.5) | 0 | . | 1.00 | . | |
| >10 | 33(89.2) | 2.76 | 1.02 | 15.72 | (2.1-115.7) | |
| Age | | | | | | 0.31 |

Movement of pigs off the property was associated with the number of growers kept in the property and as expected the more growers kept the more likely a producer had moved pigs off the property in the previous year (P=0.006). In addition, producers with more growers were more likely to send animals to an abattoir (P=0.041). Similar to introduction, movements to saleyards increased with the years keeping pigs, with those producers who only kept pigs from 1 to 5 years being less likely to move animals to a saleyard than other producers (P=0.021). Pig producers keeping poultry were less likely to move pigs from and to a saleyard than those producers without poultry (P<0.05; Table 29,

Table 30). Regarding movements to another farm, producers with less than 10 sows were more likely to move pigs to this destination than producers with more than 10 sows (P=0.037). Records of movements were kept by most producers as previously explained, and a tendency was observed, with producers with moderate to high knowledge of biosecurity being more likely to keep records than those with minimal to low knowledge of biosecurity (P=0.044).

Table 30. Multivariable logistic regression analysis of practices related to the movement of animals off the property of 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Did you move new pigs off your property in the previous 12mths?* | | | | | | |
| Growers | | | | | | 0.006 |
| 0 | 38(74.5) | 0 | . | 1.00 | . | |
| 1-10 | 39(79.6) | 0.33 | 0.50 | 1.38 | (0.5-3.7) | |
| 10-50 | 51(94.4) | 1.97 | 0.71 | 7.19 | (1.8-28.8) | |
| >50 | 42(97.7) | 2.67 | 1.07 | 14.43 | (1.8-118.6) | |
| Age | | | | | | 0.522 |
| Gender | | | | | | 0.092 |
| *Did you move pigs to a saleyard?* | | | | | | |
| Years | | | | | | 0.021 |
| 1-5 | 22(26.2) | 0 | . | 1.00 | . | |
| 6-15 | 21(53.8) | 1.20 | 0.46 | 3.32 | (1.4-8.1) | |
| 16-29 | 6(50.0) | 1.34 | 0.68 | 3.80 | (1.0-14.5) | |
| >30 | 17(51.5) | 1.17 | 0.54 | 3.23 | (1.1-9.3) | |
| Poultry | | | | | | 0.016 |
| No | 50(47.2) | 0 | . | 1.00 | . | |
| Yes | 16(25.0) | -0.98 | 0.41 | 0.38 | (0.2-0.8) | |
| Age | | | | | | 0.043 |
| Gender | | | | | | 0.462 |
| *Did you move pigs to an abattoir?* | | | | | | |
| Poultry | | | | | | 0.01 |
| No | 54(50.9) | 0 | . | 1.00 | . | |
| Yes | 46(71.9) | 0.99 | 0.39 | 2.68 | (1.3-5.7) | |
| No of growers | | | | | | 0.041 |
| 0 | 16(42.1) | 0 | . | . | . | |
| 1-10 | 22(56.4) | 0.44 | 0.51 | 1.55 | (0.6-4.2) | |
| 10-50 | 31(60.8) | 0.86 | 0.48 | 2.35 | (0.9-6.0) | |
| >50 | 31(73.8) | 1.46 | 0.53 | 4.31 | (1.5-12.2) | |
| Age | | | | | | 0.081 |
| Gender | | | | | | 0.907 |
| *Did you move pigs to another farm?* | | | | | | |
| Poultry | | | | | | 0.038 |
| No | 22(20.8) | 0 | . | 1.00 | . | |
| Yes | 28(43.8) | 0.77 | 0.37 | 2.17 | (1.0-4.5) | |
| Sows | | | | | | 0.037 |
| 0-10 | 40(36.4) | 0 | . | 1.00 | . | |
| >10 | 10(16.7) | -0.89 | 0.43 | 0.41 | (0.2-0.9) | |
| Age | | | | | | 0.523 |
| Gender | | | | | | 0.145 |
| *Do you keep records of animal movements?* | | | | | | |
| Biosecurity knowledge | | | | | | 0.044 |
| No - low | 83(95.4) | 0 | . | 1.00 | . | |
| Moderate -high | 45(84.9) | -1.33 | 0.66 | 0.27 | (0.1-1.0) | |
| Age | | | | | | 0.966 |
| Gender | | | | | | 0.534 |
| *Do you use a computer to keep records of animal movements?* | | | | | | |
| Years keeping pigs | | | | | | 0.047 |
| 1-5 | 18(21.2) | 0 | . | 1.00 | . | |
| 6-15 | 2(4.9) | -1.52 | 0.78 | 0.22 | (0.0-1.0) | |
| 16-29 | 4(30.8) | 0.20 | 0.70 | 1.23 | (0.3-4.8) | |
| >30 | 2(6.1) | -1.72 | 0.84 | 0.18 | (0.0-0.9) | |
| Age | | | | | | 0.344 |
| Gender | | | | | | 0.966 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Do you use Pig Pass NVD to keep records of animal movements?* | | | | | | |
| State | | | | | | 0.001 |
| NSW | 45(80.4) | 0 | . | 1.00 | . | |
| QLD | 33(89.2) | 0.73 | 0.66 | 2.08 | (0.6-7.5) | |
| SA | 13(86.7) | 0.10 | 0.89 | 1.11 | (0.2-6.3) | |
| TAS | 4(28.6) | -3.40 | 0.90 | 0.03 | (0.0-0.2) | |
| VIC | 34(85.0) | 0.57 | 0.64 | 1.76 | (0.5-6.2) | |
| WA | 12(100.0) | 6.50 | 10.60 | 638.80 | . | |
| Cattle | | | | | | 0.029 |
| No | 51(87.9) | 0 | . | 1.00 | . | |
| Yes | 90(76.9) | -1.37 | 0.63 | 0.25 | (0.1-0.9) | |
| Age | | | | | | 0.281 |
| Gender | | | | | | 0.606 |

#### 4.2.3.3 Biosecurity knowledge and practices

Biosecurity practices reported by smallholders keeping pigs and their understanding of the term biosecurity are described in Table 31 and results from the logistic regression models are shown in Table 32. The level of understanding of the term biosecurity among these smallholders was generally inadequate, with more than half of the responses defining the term biosecurity indicating a low to no/poor level of understanding of the term. Biosecurity knowledge seemed to be lower among this group of smallholders than among smallholders (general) (
Table 16). Although years keeping pigs was statistically associated with producers' understanding of the term biosecurity (P=0.03), data does not show a logical trend, likely due to the low number of producers in some of the categories used for years raising pigs. According to this data, producers with more than 30 years of experience raising pigs had a lower knowledge of biosecurity (16.7%) than producers with only 1 to 5 years of experience (48.0%). However, those producers with 6 to 15 years of experience (25.9%) had less knowledge of biosecurity than producers with 1 to 5 years of experience and those with 16 to 29 years of experience (46.2%).

Most respondents did not report following correct biosecurity protocols related to animal handlers and visitors, with only 18.8% of respondents reporting keeping records of visitors and over half requiring animal handlers to wash their hands when handling their pigs. Female respondents were more likely to require animal handlers to wash their hands (P=0.026) and to keep a record of visitors (P=0.043) than male respondents. The median of the average number of times per year that animal handlers with close contact with pigs visited the property was 1, with a 25-75 percentile between 0 and 1. In addition, producers keeping more than 10 sows were also more likely to keep records of visitors than producers with less than 10 sows (P=0.01). Isolation of incoming livestock was reported by 58.7% of respondents, with the average number of days of isolation being 23.6. As for the smallholders (general), the most frequently reported reason for not isolating livestock was the perception that there was no need on their property. However, lack of space also seems to be a significant reason for not isolating, with almost 30% of producers keeping pigs selecting this option.

Table 31. Biosecurity practices and knowledge reported by 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013

| **Biosecurity practice** | | | **n(%) respondents** |
|---|---|---|---|
| *Are animal handlers required to wash hands before and after handling pigs* | | | |
| No | | | 72(45.0) |
| Yes | | | 88(55.0) |
| *Number of animal handlers* | *Minimum* | *Average* | *Maximum* |
| Mean | 0.9 | 1.5 | 2.5 |
| Sd | 2.4 | 4.3 | 7.0 |
| Median | 0 | 1 | 1 |
| Min – Max | 0 – 25 | 0 – 40 | 0 – 50 |
| 25 – 75% | 0 - 1 | 0 - 1 | 0 - 2 |
| *Are visitors with contact with pigs provided with clothes/overalls* | | | |
| No | | | 144(89.4) |
| Yes | | | 17(10.6) |
| *Do you keep records of visitors* | | | |
| No | | | 134(81.2) |
| Yes | | | 31(18.8) |
| *Do you isolate incoming livestock?* | | | |
| No | | | 43(41.3) |
| Yes | | | 61(58.7) |
| Number of days isolated | | | |
| Mean | 23.6 | | |
| Sd | 17.3 | | |
| Min – Max | 1 - 90 | | |
| *Reasons for not isolating* | | | |
| Lack of time | | | 5(11.6) |
| Lack of space | | | 12(27.9) |
| Lack of money | | | 3(7.0) |
| No need on property | | | 15(34.9) |
| Unaware of reason | | | 6(14.0) |
| *How would you define the term biosecurity* | | | |
| No understanding | | | 55(39.0) |
| Low level of understanding | | | 33(23.4) |
| Moderate level of understanding | | | 45(31.9) |
| High level of understanding | | | 8(5.7) |

Table 32. Multivariable logistic regression analysis of biosecurity related practices of 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Do you require animal handlers to wash their hands before and after handling your pigs?* | | | | | | |
| Growers | | | | | | 0.023 |
| 0 | 18(41.9) | 0 | . | 1.00 | . | |
| 1-10 | 28(65.1) | 1.23 | 0.48 | 3.40 | (1.3-8.8) | |
| 10-50 | 17(44.7) | 0.25 | 0.48 | 1.28 | (0.5-3.3) | |
| >50 | 25(69.4) | 1.13 | 0.51 | 3.10 | (1.1-8.3) | |
| Gender | | | | | | 0.026 |
| Male | 51(48.1) | 0 | . | 1.00 | . | |
| Female | 34(69.4) | 0.88 | 0.40 | 2.41 | (1.1-5.2) | |
| Age | | | | | | 0.541 |
| *Do you keep records of visitors?* | | | | | | |
| Gender | | | | | | 0.043 |
| Male | 13(12.0) | 0 | . | 1.00 | . | |
| Female | 15(29.4) | 0.94 | 0.47 | 2.57 | (1.0-6.4) | |
| Sows | | | | | | 0.01 |
| 0-10 | 13(11.5) | 0 | . | 1.00 | . | |
| >10 | 18(34.6) | 1.19 | 0.46 | 3.29 | (1.3-8.1) | |
| Age | | | | | | 0.578 |
| *Producer understanding of the term biosecurity – No and low understanding compared to moderate and high understanding* | | | | | | |
| Years | | | | | | 0.03 |
| 1-5 | 36(48.0) | 0 | . | 1.00 | . | |
| 6-15 | 7(25.9) | -1.08 | 0.51 | 0.34 | (0.1-0.9) | |
| 16-29 | 6(46.2) | -0.29 | 0.64 | 0.75 | (0.2-2.6) | |
| >30 | 4(16.7) | -1.69 | 0.70 | 0.18 | (0.0-0.7) | |
| Age | | | | | | 0.689 |
| Gender | | | | | | 0.154 |

#### 4.2.3.4 Health and management practices

Table 33 describes the herd health management practices reported by the smallholders keeping pigs participating in the study. Most respondents reported inspecting their pigs daily (97.4%). Over half of smallholders record animal deaths and animals with disease with approximately 69% recording animal treatments. Only a third of these producers had contacted a veterinarian in the last 12 months; and among those who did not contact a veterinarian in the last year, almost 30% had never contacted a veterinarian regarding the health of their pigs. These results are very similar to those reported by smallholders (general).

Regarding whom the producer would contact if they saw symptoms of disease or unusual behaviour in their pigs, results observed among smallholder keeping pigs are very similar to those reported by smallholders (general). The majority of smallholders keeping pigs reported that they would treat the animals themselves (30.2% always; 64.2% sometimes), would call a veterinarian (42.4% always; 54.9% sometimes) and would call a neighbour/friend/other producer (16.8% always; 53.7% sometimes). Most producers would never call a livestock agent (83.8%). Over 40% of producers would never contact the State Department of Primary Industries or Agriculture and almost 60%

would never call the exotic disease hotline. In addition, 3.9% and 28.1% of these smallholders reported that they would do nothing in the event of unusual symptoms, sometimes or always, respectively.

Table 33. Herd health and management behaviour reported by 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013.

| **Health management practice** | | | **n(%) respondents** |
|---|---|---|---|
| *How often do you inspect your pigs* | | | |
| Daily | | | 190(97.4) |
| Weekly | | | 4(2.1) |
| Fortnightly | | | 1(0.5) |
| Monthly | | | 0 (0.0) |
| *Do you record the number of animals with disease* | | | |
| No | | | 75(45.2) |
| Yes | | | 91(54.8) |
| *Do you record the number of animals that died or were euthanased* | | | |
| No | | | 69(40.4) |
| Yes | | | 102(59.6) |
| *Do you record treatment routine* | | | |
| No | | | 52(31.3) |
| Yes | | | 114(68.7) |
| *Have you contacted a vet in the last 12 months[a]?* | | | |
| No | | | 132(67.3) |
| Yes | | | 64(32.7) |
| *If no, last time veterinarian contacted* | | | |
| Never | | | 50(43.5) |
| 1-2 yrs ago | | | 34(29.6) |
| 3-5yrs ago | | | 16(13.9) |
| >5yrs ago | | | 15(13.0) |
| *What would you do if you saw symptoms of disease or unusual behaviour in your pigs?* | | | |
| | Always | Sometimes | Never |
| Do nothing – it will get better with time | 6(3.9) | 43(28.1) | 104(68.0) |
| Treat myself | 49(30.2) | 104(64.2) | 9(5.6) |
| Call a neighbour / friend / other producer | 25(16.8) | 80(53.7) | 44(29.5) |
| Call a veterinarian | 78(42.4) | 101(54.9) | 5(2.7) |
| Call the livestock agent / sale yard | 4(2.7) | 20(13.5) | 124(83.8) |
| Call the Dept. of Primary Ind./Agriculture | 23(14.9) | 64(41.6) | 67(43.5) |
| Call the exotic disease hotline | 15(10.1) | 46(31.1) | 87(58.8) |

[a] 2 additional smallholders indicated that they were veterinarians

Results suggest that female respondents and those keeping more than 10 sows were more likely to have contacted a veterinarian in the past 12 months than male respondents (P=0.037) and those with less than ten sows (P=0.002). In addition, those producers without sheep were also more likely to have contacted a veterinarian than those keeping sheep (P=0.002).

Table 34. Multivariable logistic regression analysis of herd and health management related practices of 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Have you contacted a vet in the last 12months regarding the health of your pigs?* | | | | | | |
| Gender | | | | | | 0.037 |
| Male | 34(26.4) | 0 | . | 1.00 | . | |
| Female | 27(45.0) | 0.75 | 0.36 | 2.12 | (1.1-4.3) | |
| Sows | | | | | | 0.002 |
| 0-10 | 35(26.1) | 0 | . | 1.00 | . | |
| >10 | 29(46.8) | 1.15 | 0.37 | 3.15 | (1.5-6.5) | |
| Sheep | | | | | | 0.002 |
| No | 30(42.3) | 0 | . | 1.00 | . | |
| Yes | 34(27.2) | -1.08 | 0.36 | 0.34 | (1.2-0.7) | |
| Age | | | | | | 0.215 |
| *Do you record the number of animals with disease?* | | | | | | |
| Years | | | | | | 0.024 |
| 1-5 | 54(65.9) | 0 | . | 1.00 | . | |
| 6-15 | 18(43.9) | -1.07 | 0.43 | 0.34 | (0.1-0.8) | |
| 16-29 | 6(50.0) | -0.97 | 0.69 | 0.38 | (0.1-1.5) | |
| >30 | 11(37.9) | -1.23 | 0.53 | 0.29 | (0.1-0.8) | |
| Gender | | | | | | 0.147 |
| Age | | | | | | 0.041 |
| *Do you record the number of animals that died or were euthanased?* | | | | | | |
| Age | | | | | | 0.02 |
| 18-34 | 13(72.2) | 1.27 | 0.62 | 3.56 | (1.1-12.0) | |
| 35-44 | 21(43.8) | 0 | . | 1.00 | . | |
| 45-54 | 38(63.3) | 1.03 | 0.43 | 2.81 | (1.2-6.5) | |
| 55-64 | 24(72.7) | 1.47 | 0.52 | 4.35 | (1.6-12.1) | |
| >65 | 4(40.0) | 0.06 | 0.75 | 1.06 | (0.2-4.6) | |
| Sheep | | | | | | 0.01 |
| No | 47(72.3) | 0 | . | 1.00 | . | |
| Yes | 55(51.9) | -0.93 | 0.36 | 0.39 | (0.2-0.8) | |
| Gender | | | | | | 0.125 |
| *Do you record treatment routine*? | | | | | | |
| Sheep | | | | | | 0.033 |
| No | 49(77.8) | 0 | . | 1.00 | . | |
| Yes | 65(63.1) | -0.82 | 0.39 | 0.44 | (0.2-0.9) | |
| Age | | | | | | 0.285 |
| Gender | | | | | | 0.082 |
| *What would you do if you saw symptoms of disease or unusual behaviour in your pigs? Never (vs. always/sometimes) contact - Neighbour/friend/other producer* | | | | | | |
| Years | | | | | | 0.017 |
| 1-5 | 62(83.8) | 0 | . | 1.00 | . | |
| 6-15 | 24(64.9) | -1.00 | 0.50 | 0.37 | (0.1-1.0) | |
| 16-29 | 4(36.4) | -2.07 | 0.73 | 0.13 | (0.0-0.5) | |
| >30 | 14(56.0) | -1.01 | 0.56 | 0.36 | (0.1-1.1) | |
| Age | | | | | | 0.408 |
| Gender | | | | | | 0.631 |

It seems producers who kept animals for longer (and as a consequence older producers) are less likely to keep a record of the number of animals with disease and deaths (P<0.05). In addition, those producers keeping sheep are less likely to keep records of treatment routines than other producers (P=0.033). The years of experience raising pigs was also associated (P=0.017) with the attitude of contacting another producer in the event of unusual symptoms of disease or behaviour in the pigs,

with those producers who kept pigs for only 1 to 5 years (83.8%) more likely to report this practice than producers with more experience.

#### 4.2.3.5 Communication networks and behaviour

Communication networks and behaviour among smallholders keeping pigs participating in the current study are shown in Table 35 and results of the multivariable logistic regression models in regards to this topic are presented in

As expected, the less experience a producer had raising pigs the more likely (P<0.001) he/she would seek information on pig management and health, with over 90% of producers with only one to five years of experience seeking information compared to 68.6% among producers with more than 30 years experience (Table 36). In addition those producer with more than ten sows were also more likely to seek information (P=0.007). Interestingly, producers who reported keeping sheep (53.5%) in addition to pigs were more likely (P=0.016) to consider the DPI a useful source of information than those without sheep (35.5%). And data suggest that producers with smaller property sizes were more likely to consider the veterinarian a useful source of information. There was an indication that producers with less years of experience were more likely to rely on other smallholders are useful source of information. Over 40% of producers with 1 to 5 years of experience raising pigs compared to between 8.3 to 25% of producers with over five years of experience, considered other smallholders as useful sources of information. Keeping poultry was significantly associated with considering non-government internet sites as useful sources of information (P=0.009) and those producers with a moderate to high knowledge on biosecurity were also more likely to select these internet sites as useful sources of information (P-0.004). The LHPA (currently LLS, Local Livestock Services) were more likely to be considered useful sources of information among pig producers without cattle than among those who reported keeping cattle in addition to pigs (P=0.038).

Regarding methods of information delivery, years of experience raising pigs, and as a consequence age of producers (as age and years keeping pigs were correlated - Figure 9), was associate with the preferred methods (Table 37). Producers with over 30 years of experience were less likely to consider internet based methods (emails and websites) as the most useful methods of information delivery, and were more likely to consider newsletters as a useful method. In addition, male respondents (30.8%) were more likely to consider newspapers as useful sources of information (P=0.022) than female respondents (13.3%).

Table 36 and Table 37. The majority of smallholders seek information on the health of their pigs (82.3%), with veterinarians considered as being a useful information source by 67% of producers. The following most useful source of information was other producers (50.5%), including other smallholders (31.9%) and large scale livestock producers (19.6%). In addition, the State Department of Primary Industries/Agriculture and non-government internet sites were selected as useful sources of information about pigs by over 40% of producers. Websites, emails and newsletters were the preferred methods of information delivery for 23.8%, 21.4% and 19.7% of producers, respectively.

Table 35. Communication networks and behaviour reported by 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013.

| **Communication network practices** | **n(%) respondents** |
|---|---|
| *Do you seek information on management and health of your pigs* | |
| No | 35(17.7) |
| Yes | 163(82.3) |
| *If yes, which ones are the three most useful sources of information?* [a] | |
| DPI | 76(46.6) |
| Veterinarian | 109(66.9) |
| Rural supplier | 44(27.0) |
| Other smallholders | 52(31.9) |
| Large scale livestock producers | 32(19.6) |
| Government internet sites | 47(28.8) |
| Other internet sites | 68(41.7) |
| Small farms network | 13(8.0) |
| NRM/CMA/Landcare | 4(2.5) |
| LHPA[b] | 22(13.5) |
| Industry breed groups | 34(20.9) |
| Community based small farms groups | 10(6.1) |
| *Select the three most useful methods of information delivery* | |
| Newspaper | 46(8.6) |
| Newsletter/letter in the mail | 106(19.7) |
| Seminars/Workshops | 59(11.0) |
| Fax | 13(2.4) |
| Email | 115(21.4) |
| Telephone call | 70(13.0) |
| Website | 128(23.8) |

[a] Could select more than one
[b] Name changed to Local Land Service

As expected, the less experience a producer had raising pigs the more likely (P<0.001) he/she would seek information on pig management and health, with over 90% of producers with only one to five years of experience seeking information compared to 68.6% among producers with more than 30 years experience (Table 36). In addition those producer with more than ten sows were also more likely to seek information (P=0.007). Interestingly, producers who reported keeping sheep (53.5%) in addition to pigs were more likely (P=0.016) to consider the DPI a useful source of information than those without sheep (35.5%). And data suggest that producers with smaller property sizes were more likely to consider the veterinarian a useful source of information. There was an indication that producers with less years of experience were more likely to rely on other smallholders are useful source of information. Over 40% of producers with 1 to 5 years of experience raising pigs compared to between 8.3 to 25% of producers with over five years of experience, considered other

smallholders as useful sources of information. Keeping poultry was significantly associated with considering non-government internet sites as useful sources of information (P=0.009) and those producers with a moderate to high knowledge on biosecurity were also more likely to select these internet sites as useful sources of information (P-0.004). The LHPA (currently LLS, Local Livestock Services) were more likely to be considered useful sources of information among pig producers without cattle than among those who reported keeping cattle in addition to pigs (P=0.038).

Regarding methods of information delivery, years of experience raising pigs, and as a consequence age of producers (as age and years keeping pigs were correlated - Figure 9), was associate with the preferred methods (Table 37). Producers with over 30 years of experience were less likely to consider internet based methods (emails and websites) as the most useful methods of information delivery, and were more likely to consider newsletters as a useful method. In addition, male respondents (30.8%) were more likely to consider newspapers as useful sources of information (P=0.022) than female respondents (13.3%).

Table 36. Multivariable logistic regression analysis of communication networks of 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Do you seek information of the management and health of your pigs?* | | | | | | |
| Years | | | | | | <0.001 |
| 1-5 | 90(92.8) | 0 | . | 1.00 | . | |
| 6-15 | 34(72.3) | -1.84 | 0.54 | 0.16 | (0.1-0.5) | |
| 16-29 | 12(80.0) | -1.36 | 0.81 | 0.26 | (0.1-1.3) | |
| >30 | 24(68.6) | -2.63 | 0.69 | 0.07 | (0.0-0.3) | |
| Sows | | | | | | 0.007 |
| 0-10 | 107(78.7) | 0 | . | 1.00 | . | |
| >10 | 56(90.3) | 1.62 | 0.60 | 5.05 | (1.6-16.3) | |
| Age | | | | | | 0.372 |
| Gender | | | | | | 0.184 |
| *Most useful information source- DPI* | | | | | | |
| Sheep | | | | | | 0.016 |
| No | 22(35.5) | 0 | . | 1.00 | . | |
| Yes | 54(53.5) | 0.84 | 0.35 | 2.31 | (1.2-4.6) | |
| Age | | | | | | 0.864 |
| Gender | | | | | | 0.171 |
| *Most useful information source* -Vet | | | | | | |
| Hectares | | | | | | 0.017 |
| <10 | 23(88.5) | 0 | . | 1.00 | . | |
| 10 - 29 | 21(60.0) | -1.69 | 0.73 | 0.18 | (0.0-0.8) | |
| 30 - 79 | 13(50.0) | -2.31 | 0.75 | 0.10 | (0.0-0.4) | |
| >80 | 51(68.0) | -1.33 | 0.67 | 0.26 | (0.1-1.0) | |
| Age | | | | | | 0.43 |
| Gender | | | | | | 0.703 |
| *Most useful information source - Other Smallholder* | | | | | | |
| Years | | | | | | 0.015 |
| 1-5 | 39(43.3) | 0 | . | 1.00 | . | |
| 6-15 | 6(17.6) | -1.46 | 0.55 | 0.23 | (0.1-0.7) | |
| 16-29 | 1(8.3) | -2.14 | 1.08 | 0.12 | (0.0-1.0) | |
| >30 | 6(25.0) | -0.54 | 0.59 | 0.58 | (0.2-1.9) | |
| Age | | | | | | 0.919 |
| Gender | | | | | | 0.696 |
| *Most useful information source –Non-government internet* | | | | | | |
| Biosec cat | | | | | | 0.004 |
| No - low | 23(31.9) | 0 | . | 1.00 | . | |
| Moderate -high | 30(60.0) | 1.18 | 0.42 | 3.26 | (1.4-7.4) | |
| Poultry | | | | | | 0.009 |
| No | 30(30.3) | 0 | . | 1.00 | . | |
| Yes | 38(59.4) | 1.10 | 0.42 | 2.99 | (1.3-6.8) | |
| Age | | | | | | 0.809 |
| Gender | | | | | | 0.783 |
| *Most useful information source* LHPA | | | | | | |
| Cattle | | | | | | 0.038 |
| No | 13(22.8) | 0 | . | 1.00 | . | |
| Yes | 9(8.5) | -1.03 | 0.50 | 0.36 | (0.1-0.9) | |
| Age | | | | | | 0.943 |
| Gender | | | | | | 0.078 |

Table 37. Multivariable logistic regression analysis of preferred methods of information delivery of 198 smallholders keeping pigs participating in an epidemiological study in Australia in 2013 *(Only significant associations are shown)*.

| | Producers (%) | *B* | SE | Odds ratio | (95% CI) | *P* |
|---|---|---|---|---|---|---|
| *Most useful method of information delivery- Email* | | | | | | |
| Sheep | | | | | | 0.039 |
| No | 48(72.7) | 0 | . | 1.00 | . | |
| Yes | 67(55.4) | -0.76 | 0.37 | 0.47 | (0.2-1.0) | |
| Years | | | | | | 0.045 |
| 1-5 | 62(67.4) | 0 | . | 1.00 | . | |
| 6-15 | 31(72.1) | 0.43 | 0.44 | 1.54 | (0.7-3.6) | |
| 16-29 | 10(66.7) | 0.11 | 0.62 | 1.11 | (0.3-3.7) | |
| >30 | 11(32.4) | -1.10 | 0.49 | 0.33 | (0.1-0.9) | |
| Age | | | | | | 0.935 |
| Gender | | | | | | 0.25 |
| *Most useful method of information delivery* -Newsletter/Mail | | | | | | |
| Years | | | | | | 0.017 |
| 1-5 | 45(48.9) | 0 | . | 1.00 | . | |
| 6-15 | 22(51.2) | 0.28 | 0.39 | 1.33 | (0.6-2.8) | |
| 16-29 | 9(60.0) | 0.55 | 0.58 | 1.73 | (0.5-5.4) | |
| >30 | 27(79.4) | 1.91 | 0.60 | 6.72 | (2.1-21.8) | |
| Age | | | | | | 0.979 |
| Gender | | | | | | 0.173 |
| *Most useful method of information delivery -Newspaper* | | | | | | |
| Gender | | | | | | 0.022 |
| Male | 37(30.8) | 0 | . | 1.00 | . | |
| Female | 8(13.3) | -1.03 | 0.45 | 0.36 | (0.1-0.9) | |
| Age | | | | | | 0.135 |
| *Most useful method of information delivery* - website | | | | | | |
| Years | | | | | | 0.008 |
| 1-5 | 72(78.3) | 0 | . | 1.00 | . | |
| 6-15 | 30(69.8) | -0.60 | 0.44 | 0.55 | (0.2-1.3) | |
| 16-29 | 10(66.7) | -0.75 | 0.64 | 0.47 | (0.1-1.6) | |
| >30 | 13(38.2) | -1.71 | 0.50 | 0.18 | (0.1-0.5) | |
| Age | | | | | | 0.192 |
| Gender | | | | | | 0.128 |

# 5. Conclusions and Recommendations

This is the first national study characterizing smallholder livestock production in Australia. This study included smallholder producers who keep cattle, sheep and/or pigs, involved all states and territories in the country (except Northern Territory) and all the information was gathered during 2013.

The first part of the study reviewed previous research and reports on smallholders and biosecurity within Australia and identified a significant amount of research into the motivations and practices of smallholders prior to 2008; however, the level of research among smallholder declined since then, likely due to a decrease in government resources.

As previously explained, one of the main issues when conducting research among smallholders is the lack of a formal definition. Property size has been commonly used as one of the characteristics to define smallholders; however, previous studies indicate that when investigating biosecurity, the number and types of animals kept as well as the motivations for keeping livestock are more important than property size.

Consultation with stakeholders during this project identified variations in both, knowledge of the sector and the level of association with the smallholders. The only state with a government standalone support service to smallholders is Western Australia, with other states providing support as part of broader agricultural and biosecurity services. State agricultural databases have contact details of producers with a registered PIC and some non-government organizations working with smallholders do also keep a register. However, there is a lack of national or state specific register for smallholders, and registers of non-government organization lack details regarding livestock ownership. All these in conjunction with the relatively high turnover of property ownership among smallholders jeopardize the ability to have up to date contact information for this sector of the industry and as such the capacity to response in event of a disease outbreak.

Results from the distributed questionnaire suggest that smallholders, as defined in the current project, are mainly distributed closer to the coast in Queensland, New South Wales and Western Australia, compared to Victoria and Tasmania, where smallholders are evenly distributed across all state. Based on the data available, those smallholders keeping pigs (smallholder (pigs)) seem to be distributed more inland in NSW than smallholders (general).

***Demographics and general husbandry:*** Most smallholders are male, over 45 years of age and of Australian background. In addition, over 40% are involved in other agricultural and environmental activities. Extra income and home consumption are the main reasons for keeping livestock.

Among smallholders (general), most own relatively small properties (<80 ha) and define themselves as hobby farmers (with older producers less likely to define themselves as hobby farmers). Most keep cattle, almost 40% keep sheep and approximately 30% keep poultry and horses.

Among smallholders (pigs), reported property size is bigger than among smallholders (general), approximately half of participants having properties with more than 80 ha. Data indicates that pig smallholders who also keep cattle and sheep in the property have bigger property sizes. The majority of pig smallholders keep between 1 and 10 sows with a median number of 5 sows. Producers keeping less than 10 sows and those keeping poultry were also more likely to keep pigs as conservation of rare breeds than other producers, and those pig producers keeping also cattle are more likely to have pigs for home consumption than other producers. One of the limitations of the study is that the

number of cattle and sheep kept in the property among smallholders (pigs) was not recorded and as such, some pig producers identified as smallholders in relation to pig production, might not have been smallholders for sheep and/or cattle production.

***Animal movements:*** Between 40 and 50% of smallholders introduced animals in the previous year, from other farms and saleyards. In addition, most smallholders moved livestock off their property in the previous year, mainly to saleyards and abattoirs. Most smallholders keep records of animal movements; however, these records are mainly kept in paper only.

Among smallholders (general), producers with only sheep were less likely to introduce into and move animals off their property than other smallholders and when sheep was introduced it was more likely to be sourced from another farm. Movement of animals off the property was more likely among producers who have kept livestock for more than 15 years and have properties with more than 10 ha.

Among smallholders (pigs), producers with more than ten sows were more likely to have introduced pigs in the previous 12 months and used other farms as the source of their pigs. The more growers kept in the property the more likely a producer had moved pigs off the property in the previous year and had used an abattoir as the destination of these pigs.

***Biosecurity knowledge and practices:*** The level of understanding of the term biosecurity among smallholders was variable, with approximately half of the responses defining the term biosecurity indicating at least a moderate level of understanding of the term. The knowledge of the term biosecurity seemed to be lower among smallholders (pigs) than smallholders (general). Among all smallholders, biosecurity practices related to animal handlers, visitors and isolation of incoming animals were generally inadequate, with most respondents not following correct protocols. For example, approximately 40% of smallholders do not isolate incoming livestock, with the most frequently reported reason for not isolating being the perception that there was no need on their property. In addition, records of visitors and hand wash requirements were limited.

***Health and management practices:*** A low contact with the veterinarian was observed, with almost 30% of smallholders reporting that they never contacted a veterinarian. Interestingly, smallholders would call the veterinarian if they saw unusual symptoms of disease or behaviour in their livestock. However, most would also treat themselves or call another producer and over a third would do nothing and expect that it would get better with time. Approximately half and between 60 and 70% of smallholders would never contact the State DPI or the exotic disease hotline, respectively. Between 50 and 70% of smallholders record information on animals with disease, animal deaths and treatment routines.

Among smallholders (general), it seems that those producers keeping cattle and sheep, keeping horses and with better biosecurity knowledge are more likely to have used a veterinarian in the past 12 months.

Among smallholders (pigs), producers with more than 10 sows are more likely to have contacted a veterinarian in the previous year than producers with smaller herds.

***Communication networks and behaviour:*** Most smallholders seek information on the health of their livestock and veterinarians are considered as being the most useful information source, followed by the State Department of Primary Industries / Agriculture and other smallholders. In addition, rural

suppliers are also considered an important useful source of information among smallholders (general); while smallholders (pigs) also considered non-government internet sites as important sources of information. Younger producers and with less experience raising livestock are more likely to seek information on health and management of their livestock. Among smallholders (general), producers from NSW and Western Australia were more likely to consider the State DPI a useful source of information than producers from other states.

The most useful methods of information delivery were newsletters, email and websites. However, internet based methods are preferred by younger smallholders, with older producers preferring paper based methods.

Results from this study provide baseline information on the demographics and practices of livestock producers keeping less than 50 cattle, sheep and/or pigs. The questionnaire was provided in English only, and it is noted that there may be a potential bias on the information collected from respondents due to the English language requirements for completion of the questionnaire.

This study used this definition for smallholders based on findings from previous studies and in consultation with government and industry stakeholders. However, it is still uncertain how best to define a smallholder. The number of animals kept in the property is definitely an important characteristic which affects the practices conducted on-farm, such as animal movements, biosecurity, health management and communications. However, other characteristics, such as the motivations for keeping animals and how a producer defines his/her own enterprise might also be significant and affect their practices. Independently of how we define them, findings from this study suggest that there is a lack of awareness and practice of biosecurity and health management, and the animal movement patterns among smallholders are similar to those of commercial producers. Smallholders seek information on the health and management of their livestock; however, a significant proportion of smallholders do not consider the government as a useful source of information. The main recommendations arising from this project are the following:

1. **State registers with up to date information on livestock producers, including location and number and type of animals kept**

2. **A better understanding of the extension programs and communication channels used among smallholders and how the influence their practices**

3. **Use of trusted sources of information to implement and deliver extension programs**

This project identified a lack of up to date registers of livestock producers within the State government agencies as well as within non-government organizations and groups. The high turnover of ownership among producers with low number of animals makes difficult to keep up to date information; however, efforts should be focused on maintaining updated information, to minimize the potential impact of a disease outbreak.

This project only gathered baseline information on the communication network of smallholders. However, there is a lack of clear understanding of the methods currently used to engage smallholders with biosecurity and disease recognition and reporting. Findings from this study indicate that the sources of the information smallholders receive and the methods used for delivery

of this information are crucial for engaging producers. Similarly, the amount of information they receive might also affect how they respond to this information and the influence this information has on their practices. In addition, effectiveness of the current communication strategies is uncertain; however, the low level of biosecurity practices applied on farm among smallholders as well as some of their health management practices might indicate that these strategies are not as effective as they should be. Further research is warranted to understand how effective the current communication strategies are and how to develop appropriate strategies that are effective for the target audience and would achieve the desired practice change.

The current study identifies veterinarians as the most trusted sources of information; however, contact with veterinarians is not frequent, limiting the potential influence that the veterinarian could have on the practices of smallholders. Other producers are also identified as one of the most useful sources of information. Direct engagement of what we could define as 'champion' producers on the delivery of extension programs might increase producer engagement.

There is a need for a coordinated approach among government and industry organizations, including all stakeholders involved with smallholders, to develop appropriate communication strategies, with clear messages, and delivered by trusted stakeholders.

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# 7. Appendix

**Appendix A -Definitions of smallholders – Overseas**

| **United States of America** (Hoppe and Banker, 2010p1) | |
|---|---|
| Small family farms (gross farm sales less than $250,000) | |
| Retirement farms. | Small farms whose operators report they are retired, although they continue to farm on a small scale. These operations sell enough farm products (at least $1,000 worth) to qualify as farms under the current farm definition. |
| Residential/lifestyle farms. | Small farms whose operators report a major occupation other than farming<br>The category also includes a small number of farms—8 percent of the group in 2007—whose operators are not in the labor force. |
| Farming-occupation farms. | Small family farms whose operators report farming as their major occupation.<br>•Low-sales farms. Gross sales less than $100,000.<br>•Medium-sales farms. Gross sales between $100,000 and $249,999 |
| **EU (European Commission Agriculture and Rural Development, 2011)** | |
| | No clear definition<br>Commonly used criteria- physical measures (land or labour input), market participation and economic size |

**Appendix B- Main types of smallholders according to previous research**

| Terms | Description | Reference |
|---|---|---|
| Treechangers | Moved from a large city to a smaller town or rural area (bush rather than coastal) | Aslin (2006p3) |
| Hobby farmer | Someone who owns a rural property but is not primarily a farmer by occupation or income | |
| Lifestyle farmer | Rural landholder who farms or lives on the land principally for lifestyle reasons not for financial reasons related to farming | |
| Small farmer | Rural landholder who owns a small acreage probably insufficient in size to farm commercially | |
| Peri-urban landholder | Landholder owning land at the fringe of an urban area, beyond the suburbs | |
| Downshifter | Someone making a voluntary decision to sacrifice financial benefits in favour of a better lifestyle e.g. more leisure | |
| Peri-urban-dwellers | Urban fringe, metropolitan fringe, rural- urban fringe, urban-rural interface, the near-urban, the pre-urban, peri-metropolitan, exurban or urban (Buxton et al., 2006) | Wadsworth and Choy (2011) |
| Part-time Farmers | Hobby farmers, quasi-commercial farmers/producers, income supplementers | Maller et al. (2007p34) |
| Full-time Farmers | Commercial intensive growers intensive livestock | |
| Part-time Lifestylers | Commuters, hobbyists, recreationists, absentees | |
| Full-time Lifestylers | Retirees, downshifters, forced relocators, conservationists, misfits, 'ferals', sea changers, tree changers, dirt changers | |
| Green small lifestyle | Focus on land purchase is to improve/care for the environment. Perceive native biodiversity as very important, top priority, have a land stewardship ethic, broadly recognise environmental problems, are highly motivated to improve conservation values. May or may not be involved in agriculture. | Hollier et al (2004p19) |
| Lifestyle small lifestyle | Buy land solely for lifestyle purpose – to be out of the 'rat race', or have an open space for the kids, or so they can have chickens and a vegetable patch. Generally live on the land. Environment and land stewardship concepts can be important, but is not highest priority, and recognition of environmental problems and native biodiversity is usually low. | |
| Farming small lifestyle | Purchase land with the ideal of making money in the future. Small scale. Can live on or off the land. May or may not perceive environment and land stewardship as important. Recognition of environmental problems would be higher than lifestyle farmers, but not as high as green farmers. | |

**Appendix C -Definitions of smallholders - Australia (Industry/Service provision)**

| **National** | | |
|---|---|---|
| Australian Pork Limited | *Number of Sows* | *Classification band* |
| | Up to 2 pigs (or 2 sows) | Own use |
| | < 8 | Pig keeper |
| | 8 – 50 | Small holder or Small producer |
| Australian Pork Industry Quality Assurance Program (APIQ) | Maintains a breeding sow herd of 50 or less sows; AND/OR produces, trades or sells live, or to slaughter, up to 1000 pigs in a financial year. | |
| ABS | No data collected if EVAO <$5000<br>Sub-commercial farms- Estimated value of agricultural operations (EVAO) of between AUS$5,000 and AUS$22,499 | |
| **Western Australia** | | |
| Small Landholder Information Service | 1-100 hectares. | |
| South Coast NRM | 1 - 100 acres. | |
| Blackwood Valley Small Landholders group | No formal definition. Their members generally have between ½ and 80 hectares. | |
| **Victoria** | | |
| North East Catchment Management Authority | 2-100 Ha, though mostly 5-40ha. Generally low agricultural production (ie exclude small area but intensive production such as horticulture) and mostly grazing enterprises. Generally have off farm income. | |
| **Queensland** | | |
| Fitzroy River and Coastal Catchments | Generally people who are not making a fulltime income from the land. Focus small landholder workshops on properties between a couple and 100 hectares. Rockhampton Regional Council sends smallholder information to people who have less than 500 hectares. | |
| **South Australia** | | |
| PIRSA | No clear definition | |
| **NSW/ACT** | | |
| Small Farms Network | No formal definition but in general it is properties between 2 and 40 hectares. | |
| Molonglo Catchment Group | Generally considered being a 20 acre block. | |
| Hastings Landcare Inc | Not formally defined – but generally considered to be the peri-urban – rural residential areas | |
| **Tasmania** | | |
| NRM North | 2-50 hectares. Non commercial | |
| NRM South | No definition. Generally viewed as 2-100hectares. | |

**Appendix D - Stakeholder consultation question template**

1. Definition of smallholder according to your organisation
2. Nature of the service and or involvement of your organisation with smallholders
3. How many people within your organisation work and/or are involved with smallholders?
4. What are the main communication methods used by your organisation to contact smallholders?
5. Does your organisation keep a register of smallholders?
6. What is the legal requirement regarding registration of smallholders within your organisation?
7. Do you have an estimate of the number of smallholders in your jurisdiction?
8. Are there specific areas or location in your state where smallholders concentrate?
9. Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)?
10. Do you have basic demographic information on these smallholders, such as animal species and number of animals kept?
11. Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)?
12. Is there any literature/report/documentation available in your jurisdiction in relation to smallholders?

**Appendix E Information Statement and Questionnaire distributed among smallholders (pigs) in Australia.**

Charles Sturt University

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## Information Statement

**Project title:** Characterization of smallholder livestock production in Australia

- **Principal Investigator:** Phone: W 02 6933 2086
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- **Research Assistant:** Phone: W 02 6933 2802
Lynne Hayes Email: lhayes@csu.edu.au

Thank you for taking the time to participate in this research project. The questionnaire takes approximately 10 minutes to complete.

The project is funded by the Department of Agriculture, Fisheries and Forestry with the aim of gaining a better understanding of smallholder livestock production in Australia, including the demographic characteristics, on-farm practices and communication networks of smallholders. Smallholders play an important role in livestock production but there are gaps in our knowledge. Through being involved in the project you will be contributing to the overall knowledge and understanding of smallholders and biosecurity. This knowledge will lead to a clearer understanding of your needs and how best to support them.

**What you need to do to participate:**
Please complete the questionnaire provided and return it in the reply paid envelope. Alternatively the completed questionnaire can be faxed to Lynne Hayes - 02 6933 2991.

Please note that you may inadvertently receive this questionnaire more than once, either by post or as an email. We have tried to minimise the chances of this occurring but apologise for any inconvenience should this happen. We ask that you only complete and return the questionnaire once.

**What this means for you as a participant:**
By completing and returning the questionnaire you are agreeing to freely volunteer to participate in this project. Any information or personal details gathered in the course of this research are confidential and no identifying information will be used or published without your written permission.

**What happens afterwards?**
The data collected will be analysed and a report produced. All data collected in this project will be fully anonymised and no participants or their situations will be identifiable in any publications that arise from this work. You have the option to include your contact details to go into a prize draw for a $50 Coles/Myer voucher. If you choose to provide your contact details as part of this draw, your details will be recorded for this purpose only in a secure electronic file and deleted at the completion of the draw.

**Your rights:**
You may withdraw from the project by not submitting a questionnaire if you perceive it violates your privacy and confidentiality. You may choose to not answer a question if you prefer. By submitting the questionnaire you are indicating your agreement to participate in the project.

**NOTE:** The School of Animal and Veterinary Sciences Ethics Committee has approved this project. If you have any complaints or reservations about the ethical conduct of this project, you may contact the Committee through the Executive Officer:
**Dr Raf Freire, Chair, School of Animal and Veterinary Sciences Human Ethics Committee,**
Locked Bag 588, Wagga Wagga 2678 NSW.
**Telephone: (02) 6933 4451; Email: rfreire@csu.edu.au.**
Any issues you raise will be treated in confidence and investigated fully and you will be informed of the outcome

With many thanks,

Dr Marta Hernandez-Jover
Principal Investigator, on behalf of the Research Team

Charles Sturt University

**Understanding small scale pig production in Australia**

THE UNIVERSITY OF SYDNEY

**Private & Confidential:** Response is voluntary; however, we would be grateful if you would agree to take part in our study and return the completed questionnaire within three weeks. Your report will improve understanding of your needs as a small-scale pig producer. Please circle or tick the most appropriate option.

**Demographics and general husbandry:**

1. Postcode: _____
2. How many years have you kept pigs for?

   _____
3. How many sows (including gilts) do you keep? _____
4. How many growers (weaners to finishers) do you keep?

   _____
5. Why do you keep pigs? please circle any that apply

   Primary income / Extra income/ Family tradition /
   Home consumption /Pet / Rare breeds / Hobby/
   Other:_____
6. Which other animal species do you keep on your property?

   _____

   _____
7. Do you undertake any other agricultural/horticultural activities on your property? Please describe.

   _____

   _____
8. Are you involved in any biodiversity /conservation /environmental activities on your property? Please describe.

   _____

   _____
9. How many acres is your property? _____
10. How many commercial piggery operations are within 5km of your property? _____

**Animal movements:**

11. Did you introduce new pigs onto your property in the previous 12 months (do not include new births)? Y ☐ N ☐

    (if yes, Q12; if no, Q16)
12. Regarding sources of new pigs introduced onto your property:

    Saleyard:

| Postcode of saleyard | Type of animal | Number of introductions/year | Average animals per introduction |
|---|---|---|---|
| | | | |

    Another farm:

| Postcode of other farm | Type of animal | Number of introductions/year | Average animals per introduction |
|---|---|---|---|
| | | | |

13. Did you introduce new pigs from another source?

    If yes, please specify: Y ☐ N ☐

    _____

    _____
14. Do you isolate incoming pigs upon arrival? Y ☐ N ☐

    If yes, how many days? _____

    If yes, how far from the main herd? _____
15. If you answered "no" to Q14 above, is it because of:

    Lack of time / Lack of space / Lack of money /

    No need on my property/ Unaware of a reason to do this
16. Did you move any pigs off your farm in the previous 12 months? Y ☐ N ☐ (If yes, Q17, if no Q19)
17. Regarding destination of pigs moved off your property:

    Saleyard:

| Postcode of saleyard | Type of animal | Number of exits/year | Average animals per exit |
|---|---|---|---|
| | | | |

    Direct to another farm:

| Postcode of other farm | Type of animal | Number of exits/year | Average animals per exit |
|---|---|---|---|
| | | | |

    Abattoir:

| Postcode of abattoir | Type of animal | Number of exits/year | Average animals per exit |
|---|---|---|---|
| | | | |

18. Did you move pigs off your farm to any another destinations? Y ☐ N ☐

    If yes, please specify:_____

Turn page ?

19. Do you keep records of animal movements? Y ☐ N ☐

If yes, please circle the most appropriate:

Paper / Computer / Whiteboard/ PigPass NVD / Waybill

20. Does your property have a registered Property Identification Code (PIC)? Y ☐ N ☐ I don't know ☐

**Biosecurity:**

21. How many times a year would animal handlers that have close contact with your pigs visit your property? (include vets, contractors, stock inspectors, etc)

| Minimum | Average | Maximum |
|---|---|---|
| | | |

22. Do you require animal handlers to wash their hands before and after handling your pigs? Y ☐ N ☐

23. Do you provide clothes/overalls for visitors with contact with pigs? Y ☐ N ☐

24. Do you keep records of visitors? Y ☐ N ☐

If yes, please specify:_____

_____

25. How would you define the term biosecurity?

_____

_____

_____

_____

**Herd/Flock and Health Management:**

26. How often do you inspect your pigs:

Daily / Weekly / Fortnightly / Monthly

27. Do you record the following health related events?

Number of animals with disease Y ☐ N ☐

Number of animals that died or were euthanased Y ☐ N ☐

Treatment routine Y ☐ N ☐

Other; please describe_____

_____

28. Have you contacted a veterinarian in the past 12 months regarding the health of your pigs? Y ☐ N ☐

If not, when was the last time a veterinarian was contacted?

Never / 1-2 y ago / 3-5 y ago / >5 y ago

29. What would you do if you saw symptoms of disease or unusual behaviour in your pigs? Please respond for all listed actions.

| | Always | Sometimes | Never |
|---|---|---|---|
| Do nothing – it will get better with time | | | |
| Treat it myself | | | |
| Call a neighbour / friend/ other producer | | | |
| Call a veterinarian | | | |
| Call the livestock agent / saleyard | | | |
| Call the Dept. of Primary Ind./Agriculture | | | |
| Call the exotic disease hotline | | | |

Communication:

30. Do you seek information on management and health of your pigs? Y ☐ N ☐

If yes, select the three (in order of importance from 1 to 3) most useful sources of information:

___ Department of Primary Industries/Agriculture
___ Veterinarian
___ Rural supplier
___ Other smallholders
___ Large scale livestock producer
Government internet sites
___ Other internet sites
___ Small farms network
___ NRM/Catchment Management Authority/Landcare
___ Livestock Health and Pest Authority
Industry/breed groups
Community based small farms group
___ Other:_____

31. Select the three (in order of importance from 1 to 3) most useful methods of information delivery for you regarding management and health of your pigs:

___ Newspaper
___ Newsletter / Letter in the mail
Seminars/Workshops
___ Fax
___ Email
___ Telephone call
___ Website

32. Regarding your pigs, what would you like to learn more about?

_____

_____

_____

**About you:**

33. Age: 18-24 / 25-34 / 35-44 / 45-54 / 55-64 / >65

34. Gender: M ☐ F ☐

35. What is your ethnic background? _____

Please return completed questionnaire in the enclosed envelope or fax to Lynne Hayes on 02 6933 2991 (Attention: Lynne Hayes) within three weeks from receiving it.

Please provide your contact details if you would like to go into the lucky draw to win one of 5 Coles Myer gift certificates worth $50 each

Name: _____

Telephone: _____

Email: _____

*Thank you for your cooperation!*

**Appendix F Information Statement and Questionnaire distributed as a postal/electronic questionnaire among smallholders (general) in Australia.**

Charles Sturt University

**SCHOOL OF ANIMAL AND VETERINARY SCIENCES**
FACULTY OF SCIENCE

Locked Bag 588
Boorooma Street
Wagga Wagga
NSW 2678

Tel: +61 2 6933 4479
Fax:+61 2 6933 2991
www.csu.edu.au/vet
Email: savs@csu.edu.au

## Information Statement

**Project title:** Characterization of smallholder livestock production in Australia


- **Principal Investigator:** Phone: W 02 6933 2086
Dr Marta Hernandez-Jover Email: mhernandez-jover@csu.edu.au
- **Co-investigator:** Phone: W 02 9351 1609
Associate Professor Jenny-Ann Toribio (USyd) Email: jenny-ann.toribio@sydney.edu.au
- **Research Assistant:** Phone: W 02 6933 2802
Lynne Hayes Email: lhayes@csu.edu.au


Thank you for taking the time to participate in this research project. **We are asking for responses to the questionnaire from smallholders who keep less than 50 cattle, and/or less than 50 sheep and/or less than 50 sows.** The questionnaire takes approximately 10 minutes to complete. The questionnaire should be completed by the person at the property who has the most involvement with the livestock.

The project is funded by the Department of Agriculture, Fisheries and Forestry with the aim of gaining a better understanding of smallholder livestock production in Australia, including the demographic characteristics, on-farm practices and communication networks of smallholders. Smallholders play an important role in livestock production and by being involved in the project you will be contributing to the overall knowledge and understanding of smallholders and biosecurity. This knowledge will lead to a clearer understanding of your needs and how to best support them.

**What you need to do to participate:**
Please complete the questionnaire provided and return it in the reply paid envelope. Alternatively the completed questionnaire can be faxed to Lynne Hayes - 02 6933 2991.

Please note that you may inadvertently receive this questionnaire more than once, either by post or as an email containing a link to SurveyMonkey. We have tried to minimise the chances of this occurring but apologise for any inconvenience should this happen. We ask that you only complete and return the questionnaire once.

**What this means for you as a participant:**
By completing and returning the questionnaire you are agreeing to freely volunteer to participate in this project. Any information or personal details gathered in the course of this research are confidential and no identifying information will be used or published without your written permission.

**What happens afterwards?**
The data collected will be analysed and a report produced. All data collected in this project will be fully anonymised and no participants or their situations will be identifiable in any publications that arise from this work. You have the option to include your contact details to go into a prize draw for a $50 Coles/Myer voucher. If you choose to provide your contact details as part of this draw, your details will be recorded for this purpose only in a secure electronic file and deleted at the completion of the draw.

**Your rights:**
You may withdraw from the project by not submitting a questionnaire if you perceive it violates your privacy and confidentiality. You may choose to not answer a question if you prefer. By submitting the questionnaire you are indicating your agreement to participate in the project.

**NOTE:** The School of Animal and Veterinary Sciences Ethics Committee has approved this project. If you have any complaints or reservations about the ethical conduct of this project, you may contact the Committee through the Executive Officer:
**Dr Raf Freire, Chair, School of Animal and Veterinary Sciences Human Ethics Committee,**
Locked Bag 588, Wagga Wagga 2678 NSW.
**Telephone: (02) 6933 4451; Email: rfreire@csu.edu.au.**
Any issues you raise will be treated in confidence and investigated fully and you will be informed of the outcome

With many thanks,

Dr Marta Hernandez-Jover
Principal Investigator, on behalf of the Research Team

Charles Sturt University

**Understanding small landholders in Australia**

THE UNIVERSITY OF SYDNEY

**Private & Confidential:** Response is voluntary; however, we would be grateful if you would agree to take part in our study by answering all questions and returning the questionnaire within three weeks. Your report will improve understanding of your needs. Please circle or tick the most appropriate option.

**The questionnaire should be completed by the person at the property who has the most involvement with the livestock.**

**Demographics and general husbandry:**

1. Postcode: _____
2. How many years have you been involved with livestock? ☐
3. Do you keep cattle- include bulls, steers, heifers, cows -on your property? Y ☐ N ☐
   - If yes, how many adult cattle do you keep? ☐
   - Why do you keep cattle? please circle any that apply

   Primary income / Extra income / Family tradition / Home consumption/ Pet/ Other: _____
4. Do you keep sheep- include rams, ewes, wethers -on your property? Y ☐ N ☐
   - If yes, how many adult sheep do you keep? ☐
   - Why do you keep sheep? please circle any that apply

   Primary income / Extra income / Family tradition / Home consumption /Pet / Other: _____
5. Do you keep pigs on your property? Y ☐ N ☐
   - If yes, how many sows do you keep? ☐
   - If yes, how many growers do you keep? ☐
   - Why do you keep pigs? please circle any that apply

   Primary income / Extra income/ Family tradition / Home consumption /Pet/ Other: _____
6. Which other animal species do you keep on your property?

   _____

   _____
7. Do you undertake any other agricultural/horticultural activities on your property? Please describe.

   _____

   _____
8. Are you involved in any biodiversity /conservation /environmental activities on your property? Please describe.

   _____

   _____
9. How would you define your livestock operation?

   Self-sufficiency / hobby farmer / lifestyle / exhibition or rare breeds / Other: _____
10. How many acres is your property? _____

**Animal movements:**

11. Did you introduce new livestock (cattle, sheep and or pigs) onto your property in the previous 12 months (do not include new births)? Y ☐ N ☐

    (if yes, Q12; if no, Q16)
12. Regarding sources of new livestock introduced onto your property:

    Saleyard:

| Postcode of saleyard | Animal species | Number of times per year | Average animals per introduction |
|---|---|---|---|
| | | | |
| | | | |

    Another farm:

| Postcode of other farm | Animal species | Number of times per year | Average animals per introduction |
|---|---|---|---|
| | | | |
| | | | |

13. Did you introduce new livestock from another source?
    If yes, please specify: Y ☐ N ☐

    _____

    _____
14. Do you isolate incoming livestock upon arrival? Y ☐ N ☐
    If yes, how many days? ☐
15. If you answered "no" to Q14 above, is it because of:

    Lack of time / Lack of space / Lack of money /

    No need on my property/ Unaware of a reason to do this
16. Did you move any livestock off your farm in the previous 12 months? Y ☐ N ☐ (If yes, Q17, if no Q19)
17. Regarding destination of livestock moved off your property?

    Saleyard:

| Postcode of saleyard | Animal species | Number of times/year | Average animals per exit |
|---|---|---|---|
| | | | |
| | | | |

    Direct to another farm:

| Postcode of other farm | Animal species | Number of times/year | Average animals per exit |
|---|---|---|---|
| | | | |
| | | | |

Turn page ?

18. Did you move livestock off your farm to any other destinations? Y ☐ N ☐

    If yes, please describe: _____

19. Do you keep records of animal movements? Y ☐ N ☐

    If yes, please circle the most appropriate:
    Paper/Computer/Whiteboard

20. Does your property have a registered Property Identification Code (PIC)? Y ☐ N ☐ I don't know ☐

**Biosecurity:**

21. How many times a year would animal handlers that have close contact with your livestock visit your property? (include vets, contractors, stock inspectors, etc)

| Minimum | Average | Maximum |
|---|---|---|
| | | |

22. Are animal handlers required to wash their hands before and after handling your livestock? Y ☐ N ☐

23. Are visitors with contact with livestock provided with clothes/overalls? Y ☐ N ☐

24. Do you keep records of visitors? Y ☐ N ☐

    If yes, please specify: _____

    _____

25. How would you define the term biosecurity?

    _____

    _____

    _____

**Herd/Flock and Health Management:**

26. How often do you inspect your livestock:

    Cattle: daily / weekly / fortnightly / monthly

    Sheep: daily / weekly / fortnightly / monthly

    Pigs: daily / weekly / fortnightly / monthly

27. Do you record the following health related events?

    Number of animals with disease Y ☐ N ☐

    Number of animals that died or were euthanased Y ☐ N ☐

    Treatment routine Y ☐ N ☐

    Other; please describe _____

28. Have you contacted a veterinarian in the past 12 months regarding the health of your livestock? Y ☐ N ☐

    If not, when was the last time a veterinarian was contacted?

    Never / 1-2 y ago / 3-5 y ago / >5 y ago

29. What would you do if you saw symptoms of disease or unusual behaviour in your livestock? Please respond for all actions.

| | Always | Sometimes | Never |
|---|---|---|---|
| Do nothing – it will get better with time<br>Treat it myself | | | |
| Call a neighbour / friend/ other producer<br>Call a veterinarian | | | |
| Call the livestock agent / saleyard | | | |
| Call the Dept. of Primary Ind./Agriculture<br>Call the exotic disease hotline | | | |

**Communication:**

30. Do you seek information on management and health of your livestock? Y ☐ N ☐

    If yes, select the three (in order of importance from 1 to 3) most useful sources of information:

    ___ Department of Primary Industries/Agriculture
    ___ Veterinarian
    ___ Rural supplier
    ___ Other smallholders
    ___ Large scale livestock producer
    ___ Government internet sites
    ___ Other internet sites
    ___ Small farms network
    ___ NRM/Catchment Management Authority/Landcare
    ___ Livestock Health and Pest Authority
    ___ Industry/breed groups
    ___ Community based small farms group
    ___ Other: _____

31. Select the three (in order of importance from 1 to 3) most useful methods of information delivery for you:

    ___ Newspaper
    ___ Newsletter / Letter in the mail
    ___ Seminars/Workshops
    ___ Fax
    ___ Email
    ___ Telephone call
    ___ Website

32. Regarding your livestock, what would you like to learn more about?

    _____

    _____

    _____

**About you:**

33. Age: 18-24 / 25-34 / 35-44 / 45-54 / 55-64 / >65

34. Gender: M ☐ F ☐

35. What is your ethnic background? _____

Please return completed questionnaire in the enclosed envelope or fax to Lynne Hayes on 02 6933 2991 (Attention: Lynne Hayes) within three weeks from receiving it.

Please provide your contact details if you would like to go into the lucky draw to win one of 5 Coles Myer gift certificates worth $50 each.

Name: _____

Telephone: _____

Email: _____

*Thank you for your cooperation!*

## Appendix G - Stakeholder consultations

**Western Australia**

**Small Landholder Information Service (SLIS) - Yolandee Jones**

| | | |
|---|---|---|
| 1. | Definition of smallholder according to your organisation | 1-100 hectares. |
| 2. | Nature of the service and or involvement of your organisation with smallholders | SLIS- Work with new small landholders.<br>3 tiered approach.<br>1. Information. Farmnotes<br>2. Workshops, field days, events<br>3. Enquiry service. Provides both general and specific information |
| 3. | How many people within your organisation work and/or are involved with smallholders? | 2 staff members- 1.2 FTE. They are able to draw on the expertise of other staff working in Biosecurity, Vet and Horticulture. |
| 4. | What are the main communication methods used by your organisation to contact smallholders? | • e-newsletter (quarterly).<br>• Website.<br>• Contribute to My Block- an insert in Countryman (rural paper).<br>• Noteworthy series.<br>• The SLIS has had their budgets adjusted so the number of workshops set to run this year is between 10 and 12. Estimate 300 people engaged in workshops. They have a couple of phone enquiries each week. |
| 5. | Does your organisation keep a register of smallholders? | Database- contains contact details but doesn't specify numbers and types of livestock kept. Database was designed for large broad acre farms and doesn't capture the information SLIS would like it to. Found that it was difficult to keep up to date as there is a high turnaround in property ownership for this group (2 years). Could use the shire rates data base? |
| 6. | What is the legal requirement regarding registration of smallholders within your organisation? | No legal requirement to be registered within the organisation. Need to be registered with Department of Lands and Shires. Bunbury Brands office would have information on livestock that is registered. |
| 7. | Do you have an estimate of the number of smallholders in your jurisdiction? | In 2006 mapping was done that estimated 60,000 SLH between Geraldton and Esperance. The numbers have increased but not quantified. |
| 8. | Are there specific areas or location in your state where smallholders concentrate? | Tends to be Perth fringes (peri-urban), Blackwood (SLIS work with Blackwood Valley Small Landholders group) Bridgetown, Nannup and coastal plain from Perth to Esperance. |
| 9. | Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby | All of the above plus nature conservation, small industry and eco tourism. |

| | |
|---|---|
| farmer/lifestyle, exhibition/rare breeds, other)? | |
| 10. Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | Brands office in Bunbury has information of those register for a brand. However, in general they are a mixed flock. |
| 11. Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | Online- issue would be that WA does not have reliable internet access and there is a view that the public is being overwhelmed by online surveys. Face to face considered the best option. Discussed how we could utilise SLIS networks to reach SLH and Yolandee agreeable to assisting, depending on the numbers involved. Some suggested avenues discussed were tying in with proposed workshops looking at the new Biosecurity Act implications ( expect 30-40 people), extract contact details from the brands data base, send information to people who have shown an interest in the SLIS seeking their involvement, placing information into newsletters about the project and then following up interest. |
| 12. Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | Yolandee to follow up with any additional reports she has. |

**Blackwood Valley Small Landholders Group - Eric Wheatley**

| | | |
|---|---|---|
| 1. | Definition of smallholder according to your organisation | No formal definition. Members generally have between ½ and 80 hectares. |
| 2. | Nature of the service and or involvement of your organisation with smallholders | They are an advisory/information support group. Run workshops, publish articles and a quarterly newsletter. They do a monthly bulk email with relevant information. |
| 3. | How many people within your organisation work and/or are involved with smallholders? | N/A. They all work within the area of small holder support. |
| 4. | What are the main communication methods used by your organisation to contact smallholders? | Quarterly newsletter. Monthly bulk email. |
| 5. | Does your organisation keep a register of smallholders? | They have a mailing list of members- around 80 properties. Note that while most are small land holders, they are not all. |
| 6. | What is the legal requirement regarding registration of smallholders within your organisation? | - |
| 7. | Do you have an estimate of the number of smallholders in your jurisdiction? | Would be between 400-500. |
| 8. | Are there specific areas or location in your state where smallholders concentrate? | They are located in the Bridgetown area and generally service that area. |
| 9. | Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | They are a mix. They are mainly hobby/lifestyle farmers. Some make income from grapes, olives and alpacas. |
| 10. | Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | Mainly alpacas and sheep. Not a lot have cattle. |
| 11. | Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | They have email contact and would be willing to assist with placing project information and questionnaire in their newsletter. They would need committee approval to do this. |
| 12. | Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | - |

**South Coast NRM / Torbay Catchment Group- Craig Carter**

| | | |
|---|---|---|
| 1. | Definition of smallholder according to your organisation | Between 1 and 100 acres. |
| 2. | Nature of the service and or involvement of your organisation with smallholders | Umbrella organisation over the catchments. Community engagement. Educational. Workshops through the Catchment groups- suggest Torbay and Wilson Inlet. Main focus is on property management |
| 3. | How many people within your organisation work and/or are involved with smallholders? | They work with the catchments and as such all staff work with all land holders- not specifically smallholders. |
| 4. | What are the main communication methods used by your organisation to contact smallholders? | *Torbay Catchment Group*- 6monthly Newsletter<br>*Wilson Inlet Catchment*<br>Green skills- funded by the South Coast NRM – have website to educate and involve the community in natural resource management and encourage sustainable farming practices. www.mysmallproperty.greenskills.org.au |
| 5. | Does your organisation keep a register of smallholders? | No. The catchment groups would have details for Newsletters etc but these may not all be small holders. |
| 6. | What is the legal requirement regarding registration of smallholders within your organisation? | - |
| 7. | Do you have an estimate of the number of smallholders in your jurisdiction? | Approximately 300. |
| 8. | Are there specific areas or location in your state where smallholders concentrate? | - |
| 9. | Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | Mix |
| 10. | Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | Mainly cattle, then sheep. No details on numbers kept. |
| 11. | Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | If catchment committees agree we could link in with their Newsletters. |
| 12. | Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | http://www.greenskills.org.au/pub/rcep/rcep.pdf |

**NSW**

**Belinger Landcare- Colin Matthews**

| | | |
|---|---|---|
| 1. | Definition of smallholder according to your organisation | -not defined |
| 2. | Nature of the service and or involvement of your organisation with smallholders | They provide extension activities with the CMA and DPI- workshops, skills and awareness. Smallholders are a part of the group that they work with. Over the last 5-10 years supporting new small landholders has been a growing part of what they do. A few years ago they tried to set up a small farms network but found this very hard. |
| 3. | How many people within your organisation work and/or are involved with smallholders? | - |
| 4. | What are the main communication methods used by your organisation to contact smallholders? | They have a newsletter |
| 5. | Does your organisation keep a register of smallholders? | They have a register that includes small land holders, but not a specific small landholder's register. |
| 6. | What is the legal requirement regarding registration of smallholders within your organisation? | - |
| 7. | Do you have an estimate of the number of smallholders in your jurisdiction? | Couldn't put a figure on it but it is a large number. |
| 8. | Are there specific areas or location in your state where smallholders concentrate? | Bellinger Landcare covers Bellinger-Dorrigo region. |
| 9. | Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | Mostly beef cattle. Some sheep goats and alpacas. |
| 10. | Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | They are not a cohesive group and they have different drivers to other farmers. No details on species and numbers. |
| 11. | Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | They have used Survey Monkey with ok results. A follow up phone call is best with this. They would be happy to assist with the distribution of the questionnaire. |
| 12. | Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | no |

**Hastings Landcare Inc- Daintry Gerrard**

| | | |
|---|---|---|
| 1. | Definition of smallholder according to your organisation | Not formally defined – but generally considered to be the peri-urban – rural residential areas. In actual fact, along the NSW north coast the vast majority of farms are small holdings relative to western districts. |
| 2. | Nature of the service and or involvement of your organisation with smallholders | We provide access to NRM knowledge and workshops on specific issues – soil biology, grazing and pastures, biodiversity, weeds, information on funding opportunities and access to further technical advice |
| 3. | How many people within your organisation work and/or are involved with smallholders? | 2 part time – equivalent 4 days per week |
| 4. | What are the main communication methods used by your organisation to contact smallholders? | Newsletter – electronic and hardcopy, email Electronic updates, website and facebook , along with workshops and field days. |
| 5. | Does your organisation keep a register of smallholders? | Yes – we have a register of interested landholders |
| 6. | What is the legal requirement regarding registration of smallholders within your organisation? | We cannot pass this list on to anyone else. |
| 7. | Do you have an estimate of the number of smallholders in your jurisdiction? | No |
| 8. | Are there specific areas or location in your state where smallholders concentrate? | The Northern Rivers region of the NSW has , I understand, the highest population /area in Australia – it has large number of small landholders. |
| 9. | Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | Lifestyle / hobby farmer are a large proportion – as most are working off farm or retired – there is an increasing number working via home and travelling to Sydney part-time each week. We also have a large number of people working in the mining industry elsewhere and running properties in between flying out and flying in. |
| 10. | Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | No – some information may be available through the state based Livestock Health and Pest Authority. Landholders have to declare # of livestock etc if over a certain threshold. |
| 11. | Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | Wouldn't Aust Bureau of Statistics have a lot of this data. |
| 12. | Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | There is a plethora of information available as resource information for landholders – large and small. Landcare Networks such as ours aim to improve access / opportunity to access information on range of best practice land management. Our focus is really more on land management – than livestock management – this has been done more by the Dept of Primary |

| | |
|---|---|
| | Industries .<br>I do consider that, particularly with the local food revolution, there is considerable movement of livestock amongst the small holding community. Improved quality of information and clarity of information as to the risks, the do's and don'ts and the legal requirements does need to be readily available.<br>One of the problems is the seemingly constant changes of govt dept and whose responsibility things are – the change to Local Land Services may well be of great value to have a 'one stop shop' if the staff are well informed.<br>Another is keeping this information up to date – printed material rapidly goes out of date.<br>I will put a couple of things in post to you – which you may find interesting –<br>I would be happy to include some background and a survey in our quarterly HaTCH newsletter which has a distribution of some 800 – but not sure how many responses you would get! |

**Small Farms Network- Andrew Britton**

| | | |
|---|---|---|
| 1. | Definition of smallholder according to your organisation | No formal definition but in general it is properties between 2 and 40 hectares. |
| 2. | Nature of the service and or involvement of your organisation with smallholders | Established in 2004 to work with small landholders . The Small Farms Network was created in partnership with Southern Councils Group, Southern Rivers Catchment Management Authority and NSW DPI. They work with DPI in as much as they put smallholders through DPI workshops and provide a link between the groups as the extension work has become restricted this has changed. They are funded through the CMA. However they also apply for their own funding for expansion. They also have established links with government, industry and sub networks eg Sheep Network, this is an industry group for sheep producers in the region, three field days are held in the Southern Highlands area each year for Sheep Network members; Shoalhaven Beef Producers -assist and promote the group and support the work of the Boar-Goat Network. |
| 3. | How many people within your organisation work and/or are involved with smallholders? | |
| 4. | What are the main communication methods used by your organisation to contact smallholders? | They have a weekly email that goes out to approximately 560. They have contact details for approximately 800 but these are not always complete. |
| 5. | Does your organisation keep a register of smallholders? | AS ABOVE |
| 6. | What is the legal requirement regarding registration of smallholders within your organisation? | N/A. They encourage and support the NLIS but do not keep information on compliance etc. |
| 7. | Do you have an estimate of the number of smallholders in your jurisdiction? | The numbers they work with are " a drop in the ocean" |
| 8. | Are there specific areas or location in your state where smallholders concentrate? | Anywhere along the coastal areas of NSW. They work primarily with the South Coast and Southern Highland areas but field calls from all over NSW as areas become developed and peri-urban areas are established. |
| 9. | Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | Varied. Of those keeping livestock estimates that 96% keep cattle. Sheep are more common on coastal areas and there are small numbers of alpacas/pigs/goats |
| 10. | Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | Mixed. |
| 11. | Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, | Postal survey or through their workshops. Not sure how online would go. Have not had any feedback |

| | | |
|---|---|---|
| | face-to-face interviews, newsletters...)? | from members re this. |
| 12. | Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | No new literature. Commented that they tried to get a national network established (post Fremantle conference). |

**Molonglo Catchment Group- Lynton Bond**

| | |
|---|---|
| • Definition of smallholder according to your organisation | Generally considered being a 20 acre block. However property size isn't a pre requisite for involvement in their group. |
| • Nature of the service and or involvement of your organisation with smallholders | The Molonglo Catchment Group was formed in late 2003 as a network of Landcare and Park Care groups in the Molonglo Catchment. Their role is to help these groups promote and undertake environmental protection and enhancement within the catchment. As a part of this they work with SLH (and others) on projects related to land management- this incorporates livestock. |
| • How many people within your organisation work and/or are involved with smallholders? | Nil specifically. |
| • What are the main communication methods used by your organisation to contact smallholders? | Newsletter to members, radio, television, workshops and information sessions. They provide an information pack to all new members. |
| • Does your organisation keep a register of smallholders? | They have a member's register- 400. Not all are SLH. |
| • What is the legal requirement regarding registration of smallholders within your organisation? | They cover ACT and NSW but they are not responsible for any legal aspects of SLH. |
| • Do you have an estimate of the number of smallholders in your jurisdiction? | Can't provide info on the numbers of SLH but there are 70,000 living in rural villages. |
| • Are there specific areas or location in your state where smallholders concentrate? | Rural villages around the ACT and NSW ( within proximity to Canberra) |
| • Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | Mixed. All of the above. |
| • Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | In the past there were a lot of properties with sheep, however this has changed over recent years to see an increase in horses. There are mixed livestock (sheep, cattle, goats, alpacas). Numbers vary depending on the block size. |
| • Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | They would be happy to assist with distribution through their members. |
| • Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | No new literature. |

Other NSW contacts

- Graham Centre for Agricultural Innovation- Peter Orchard
- No data base of details for SLH

**South Australia**

**PIRSA - Chris Van Dissel**

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| 1. | Definition of smallholder according to your organisation | No clear definition |
| 2. | Nature of the service and or involvement of your organisation with smallholders | PIRSA- provide information across all groups |
| 3. | How many people within your organisation work and/or are involved with smallholders? | As a part of their wider duties but no one specifically working in the area of smallholdings. Their aim is to get someone to work in this area but there are funding considerations. |
| 4. | What are the main communication methods used by your organisation to contact smallholders? | For information on PIC numbers they set up in Fodder Stores, NRM Boards. |
| 5. | Does your organisation keep a register of smallholders? | No- only those on NLIS, Pig Pass and PIC databases |
| 6. | What is the legal requirement regarding registration of smallholders within your organisation? | Livestock ID systems |
| 7. | Do you have an estimate of the number of smallholders in your jurisdiction? | |
| 8. | Are there specific areas or location in your state where smallholders concentrate? | Coastal areas and within a 100km arc around Adelaide. Also, Adelaide Hills, Port Lincoln, Port Augusta and Mt Gambier |
| 9. | Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | Mixed |
| 10. | Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | Only data is on the NLIS data base and PIC, PigPass. The species profile is area specific- closer to Adelaide there are more cattle. Not a lot of pigs. |
| 11. | Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | Face to face would be most effective. Online would only capture a certain demographic and would exclude a lot of NESB SLH. |
| 12. | Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | Chris has done no research since the project with Marta |

**Tasmania**

**NRM North -Kate Thorn**

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| 1. | Definition of smallholder according to your organisation | 2-50 hectares<br>Non commercial |
| 2. | Nature of the service and or involvement of your organisation with smallholders | Have very recently started a small landholder service.<br>Field days, developing website.<br>Demand is for information and advice rather than on ground work funding. |
| 3. | How many people within your organisation work and/or are involved with smallholders? | 1 |
| 4. | What are the main communication methods used by your organisation to contact smallholders? | Website. Previous surveys have been online and have had a better response than mailouts. |
| 5. | Does your organisation keep a register of smallholders? | They have details of those that attended the workshops- 200- note that they do not all have livestock. |
| 6. | What is the legal requirement regarding registration of smallholders within your organisation? | - |
| 7. | Do you have an estimate of the number of smallholders in your jurisdiction? | Estimated 5000 . In one area, Break O'Day there are 1200 properties but half of those are absentee. Figures obtained from local councils NRM facilitators. Had data for 3/7 and extrapolated. |
| 8. | Are there specific areas or location in your state where smallholders concentrate? | Concentrated within 1 hour of Launceston and on the coast in the Northern Region |
| 9. | Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | Diverse- no data. Plan is to develop a self assessed property management planning form for smallholders with a 1 page returnable section that will have questions related to property use. |
| 10. | Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | No |
| 11. | Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | Suggest online questionnaires would be better received than postal. |
| 12. | Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | Has sent through report done by Wombat Creative on Engaging rural lifestyle landholders. |

**NRM South- Huon Valley – Tim Ackroyd**

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| 1. Definition of smallholder according to your organization | I don't think NRM South has defined what a Small land owner is. I have based my definition according to literature/studies undertaken in WA<br>Definition: Life-styler, Hobby Farmer and/or Small Scale Farmer (running a commercial enterprise on a smallholding) with a property between 2-100 HA |
| 2. Nature of the service and or involvement of your organization with smallholders | Support Small land holders to sustainable manage natural resources through capacity building (workshops and training), support funding applications and on-ground works to improve farming practices and maintain and/or enhance biodiversity values and reduce threats/impacts to natural values. |
| 3. How many people within your organization work and/or are involved with smallholders? | Directly seven staff members – 5 local facilitators, I regional land care facilitator and a Biodiversity Officer |
| 4. What are the main communication methods used by your organization to contact smallholders? | Direct contact via email: Mailing / Contact lists developed through events, workshops and general communication<br>ENews letters, website and media releases/advertisements in local publications |
| 5. Does your organization keep a register of smallholders? | Not specifically |
| 6. What is the legal requirement regarding registration of smallholders within your organization? | ? |
| 7. Do you have an estimate of the number of smallholders in your jurisdiction? | No |
| 8. Are there specific areas or location in your state where smallholders concentrate? | There are a large proportion of small land owners in the Huon and Channel area. I am not sure how this compares to the whole state. |
| 9. Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | There will be the whole range, from Lifestylers to managers of rare breed studs |
| 10. Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | No |
| 11. Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | Online surveys<br>Face to face interviews |
| 12. Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | Only educational products - factsheets |

**Other Tasmania contacts**

- Tasmanian Farmers and Graziers Association -Nick Steele
  Majority of members are commercial farmers.

**Queensland**

**Fitzroy River and Coastal Catchments - Jeff Krause**

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| 1. | Definition of smallholder according to your organisation | Generally people who are not making a fulltime income from the land. Rockhampton Regional Council sends smallholder info to people who have less than 500 hectares. FRCC have a lot of properties between 100-500 hectares but focus the small landholder workshops on properties between a couple and 100 hectares. |
| 2. | Nature of the service and or involvement of your organisation with smallholders | Their interest in smallholders is mainly an environmental one- run off to the reef, pesticides etc. They run small landholder information days (next one scheduled for mid August 2013) |
| 3. | How many people within your organisation work and/or are involved with smallholders? | Not the main focus so no one specifically allocated. |
| 4. | What are the main communication methods used by your organisation to contact smallholders? | Have strong links with local newspapers, advertise on television, website. They have 500 members and approximately 45 groups that are members. They have a catchment of approximately 110,000. 150-200 small landholders. |
| 5. | Does your organisation keep a register of smallholders? | No. |
| 6. | What is the legal requirement regarding registration of smallholders within your organisation? | Local government and other relevant authority's regs only. |
| 7. | Do you have an estimate of the number of smallholders in your jurisdiction? | Based on council rates there are 4000 along the Rockhampton/Capricorn coast with property sizes from 2-500 hectares. Of this, 3400 are less than 100 hectares. |
| 8. | Are there specific areas or location in your state where smallholders concentrate? | As above |
| 9. | Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | They do a bit of everything – Rockhampton is the grazing capital so they have a lot with livestock- mainly cattle. Difficult to say what type of smallholders they are as they do not keep data. |
| 10. | Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | Again, they are a mixed group. Cattle predominantly but the smaller "hobby farms" often have alpacas. |
| 11. | Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | Estimate that 15% do not have internet access. Have used postal area services to do mass mail outs as they found this the best way to connect with the community. Networks to contact smallholders. - Newsletter, small landholder information days, quarterly mail out to members and email newsletters. Estimate that they have 150-200 contacts. |
| 12. | Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | No. Jeff to send through the details from their small landholder information days. |

**Other Qld contacts**

- Queensland Department of Agriculture, Fisheries and Forestry - David Pitt Senior Veterinary Officer Biosecurity

They have a database- Agricultural Property System- (This site is intended to be used by anyone who owns and/or manages an agricultural property and has a tail tag (PIC)).
Do not have staffs that are dedicated to SLH. They now have a call centre that answers everything and does not differentiate with herd/land size etc
Confirmed that smaller orgs (NRM, CMA, and Landcare) work more directly with SLH.

**Victoria**

**North East Catchment Management Authority - Tom Croft**

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| 1. Definition of smallholder according to your organization | Small and lifestyle landholders, generally in this region from 2-100 Ha, though mostly 5-40ha. Generally low agricultural production (ie exclude small area but intensive production such as horticulture) and mostly grazing enterprises. Generally have off farm income. |
| 2. Nature of the service and or involvement of your organization with smallholders | Through the CMA extension staff, and Landcare support staff (either within or external to CMA) relatively extensive involvement with smallholders, due to high demand for land management advice, and regular involvement in biodiversity projects. The relatively high level of 'tree changers' in the region means many are involved in biodiversity projects. |
| 3. How many people within your organization work and/or are involved with smallholders? | 6-8 people regularly involved with dealing with these. |
| 4. What are the main communication methods used by your organization to contact smallholders? | Have to use everything available. Large areas have poor internet communications, so can only limit the use of web/email to low data use. More prevalent email use for small holder sector (often through their off farm work email access). Still regularly use print media, postal communications. Increasingly starting to use social media for communications.<br>Even with NBN – we will still need to continue to use print/postal communications for some time. |
| 5. Does your organization keep a register of smallholders? | Only those we actively deal with for project delivery – ie participants in CMA projects for soil health, river health/management, biodiversity protection, or Landcare participation. Dont keep a register of general communications/queries. |
| 6. What is the legal requirement regarding registration of smallholders within your organization? | None |
| 7. Do you have an estimate of the number of smallholders in your jurisdiction? | Not accurate. DPI Rutherglen did some estimates 6-10 years ago. ABS/ABARE would probably be better source. Maybe 1000, but this has no accuracy. |
| 8. Are there specific areas or location in your state where smallholders concentrate? | Within 30 minutes drive from major centres is the highest density, or coastal regions.<br>In our region, it is predominantly within 30 minutes (20-40km) from major centres, particularly Albury/Wodonga and Wangaratta. |
| 9. Which type of smallholders keeping livestock are in your jurisdiction (subsistence, hobby farmer/lifestyle, exhibition/rare breeds, other)? | Nearly all types. Small, niche breeders, organic/biological producers, studs, rare breeds, lifestylers, hobby farmers, horse owners.<br>Significant level of horticultural production in the |

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| | region on small holdings, including fruit, nuts (chestnut, almond, walnut), tea, wine grapes, berries. |
| 10. Do you have basic demographic information on these smallholders, such as animal species and number of animals kept? | Not accurate. Anecdotally - The majority of small holdings in the region are grazed, predominantly with beef or dairy cattle and horses. Some areas are cropped (ex tobacco farms) or horticulture. Smaller numbers of sheep and goat producers, very few small/organic pig production.<br>We are fortunate in this region that generally small holdings are more expensive than urban housing. This means that mostly small holdings are held by those with higher income and education levels, and often with the objectives of 'improving' the land (especially tree changers) or developing production business. This also means a high level of demand for information on land management. Many can afford contractors for additional labour for environmental works.<br>There are also large numbers of semi retired people with these holdings. They provide significant contributions to community groups, including Landcare etc. |
| 11. Which method would be the most effective to collect information on individual smallholders in your jurisdiction (postal survey, online survey, face-to-face interviews, newsletters...)? | A combination. We have been finding higher take-up of online surveys, but many areas still will require postal survey. Distribution of info and request via Landcare and community newsletters are possible. |
| 12. Is there any literature/report/documentation available in your jurisdiction in relation to smallholders? | Yes, primarily from Hollier et al at DPI Rutherglen, RIRDC and Curtis et al. At CSU Albury. Most is 5-10 years old though. That we are aware of. |

**Other Victoria contacts**

- Victorian Farmers Federation- Jacinta Pretty, Livestock Project Officer

Does not have numbers or specific details on small holders.

- Department of Primary Industries, Bendigo Centre -Neil Barr

NLIS best way to locate small numbers of livestock.

Currently working on large farms research

- DPI Invasive Plants and Animals Operations Branch -Michael Reid

DPI has a more problem centred approach and looks at the issue rather than the farm size. They have implemented the Better Services to Farmers as a broader initiative.

They use local government databases for their info on small farm ownership. Can usually get parcel size but not specifics of ownership etc.

- DPI Victoria -Louise Scott

Worked on the initial small landholder's project from 2007 until 2011, providing services and information to new small landholders. The first part of the small landholders work was research focused and had focus areas- east Melbourne/Gippsland, Benalla and Bendigo.

They had a small data base but this has not been updated and contained limited info.

Tended to use the CMA's to link in with small landholders