Farm-level adoption of biosecurity management – behavioural analysis

by Clinton Muller, Emily Tee, Claire Cook, Jedidiah Clark and Doris Blaesing (RMCG)
September 2023

AgriFutures® National Rural Issues

Farm-level adoption of biosecurity management – behavioural analysis

ISBN 978-1-76053-444-8
ISSN 1440-6845
Publication no. 23-206
Project no. PRO-016361

AgriFutures Australia
Building 007, Tooma Way
Charles Sturt University
Locked Bag 588
Wagga Wagga NSW 2650

02 6923 6900
info@agrifutures.com.au
www.agrifutures.com.au

Author contact details
Clinton Muller
RMCG

0498 192 596
clintonm@rmcg.com.au

In submitting this report, the author has agreed to AgriFutures Australia publishing this material in its edited form.

AgriFutures Australia is the trading name for Rural Industries Research and Development Corporation (RIRDC), a statutory authority of the Australian Government established by the *Primary Industries Research and Development Act 1989*.

Research investments made or managed by AgriFutures Australia, and publications and communication materials pertaining to those investments, are funded by industry levy payers and/or the Australian Government.

Farm-level adoption of biosecurity management – behavioural analysis

AgriFutures® National Rural Issues

Foreword

AgriFutures Australia partners with Australian rural industries and the Australian Government to grow the long-term prosperity of Australian rural industries and communities through research, development and extension.

This report delves into the intricate landscape of Australia's national biosecurity system, a linchpin in safeguarding our primary industries from the pervasive threats posed by pests and diseases.

Australia's biosecurity framework, jointly managed by the Australian Government and their state/territory counterparts, is a complex collaboration aimed at mitigating risks and ensuring the integrity of our agricultural sector. The stakes are high, with successful biosecurity implementation crucial for international market access, as well as for protecting regional and rural economies and communities. The study examined the adoption of biosecurity practices by producers, focusing on farmers, through a comprehensive analysis of existing research and consultations with key industry stakeholders.

Key findings underscore the strength of biosecurity awareness among commercial producers, however highlight variability in the extent of adoption across different sectors. They bring attention to the role of technology in biosecurity management, challenges in skills and capacity within the system, and the impacts of language and communication on biosecurity extension. The findings also shed light on the implications of biosecurity on individual producer wellbeing.

The recommendations are pivotal for shaping the future of our national biosecurity system. Decision makers across the system must consider the need for nuanced and targeted communication strategies tailored to specific industries and sectors. Recognising the importance of integrating biosecurity practices into broader production systems is crucial, as is acknowledging and addressing vulnerabilities in the current biosecurity framework. Moreover, fostering trust within the system is imperative for effective industry-wide adoption of biosecurity practices.

We invite industry stakeholders, producers and policymakers to explore the detailed findings and recommendations contained in this report. The insights presented herein offer a roadmap for enhancing the resilience and sustainability of Australia's primary industries in the face of evolving biosecurity challenges.

This report supports our priority of identifying, understanding and responding to national challenges and opportunities impacting Australian rural industries. Most of AgriFutures Australia's publications are available for viewing, free download or purchase online at www.agrifutures.com.au.

Michael Beer
General Manager, Rural Futures
AgriFutures Australia

Contents

Summary

Australia's national biosecurity system is critical to protecting our primary industries from the world's most invasive and devastating pests and diseases.

Successful implementation of the system by all concerned is key to supporting international market access for Australian agricultural products and safeguarding regional and rural economies and communities from threats and impacts of pest and disease incursions.

In Australia, biosecurity is a shared responsibility between the Australian Government and state and territory governments. The Australian Government sets the overarching policy and legislative framework for biosecurity, while state and territory counterparts have responsibility for implementing and enforcing biosecurity measures within their jurisdictions. State governments control state borders and can therefore restrict product movement to prevent incursions of pests that have been found or are endemic outside a jurisdiction's border.

The system is based on controlling risks and all players sharing responsibility; it is complex, involving industry and multiple government activities, including investment, research, extension, regulations and programs (e.g. surveillance, monitoring, farm-level practices). While there is a clear division of responsibilities between the Australian and state and territory governments, they must work together through mechanisms like the National Biosecurity Committee to coordinate and harmonise biosecurity efforts across Australia.

The system is under constant review and changes in response to emerging global and domestic challenges in areas such as agricultural, forestry and fisheries practices, technology, transport/travel, and import/export markets.

This report presents the findings of a study that explored adoption of biosecurity practices by producers in primary industries, i.e. farmers, through consolidation of existing research and consultation with key industry stakeholders. It considers key barriers and motivators for farmers in the context of the national biosecurity system, the range of biosecurity practices promoted by different agencies for on-farm adoption, and, importantly, farmers' own decision-making processes and background.

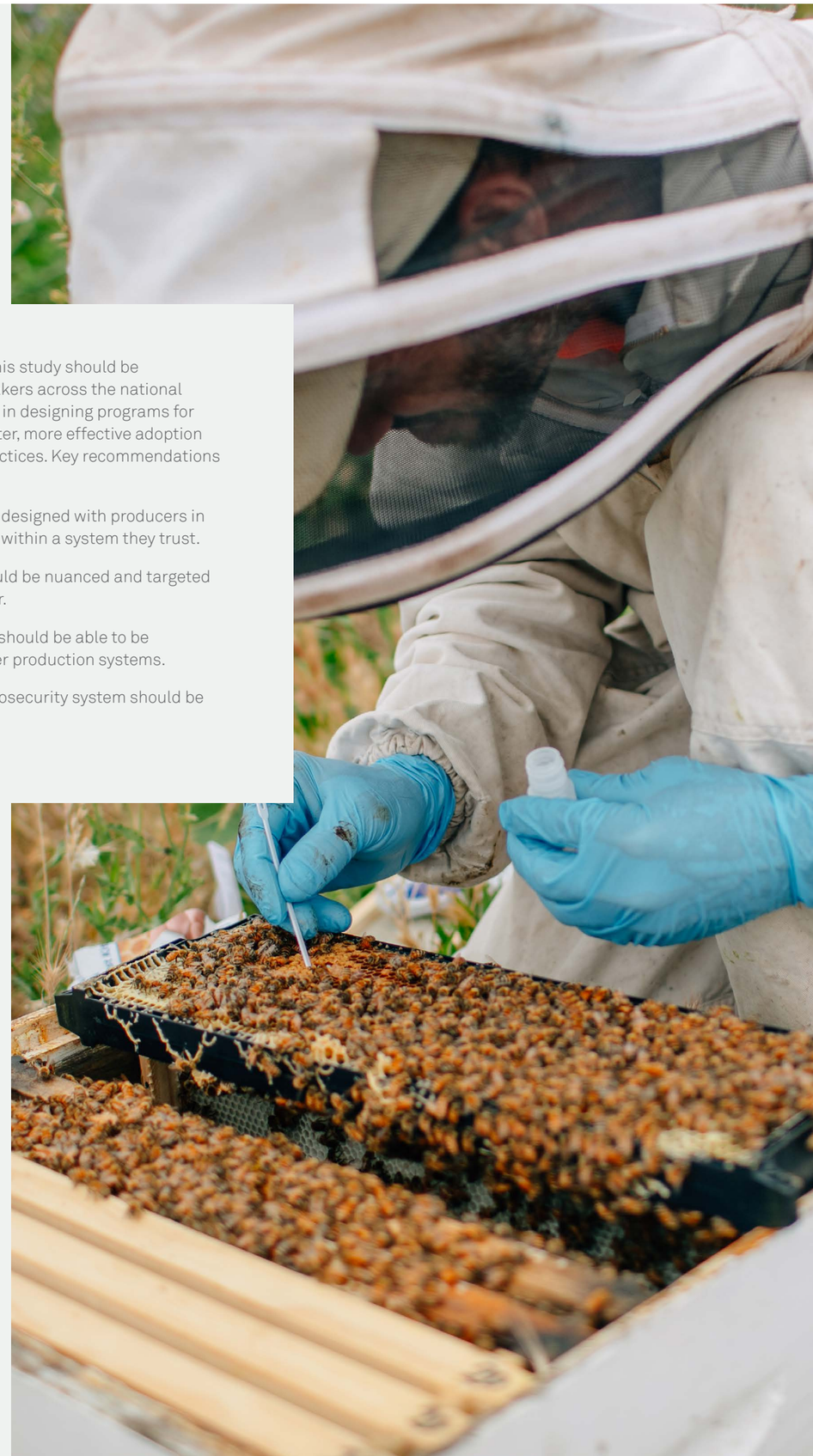
The findings are presented along with an assessment of current biosecurity information sources and extension approaches to support adoption of on-farm biosecurity practices. Potential future megatrends, threats and technologies are also considered, including the impact on primary industries' biosecurity needs and practices, and how these will need to adapt.

Key findings within the study include:

- Awareness of biosecurity across commercial producers is strong.
- Variability exists in the extent of adoption of biosecurity practices.
- Variability exists in biosecurity practice adoption between industry sectors.
- There is increasing interest in the role of technology in biosecurity management.
- There are challenges with skills and capacity within the biosecurity system.
- Trusted sources play a role in delivering biosecurity information to producers.
- Language and communication play a role in biosecurity extension.
- Biosecurity has implications on individual producer wellbeing.

Recommendations from this study should be considered by decision makers across the national biosecurity system to help in designing programs for farmers that support greater, more effective adoption of industry biosecurity practices. Key recommendations include:

1. The system should be designed with producers in mind, as they interact within a system they trust.
2. Communications should be nuanced and targeted for the industry/sector.
3. Biosecurity practices should be able to be integrated into broader production systems.
4. Other 'cracks' in the biosecurity system should be acknowledged.



Biosecurity risks and management

Biosecurity risks

Australia's status as an island nation and our extensive biosecurity system has provided protection against some of the world's most invasive pests and diseases. However, biosecurity risks are increasing and becoming more complex, driven by factors such as climate change, increasing and unpredictable trade and travel patterns, changing land use patterns, and decreasing biodiversity.

Critical biosecurity risks include pests, diseases and weeds that are:

- Exotic – those currently not known to be present in Australia or, if present, subject to a nationally agreed eradication program.
- Established/endemic – those that are self-sustaining, occurring in Australia (either widely or regionally distributed) and not considered eradicable.

Notably, a regionally distributed established pest, weed or disease may be the subject of management measures to minimise further spread. For example, Queensland fruit fly (QFF) is a particularly high-profile endemic pest and interstate quarantine restrictions are in place to ensure Tasmania, South Australia and Western Australia remain QFF-free; this status supports market access to a number of export destinations

With more than 60,000 kilometres of coastline, there is a variety of pathways for exotic pests, weeds and diseases to enter Australia. The key transmission pathways into the country include mail parcels, cargo containers, sea vessels and aircraft, international travellers, and natural pathways.

Both pre-border and at-border measures, as outlined in the following section, are implemented to manage these potential transmission pathways. However, these measures are under pressure due to the factors identified previously and resource constraints. Given this, primary industries and individual producers need to remain vigilant to potential biosecurity risks to protect their operations and supply chains from the impact of either exotic, established or endemic pests and diseases.

On-farm biosecurity management principles

While pests and diseases of biosecurity concern vary across different primary industries (i.e. intensive and extensive animal industries, broadacre cropping, horticulture, nursery and garden, forestry, and fisheries), the principles for identifying and managing biosecurity risks are similar. Through the Farm Biosecurity website,[1] Plant Health Australia (PHA) and Animal Health Australia (AHA) highlight the key pathways through which potential pest and diseases can enter and leave a farm, and basic biosecurity aspects that producers should consider. These relate to farm inputs (water, feed, fertiliser, plant material, animals), people, machinery and equipment entering and leaving a farm, production outputs (animals, plant products, packaging, waste), and native and feral animals and weeds.

Production practices such as monitoring (crops, livestock, movement of people, vehicles and equipment), appropriate chemical use, maintenance of fencing, vaccinations and general good farm hygiene are also promoted as activities important for on-farm biosecurity management.

Agricultural land managers are responsible for managing 58% of Australia's landmass. It is estimated that about 80% of Australia's biodiversity is found on privately owned farmland. Farms provide habitat for a range of species, including native plants, insects, birds and mammals. However, it is important to note that biodiversity distribution varies across different regions and ecosystems within Australia. Incursions and establishment of environmental pests, weeds and diseases is a major threat to Australian biodiversity. Many landholders are not aware of their important role in protecting natural habitats from incursions.

Australia's national biosecurity system

Australia's biosecurity system is a risk-based system underpinned by science that has the specific goal to "minimise the impact of pests and diseases on Australia's economy, environment and the community", with resources targeted to "manage risk effectively across the continuum, while facilitating trade and the movement of animals, plants, people, goods, vectors and vessels to, from and within Australia".[2] In addition, Australia's international obligations as member of the World Trade Organisation and signatory to the *Agreement on the Application of Sanitary and Phytosanitary Measures* require "a level of protection considered appropriate" for life or health within our borders.

The national biosecurity system is extensive, multi-layered and complex, with measures applied offshore, at the border and onshore. These measures involve a broad range of participants and organisations from across government, industry and the community. The system is based on a framework of shared responsibility. It is regularly under review as required by government mechanisms and in response to increasing challenges faced by the system. These include an ageing government biosecurity workforce, constrained biosecurity budgets and concerns regarding science expertise and capability in exotic pests and diseases.

Figure 1 depicts Australia's biosecurity system, outlining the key roles and functions governments, industry, research institutions and other stakeholders (including producers) play in reducing the risk of pests entering Australia and becoming established.

The figure highlights some of the key responsibilities, noting that these are shared by several entities (e.g. capacity building). Shared responsibility is required to ensure a well-resourced and strong biosecurity system, but it creates complexity and can result in unintended expectations. For example, producers expect that governments' biosecurity 'role' is to prevent exotic pests and diseases from entering Australia and therefore their farms. This has led to the perception that producers are perhaps less vigilant about these biosecurity risks, even though their on-farm practices to manage existing pests and diseases can play a significant role in biosecurity management.

[1] https://www.farmbiosecurity.com.au

[2] https://www.agriculture.gov.au/biosecurity-trade/policy/partnerships/nbc

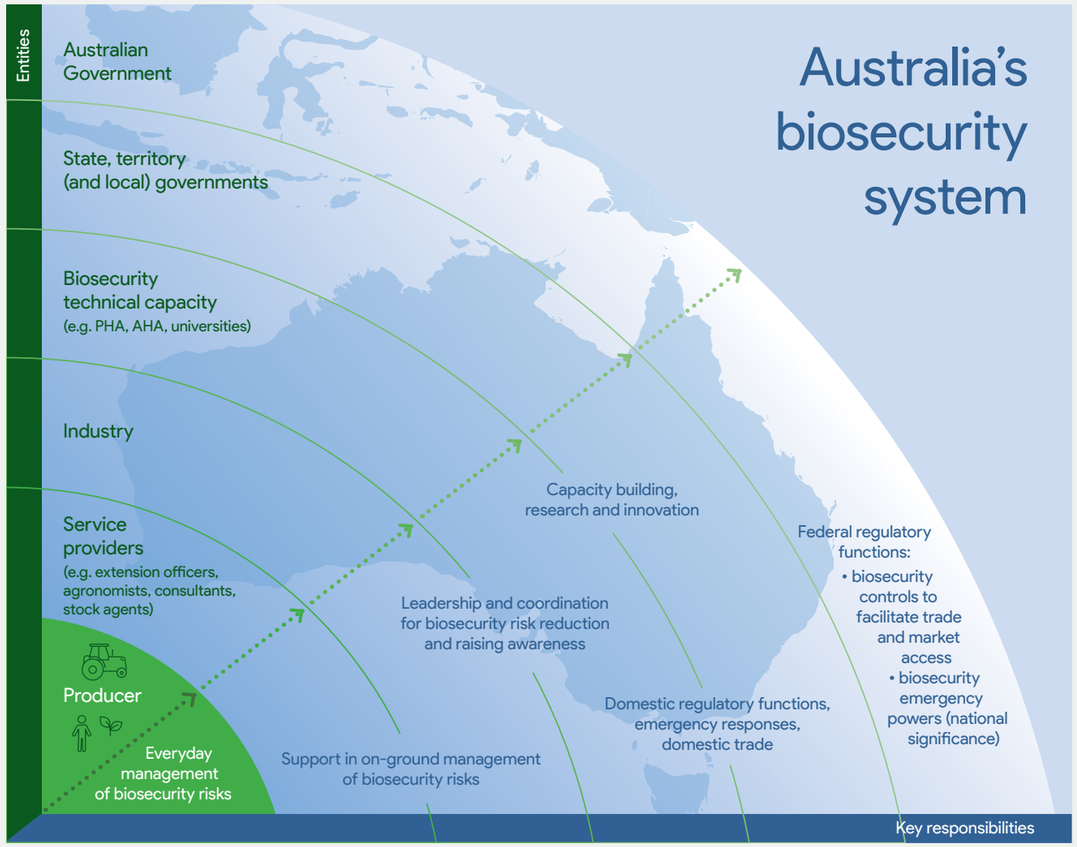


Figure 1. Overview of Australia's biosecurity system.

Government responsibilities

The Australian Government has oversight of the national biosecurity system as established through legislation, intergovernmental agreements, legislated roles and key strategies (e.g. *National Biosecurity Statement and Strategy*). The *Intergovernmental Agreement on Biosecurity* (IGAB) has been signed by all Australian governments and outlines agreed national goals and objectives, commitments, roles, responsibilities and governance arrangements. The IGAB formally establishes the National Biosecurity Committee, which has a significant role in managing the national strategic approach to biosecurity threats.

The Australian Government, mainly via the Department of Agriculture, Fisheries and Forestry (DAFF), undertakes a range of pre-border activities (e.g. overseas pest surveillance, analysing pest risks associated with proposed imports, negotiating market access) and at-border activities (e.g. imposing biosecurity measures at ports, prioritising exotic pests and diseases to target for preparedness and prevention activities). DAFF also implements onshore biosecurity management measures in collaboration with state and territory governments, plant and animal industries, PHA, AHA, producers and the community.

In summary, Australian Government responsibilities are:

- ***Biosecurity Act 2015*:** The Australian Government is responsible for enacting and administering the *Biosecurity Act 2015*, which provides the legislative framework for biosecurity in Australia. This Act establishes the requirements for managing biosecurity risks to agriculture and the environment, including the import and export of goods, people and animals.
- **Border control:** The Australian Government manages border control and is responsible for preventing the entry of exotic pests and diseases, and other biosecurity risks into Australia. This includes implementing quarantine measures at airports, seaports and international mail centres to inspect and manage the importation of goods and biosecurity risks.
- **Biosecurity risk assessments:** The Australian Government conducts risk assessments to identify and evaluate potential biosecurity threats to Australia. It develops policies, guidelines and protocols for managing these risks, and collaborates with state and territory governments, peak industry bodies, industry stakeholders and scientific experts in this process.
- **International engagement:** The Australian Government represents the nation in international forums and negotiations related to biosecurity. It works with other countries to establish harmonised biosecurity standards and facilitates the safe trade of goods while minimising biosecurity risks.

State and territory governments' main role is in leading and implementing biosecurity regulatory functions within Australia's border. This includes negotiating and facilitating domestic trade, managing emergency responses, and implementing regulatory interventions and enforcement actions. Along with the Australian Government, they also have a role in biosecurity research and capacity building, coordination, awareness raising and on-ground activities, such as surveillance.

In summary, state and territory responsibilities include:

- **Biosecurity legislation:** State and territory governments enact and enforce their own biosecurity legislation to complement the *Biosecurity Act 2015*. These laws cover specific regional biosecurity issues and allow for tailored responses to local threats.
- **Surveillance and response:** State and territory governments are responsible for conducting surveillance programs to monitor and detect biosecurity threats within their jurisdictions. They also lead response efforts when biosecurity incidents occur in their state, such as disease outbreaks or pest infestations, by coordinating quarantine measures, control strategies and public awareness campaigns. Responses may include closing state borders to prevent movement of pests, weeds or diseases from an affected state into a state declared to be a "pest-free place of production".
- **Inspection and compliance:** State and territory governments manage inspection and compliance activities related to biosecurity within their borders. This includes conducting inspections at entry points within their jurisdictions, such as airports and seaports, to ensure compliance with biosecurity requirements.
- **Partnerships and education:** State and territory governments collaborate with state and national peak industry bodies, industry stakeholders, community organisations, and members of the public to raise awareness about biosecurity risks and promote compliance with biosecurity measures. They may also provide training and educational resources to enhance biosecurity practices.

The division of responsibilities between the Australian and state and territory governments is an important feature of the Australian system. It affects decision-making processes, especially in the case of a pest incursion, and the type and flow of information to industry.

Industry biosecurity coordination

AHA and PHA are not-for-profit companies supported by industry levy funds that were established to be the national coordinators of government-industry partnership for animal and plant biosecurity, respectively, in Australia. Members of each of these companies includes relevant animal and plant-based industries, associated groups (e.g. service providers), and government.

AHA and PHA manage a range of programs in relation to biosecurity. They are also custodians to the emergency response deeds – *Emergency Animal Disease Response Agreement* (EADRA) and *Emergency Plant Pest Response Deed* (EPPRD) – which are formal legally binding agreements between the Australian Government, state and territory governments, PHA or AHA, and plant or animal industry signatories. The deeds cover the management and funding of emergency plant pest and animal disease responses, and provide a formal role for industry to participate and assume a greater responsibility in decision making.

There are no equivalent 'environmental industry' peak bodies with access to levy funds, so management and cost-sharing of national environmental biosecurity programs are largely arranged through governments. The Department of Climate Change, Energy, the Environment and Water (DCCEEW) works with state and territory governments on environmental protection and biodiversity conservation. DCCEEW has specific biosecurity responsibilities for regulating the import of live animals and plants after considering their potential environmental impact. The *National Environmental Biosecurity Response Agreement* (NEBRA) provides for responses to nationally significant environmental incidents where a combined response has public benefits.

Biosecurity information for producers

There is an extensive array of specific biosecurity information available to producers via a range of sources (i.e. government, industry associations, research and development corporations, service providers) and delivered through a variety of platforms (e.g. websites, extension activities, industry training, assurance programs). Two important biosecurity websites dedicated to farmers are:

- **Farm Biosecurity** – part of the Farm Biosecurity Program, a joint initiative managed by AHA and PHA.
- **Outbreak** – provides information about emergency responses to animal and plant pest and disease incursions, and is developed by the Australian, state and territory agriculture departments.

Clearly, a shortage of biosecurity information available to producers is not necessarily the barrier to increasing adoption of biosecurity practices on farmed land. There appears to be a lack of similar information on environmental biosecurity for landholders. Despite the information being available and concerted efforts by government and many organisations, many factors influence how readily producers take on board biosecurity information. These include the timeliness, style and consistency of communication, whether information is provided by a trusted source, and the perceived relevance and costs to a producer.

Producers who participate in industry quality assurance programs and those who need to meet market access requirements, such as through completing animal health or plant phytosanitary declarations, will readily access and implement the necessary biosecurity information that supports participation in such programs and markets.

On-farm adoption of practices

Factors influencing adoption

Farmers have different social, cultural and economic backgrounds, and have different economic drivers, decision-making processes and risk management strategies. This, along with psychological factors and other unique contexts, mean each producer's decision about biosecurity risks and potential impact to their business, and therefore adoption of farm biosecurity practices, will be nuanced in various ways.

There have been numerous theories and studies published to describe agricultural producers' decision-making processes, and therefore behaviour in adopting (or not adopting) technologies or practices, particularly for improving farm productivity and/or sustainability. However, research into the social and behavioural drivers underlying individual-level biosecurity actions by producers is relatively new.

Drawing on this adoption literature, a summary of key factors that may influence producers' behaviours around adoption of practices is illustrated in Figure 2. These factors are also relevant to the biosecurity context and include:

- Attributes of the biosecurity practices or technology that influence the ease or readiness of adopting a practice or technology, including complexity, time requirements and costs.
- The socio-cultural context and demographic aspects of an individual farmer.
- A farmer's unique personal (including psychological) aspects, including beliefs, values, risk adverseness, education and attitudes that underpin behaviour.

Attributes of the practice

The type of practice and/or management strategy for biosecurity purposes may influence whether it is readily adopted or not by producers. If it is costly or complex to implement, or does not readily align with other on-farm operations or management systems, producers are less likely to implement such practices. This is particularly the case where the benefits are difficult to observe or quantify, or may not be realised in the short or medium term. For example, producers may be reluctant to spend extra time observing and recording the absence of exotic pests and diseases on their property as part of biosecurity surveillance activities, yet undertake monitoring of particular pests, disease and beneficials as part of an integrated pest management (IPM) program.

While information and images of exotic pests and symptoms are available, most landholders and agronomists would not be able to readily identify a new exotic pest, disease or weed because, often, they look very similar to an endemic pest, disease or weed. In many cases, an exotic pest is only detected on farms after an incursion has been identified on hobby farms or in home gardens and trained officers are subsequently surveying commercial crops. Commonly, commercial crops and livestock are covered as part of a standard pest and disease control program that aims to identify many exotic pests quickly and prevent them from establishing. Usually, only when these programs fail do landholders become aware of new pests.

In other circumstances, producers may be willing to implement practices that provide a 'relative advantage' to their business, or that are a specific government requirement for 'doing business'. For example, phytosanitary requirements for overseas markets, interstate movement of plant products and materials (e.g. Plant Biosecurity Permit) and participation in industry assurance programs (e.g. Livestock Production Assurance and the National Livestock Identification System) require implementation of biosecurity practices and systems to enable sale of product into particular markets.

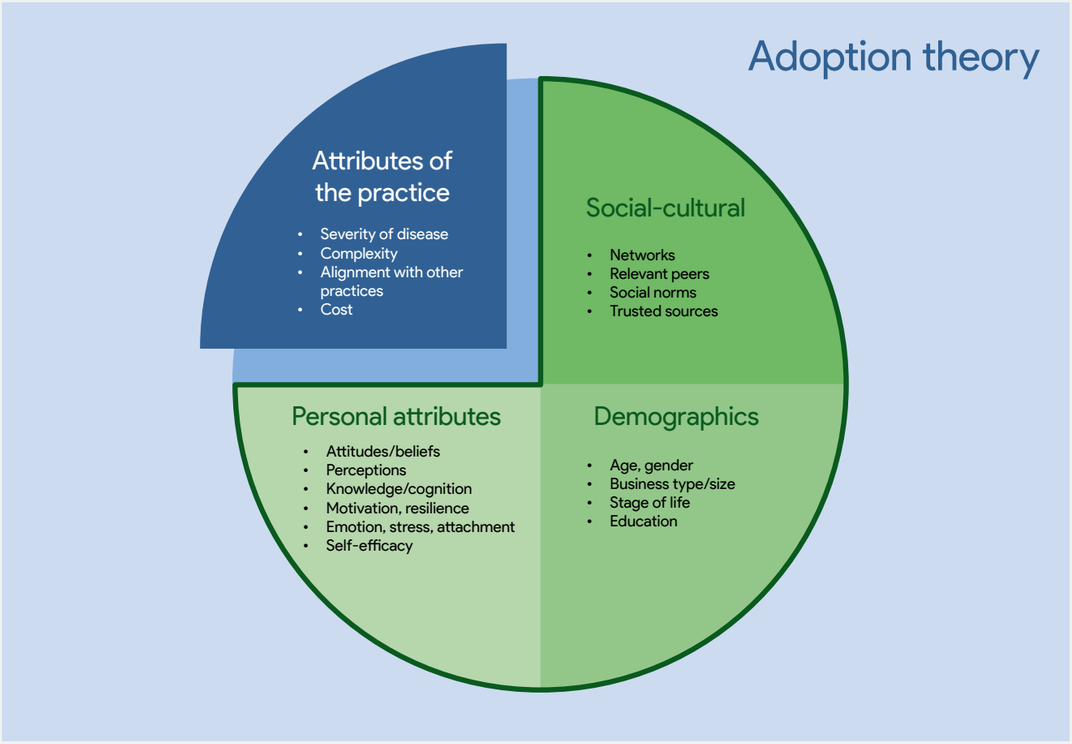


Figure 2. Summary of key factors that influence adoption behaviour based on review of adoption literature.

Social and cultural factors

Social norms regarding what is commonly approved or expected and producers' trust of others in their networks play a significant role in supporting biosecurity management on farm. Producers are more likely to implement on-farm biosecurity practices if they perceive those in their peer group are acting in the same way. There is also potential to increase biosecurity compliance if information and recommendations come from trusted sources (e.g. neighbours, other producers, agronomist, industry development officers) rather than regulators.

However, there is a risk that trust in the biosecurity system may be reduced, and therefore uptake of proactive biosecurity practices impacted, where a pest or disease has been misdiagnosed. This may also be the case where it is unclear what the social and financial implications of actively reporting a pest or disease of biosecurity concern is. Anecdotally, evidence suggests those producers who have actively reported a biosecurity pest have experienced negative impacts in terms of social stigma and product sales. As Mankad (2016) found, there is a "moral wrestle between collective/societal benefits of greater biosecurity engagement and investment versus individual/private costs of biosecurity implementation".[3]

Clearly, there is a challenge in normalising some practices, such as reporting biosecurity concerns. For many producers, there is an ethical dilemma between the wider industry and community benefits of greater biosecurity implementation and the 'trade offs', i.e. the individual private costs of implementing some biosecurity practices.

[3] Mankad, A. (2016). Psychological influences on biosecurity control and farmer decision making. A review. *Agron. Sustain. Dev*, 36, 40.

Demographics

Factors such as age, stage of life, gender, education, business type and size and location/community all influence a producer's goals, risk perception, finances and overall ability to implement biosecurity practices in their operations. Poor or low financial viability is a major constraint to adoption, while economically secure farming operations may have access to more resources to implement better biosecurity systems. Producers with significant investment (both financial and psychological) in their business are likely to implement biosecurity management systems and practices as a form of insurance, given they potentially have more to lose.

Personal attributes

A complex array of personal attributes will be unique to each producer and will influence their broader management approach to biosecurity, but also in the face of a possible pest incursion or in an outbreak situation. A producer's attitude towards biosecurity, and their underpinning beliefs and values, will intuitively guide their decision making. Producers who value contribution to their industry and/or community/region may be more willing to adopt on-farm biosecurity practices that contribute to 'shared responsibility'. However, attitudes towards risk will also come into play, given on-farm biosecurity is a unique risk domain that has impact on all aspects (e.g. finances, business, recreation, family life, emotions) of a producer's life. Mankad (2016) also noted that "farmers do not make decisions in the same way as each other; each farmer will make decisions about biosecurity risks in a nuanced way influenced by unique social, psychological and contextual factors".[4]

Producers don't perceive a biosecurity issue or indeed a 'threat' in the same way, and so will have varying levels of motivation to implement on-farm biosecurity practices. Many will perceive the level of investment, both financial and time, needed to implement such practices as costly and potentially not warranted. However, where a biosecurity threat is perceived as a serious concern, with this comes fear. As such, attitudes may change, motivating them to implement the necessary biosecurity practices. The unknown nature of a biosecurity threat can have a negative impact on a producer's emotions and stress levels. Understanding producers' motivational 'triggers' may help to tailor communication and incentives that support behavioural change and prioritisation of biosecurity practices. Still, many landholders are of the view that biosecurity is a government responsibility and can be managed via good border protection and good incursion management (eradication) alone.

Other personal aspects, such as knowledge, resilience and self-efficacy, will also influence producers' willingness and ability to adopt on-farm biosecurity practices. With respect to knowledge, producers need to see the relevance and applicability of biosecurity practices to their own context and farming operations. Where they have experience and/or knowledge of a particular biosecurity incursion event, pest or disease, this may influence their attitude regarding biosecurity risks. Producers with high self-efficacy are more likely to have a sense of control of their situation and therefore tend to engage in pre-emptive biosecurity activities. Importantly, a level of resilience is required to adapt and change practices in the face of a biosecurity threat or when eradicating a particular pest or disease.

Producers have significant demands on them (including cognitive, physical and emotional aspects) in the daily management of their farming businesses. Often, day-to-day pest, disease and crop management issues take precedent over a preventative biosecurity practice for a disease or pest that is yet to be determined as a threat. Subsequently, farm-level biosecurity tends to be reactive and opportunistic rather than consistent and disciplined.

[4] Mankad, A. (2016). Psychological influences on biosecurity control and farmer decision making. A review. *Agron. Sustain. Dev*, 36, 40.

Framework for farmer decision making

Farmer decision making

Given the volume of decisions made by farmers on a short, medium and long-term basis, and their respective business models, it is understandable there are variable factors that drive decision making around the adoption of on-farm practices, including biosecurity. Adoption of a specific practice, also known as a 'decision point', sits at the confluence of internal drivers that shape the intention of the producer and the influence from external drivers, and the extent to which attitude to risk induces the intention and influence to act. The multitude of factors that drive the decision point around farmer decision making are illustrated in Figure 3 and discussed in the subsequent sections of this report.

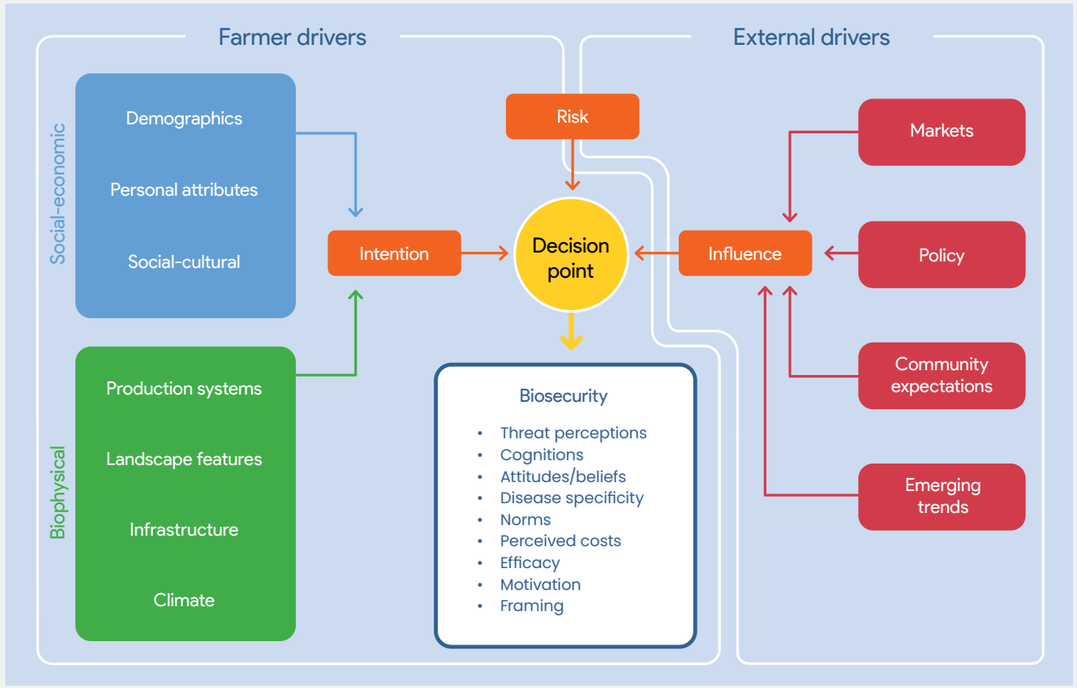


Figure 3. Farmer decision-making framework.

Farmer driver intention

Biophysical

A core driver of the intention of farmers to adopt certain practices is characterised by the nature of their production system. This is inclusive of the biophysical characteristics, including the combination of the type of crop and/or livestock production system, as well as natural features, including the landscape features and climatic variations specific to that locality. Existing available infrastructure assets within the production system also shape the intention of the decision, as well as additional cost inputs that may be required to re-engineer or establish required infrastructure.

Social-economic

While the physical features of the production system and its operating environment help shape the decision making of the farmer, the characteristics of the farmer, including their personal attributes, demographics and social-cultural background, and status within their community, also shape their intentions for practice adoption. These characteristics are later discussed in further detail, but it is important to note the combination of these attributes with the physical attributes of the farming business collectively shape the likely intention for the decision point around practice adoption or non-adoption.

External driver influence

The decision point for producers around adoption of practices does not rest solely on factors from within their production system; they are also equally influenced by external forces. These externalities include:

- **Market access** requirements, such as certification standards or practices to facilitate market access.
- **Policy and regulation** defined by government and/or industry relating to practices and the repercussions of penalties for failure of compliance.
- **Community expectations** that influence minimum standards of practice, both from within the agriculture production community and the broader public.

Risk

The role of risk and the extent to which it induces decisions being made by farmers is an important consideration in the farmer decision-making framework. Complex decisions are based on the combination of farmers' perceptions and subjectivity of lived experiences, including their own values and the biophysical attributes of their production system, coupled with the external evidence from markets and regulatory frameworks. Additionally, family and community views influence decision making. It is the probability and uncertainty of, and vulnerability to, the risk of something undesirable happening, based on the variable factors that shape the intention to act and the influence from external factors, that induces a decision to be made.

Decision point

Collectively, the extent of risk associated with the intention of producers as shaped by their own personal behaviours and their biophysical production system, combined with the influence from external forces including markets, policy and community, define the likelihood of the decision to adopt a certain practice either fully, partially or not at all.

It is important to note that the decision point itself is not a simple decision of adoption or not. Rather the decision point carries the nuances of the practice that must be considered. Mankad (2016)[5] highlights several aspects of biosecurity practices that may be adopted on farm that shape the decision point of the practice, as captured in Figure 3, including:

- Threat perceptions
- Cognitions
- Attitudes/beliefs
- Disease/pest specificity
- Norms
- Perceived costs
- Efficacy
- Motivation
- Framing
- Resilience

What is highlighted by the above points is that there are many characteristics unique to each farmer, and these shape their decision point around adoption. This includes their intention to adopt based on their social-economic and biophysical characteristics, the influence of external drivers, and the nuances of the practice itself.

[5] Mankad, A. (2016). Psychological influences on biosecurity control and farmer decision making. A review. *Agron. Sustain. Dev*, 36, 40.

Motivators and barriers to adopting on-farm biosecurity practices

Factors that influence the adoption of on-farm biosecurity by producers can be grouped according to their role in motivating or creating a barrier to adoption. These are presented in Table 1.

Table 1. Motivators and barriers to on-farm biosecurity practices.

Motivators	Barriers
Technical factors	
• Market access	• Cost of implementation
• Government policies and regulations (e.g. licensing, certification)	• Complexity of the biosecurity system, including understanding roles and responsibilities
• Quality assurance programs	• Lack of accessibility to expertise
• Industry codes of practice	• Inability to identify exotic pests and diseases
• Traceability requirements (e.g. National Livestock Identification System)	• Transmission pathways (e.g. weather events) of which a producer has minimal or no control
• Existing complementary on-farm practices	
Social factors	
• Social norms and expectation	• Concern of 'freeloading' if others are not implementing on-farm biosecurity practices
• Industry leadership	• Lack of trust in and/or poor previous experience with experts or relevant officials (e.g. from government or industry)
• Supply chain actors and influences	• Lack of access or support from trusted sources
• Community expectations (e.g. animal welfare)	• Communication or messaging that's complex, general and non-specific or not appropriately timed
• Trusted 'sources' (e.g. government agencies, extension personnel, neighbours)	• Fear of unknown or possible consequences with certain practices (e.g. reporting pests, provision of personal and production data to other organisations)
• Approachability of experts (e.g. extension personnel, veterinarians, agronomists)	
Personal factors	
• Increased awareness and knowledge of biosecurity threats and risks	• Lack of awareness and/or knowledge
• Scale of business, infrastructure and income derived from farming operation	• Competing demands – lack of time and resources
• Previous experience with or exposure to the biosecurity threat	• Impact on lifestyle and family
• Belief in shared responsibility across the industry or community	• Apathy
• High place attachment (i.e. to farm, region)	• Emotions (e.g. stress, anxiety, feeling of helplessness)
• Value and perception regarding being a 'good farmer' and running the best farm' possible	
• High perceived personal control and self-efficacy	
• Resilience and adaptability	

On-farm biosecurity management

Producer segmentation

Segmenting agriculture, fisheries and forestry businesses is important in this discussion, to tailor our understanding of the different motivators and barriers of those businesses to implementing biosecurity measures. While subjective, there is strength in differentiating producers by a market segmentation that is based on size and relative attitudes, knowledge and skills, as well as production system and capacity, as a guide to establish the likelihood of adoption but equally the risk threshold.

To support an assessment of producers based on market segmentation characteristics, five overarching hypothesised groups of producers have been identified. These market segments are defined in Table 2, with the likely extent of adoption of biosecurity best practices illustrated in Figure 4.

Table 2. Producer market segmentation shaping biosecurity adoption.

Motivators	Barriers	
Export-focused business	Viewed by peers within the industry as leaders, as evidenced by efficiencies within their production operation and/or successful adoption and trialling of technology and innovation practices.	Generally, maintains a high level of biosecurity practice adoption to ensure market access protocols are met and to avoid risks to their production system that would result in a loss of market access.
Business that relies on domestic movement (plant, soil, animal)	Producers who have a heightened awareness of regulatory requirements and on-farm management practices to facilitate the movement of product (plant, soil or animal) between sites.	Where possible, supports high adoption of relevant biosecurity practices to enable and maintain market access.
General agricultural business	Producers who operate viable production systems, however would benefit from adoption of improved production practices to support farm gate efficiency, profitability and sustainability. This group also includes most culturally and linguistically diverse (CALD) producers.	Adopts relevant biosecurity practices as aligned to production system, however not always to the full extent of the practice, i.e. monitoring rather than surveillance. Biosecurity risk can be indirectly managed, e.g. spray program.
Value-based production systems (e.g. organic)	Production systems that are driven from a value base that differs to what is considered 'conventional' farming. There is variability of practice adoption for this category of production system, reflective of the value drivers of the producer and the variability in certification systems.	Variability in extent of adoption driven by value base and relevant certification systems required for market access. Limited management practices available for biosecurity control due to restricted use of inputs.
Peri-urban or small-scale business, or rural residential	Land managers whose values and goals may not be directly driven by profit, and subsequently are restricted in their capacity to adopt innovative practices.	Limited awareness and thus adoption of biosecurity practices. Biosecurity risk is not indirectly managed, e.g. spray program.

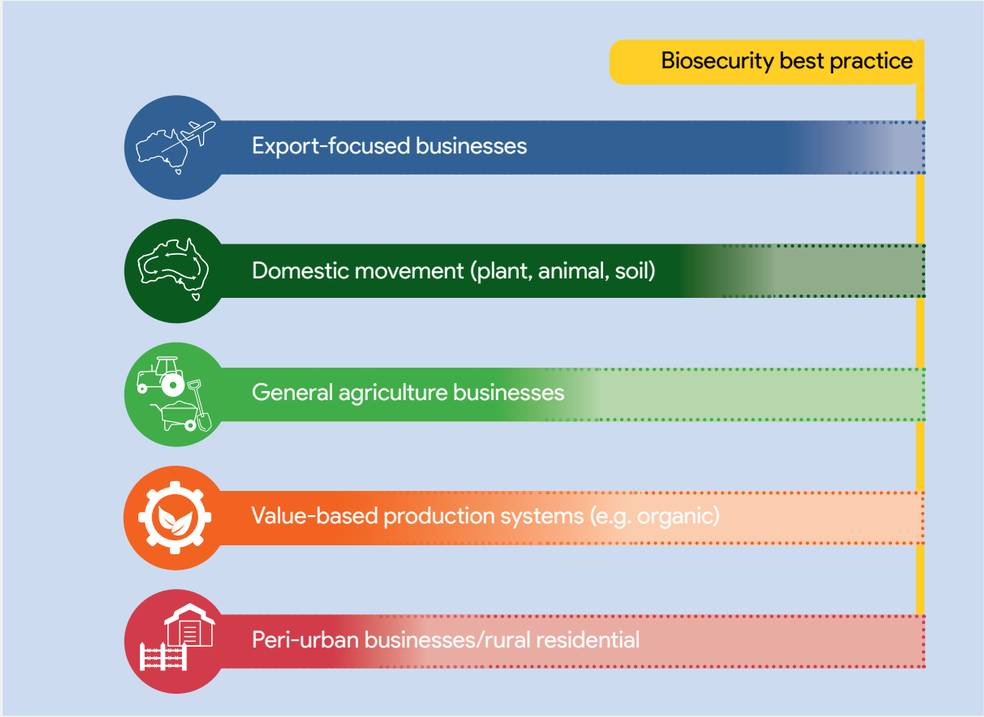


Figure 4. Assessment of the extent of biosecurity best practice adoption by market segmentation. The extent to which each bar is fully coloured (rather than faded) indicates the extent of biosecurity best practice adoption by that market segmentation.

On-farm practices

There is a high degree of variability in the extent of adoption of biosecurity best practices among producers. There is adoption of some practices, but the extent of adoption and effectiveness of those practices is highly dependent on the motivators and barriers for the producer, and linked to their on-farm drivers, external influences and risk threshold.

Where adoption of biosecurity practices does occur, the question to what extent that practice is effective in managing the threat of biosecurity risks or incursions needs to be considered.

To demonstrate the variability in the types of biosecurity practices recommended, a biosecurity hierarchy of controls has been developed, as highlighted in Figure 5. The biosecurity hierarchy of controls is a framework for reducing the risk of introduction, spread and persistence of pests and diseases in primary industries. The framework is composed of five tiers, listed in order of decreasing risk reduction: (1) prevention; (2) management and engineering controls; (3) monitoring; (4) administration and training; and (5) personal protective equipment.

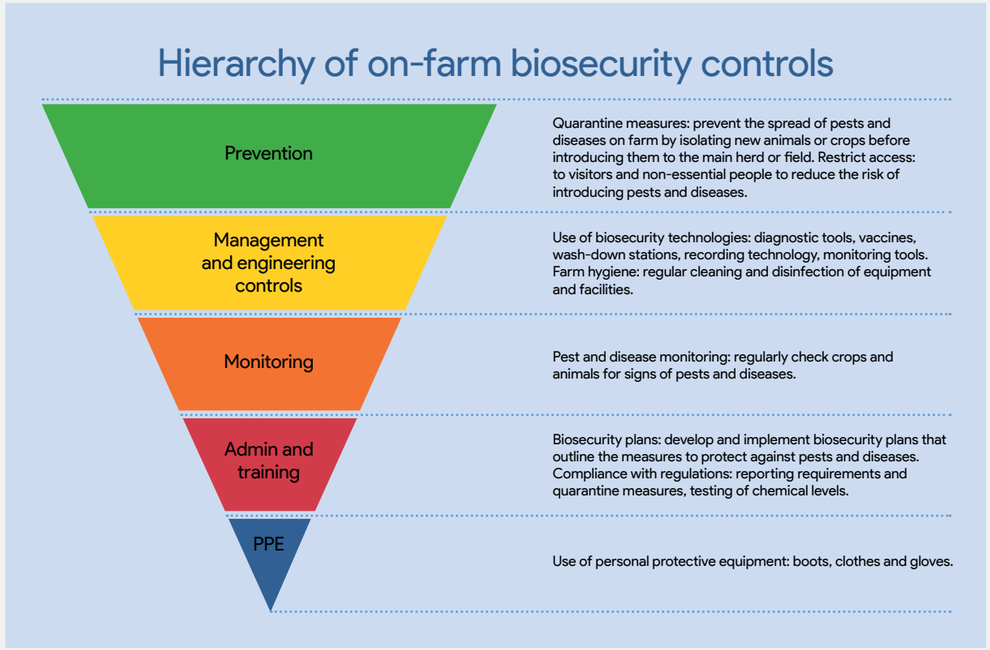


Figure 5. Biosecurity hierarchy of controls highlighting the level of effectiveness and difficulty to implement.

Prevention

This step involves preventing the hazard from entering the environment. This is the most effective way to control the risk, as the hazard no longer exists. Examples of what this looks like at a farm level are outlined below.

Quarantine measures: Farmers may implement quarantine measures to prevent the spread of pests and diseases on their farm, such as isolating new animals or crops before introducing them to the main herd or field.

Restricting access: Farmers may restrict visitors, non-essential people, vehicles and machinery from accessing their farms to reduce the risk of introducing pests and diseases. They may also keep records of visitors.

Good farm hygiene: This includes signage, regularly cleaning/sanitising and maintaining all farm equipment, tools and facilities, properly disposing and/or recycling waste, including managing crop residues after harvesting, wash-down facilities, handwashing/shower facilities for workers, good water quality for livestock and irrigation, and crop rotation.

Management and engineering controls

This step involves using physical or mechanical means to control the hazard, such as removing access to bushland or increased monitoring of animals or crops. Engineering controls are generally more effective at controlling risk than administrative controls, as they provide physical isolation from the hazard. Management controls are usually adopted once the pest and/or disease incursion is present.

Monitoring

This step involves periodic, systematic observation and recording of actual and potential pest and disease pressures within the production system for early identification and detection of new pests and diseases. While monitoring doesn't prevent or control the risk, it does allow for quicker management or eradication if detection occurs early, and enables producers to be aware of the presence or absence of key biosecurity threats.

Pest and disease monitoring: Farmers and or their agronomists/crop scouts may regularly check their crops and animals for signs of pests and diseases and report any suspicious sightings to the relevant authorities.

Administration and training

This step involves establishing policies, procedures and training programs to minimise exposure to hazards. Administrative controls include work procedures, training programs and record keeping. These controls aim to reduce exposure to hazards through changes in the way work is organised and performed.

Biosecurity plans: Farmers may develop and implement biosecurity plans, which outline the measures they and their staff must take to protect their farms from pests and diseases.

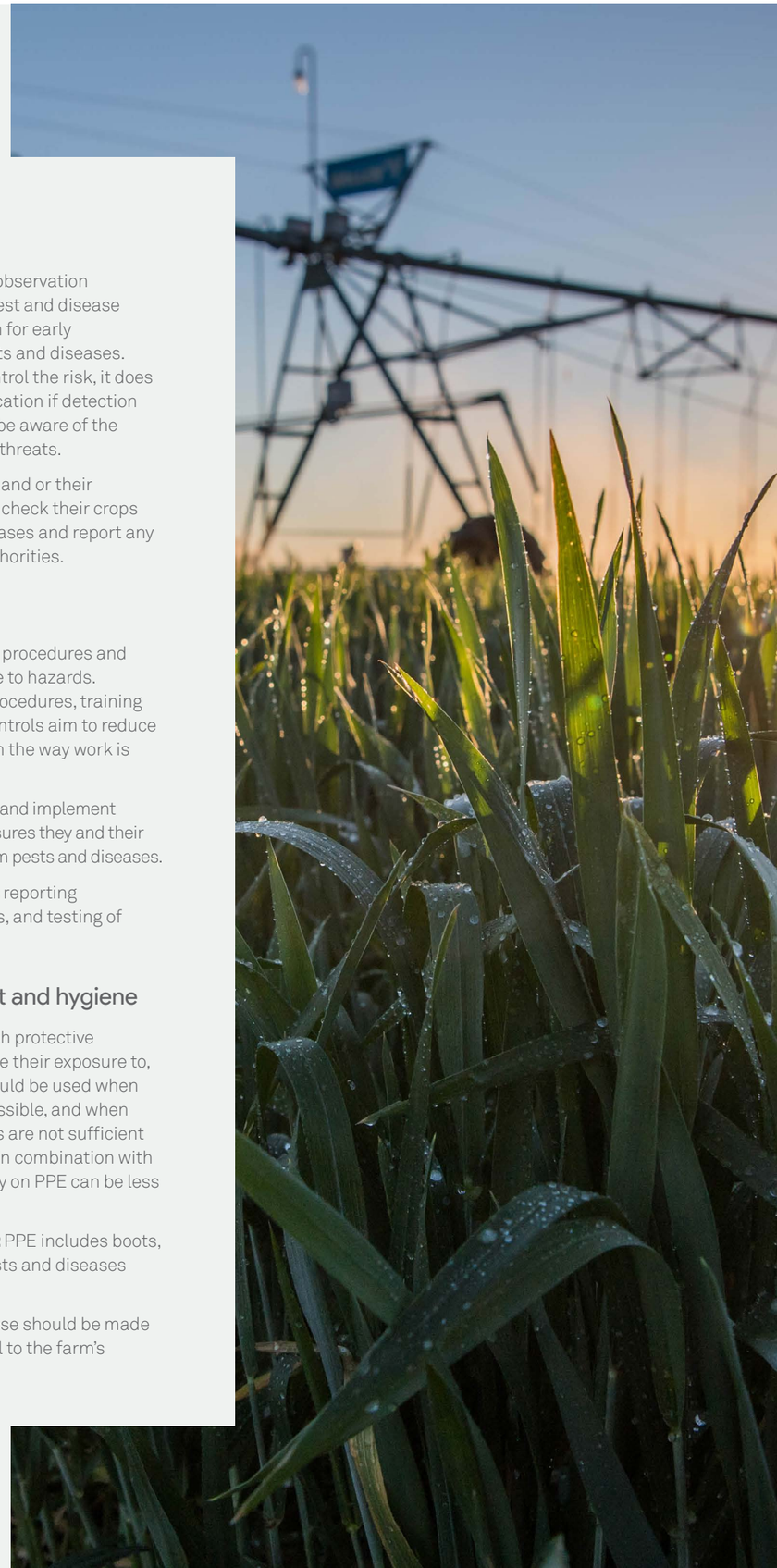
Compliance with regulations: Includes reporting requirements and quarantine measures, and testing of chemical levels.

Personal protective equipment and hygiene

This step involves providing workers with protective clothing, equipment or devices to reduce their exposure to, and risk of spreading, hazards. PPE should be used when elimination and substitution are not possible, and when engineering and administrative controls are not sufficient to control the risk. PPE should be used in combination with other control measures, as relying solely on PPE can be less effective.

Use of personal protective equipment: PPE includes boots, clothes and gloves to avoid carrying pests and diseases from one place to another.

Use of washing facilities/showers: These should be made available to staff if their use is essential to the farm's operations.



Emerging trends and possible impact on biosecurity

Several emerging trends with potential to impact on the future biosecurity system, including at the producer level, have been identified. These are grouped in themes below, noting some are likely to have clear benefits for the system, while others may create significant challenges. In some instances, it is unclear how the trend may impact the system.

External challenges to the system

Trends relating to external challenges to the system include:

- **Climate change**, which may increase the distribution and habitable zones of pests and diseases, and create challenges related to flooding, drought and changes in habitable zones of pests.
- **Increased global trade and movement** of stock (animals, plants) and people, which increases biosecurity risk and the challenge of tracking and understanding the origin of products.
- **Increased international travel and agritourism**, which increases the risk of biosecurity threats being spread through movement of people.
- **Available chemistry options** for control and management of disease pressures – either new options becoming available or existing options being no longer available.

Changes to biosecurity system components

Trends relating to changes to biosecurity system components include:

- **Constrained biosecurity workforce numbers, capability and expertise** due to an ageing biosecurity workforce. Compounding the issue, the lower rate of relevant scientists coming through the education system is reducing available expertise in areas such as entomology and pathology, and exotic pests and diseases. There is a small number of people who have good understanding of the complex biosecurity system and state governments have, in the past, divested their biosecurity capacity.
- **Regulatory requirements and protocols**, which require regular updating, including development of national protocols for handling data, to improve coordination and utilisation of nationally recognised data for international trade and market accessibility.

Technology and media

Technology and media trends include:

- **Technological advancements**, which will boost the efficiency of the biosecurity system. Advancements include the development of the Australian Agrifood Data Exchange, laser scanning systems, improved monitoring tools, and new quick detection/diagnostic tools for monitoring and during early incursion, to use both on farm and at the border.
- **There are limitations to technology** even with advancements in areas like drone detection and check-in apps. It is acknowledged that technology alone cannot replace the expertise and capacity provided by experienced field scientists.
- **The role of media**, particularly social media, in driving discussions and influencing decisions related to biosecurity, including avoidance, surveillance/reporting, control measures and chemical access. A substantial proportion of incursions are detected on hobby farms and in gardens; media can reach small-scale property owners to alert them of the importance of biosecurity measures.

On-farm diversification and intensification

Trends relating to on-farm diversification and intensification include:

- **The emerging trend of agritourism**, which is both a potential driver for adoption of biosecurity practices (e.g. heightened awareness of transmission pathways) and an increased biosecurity risk.
- **Growing urban populations and global food pressures**, which will drive intensification, vertical integration and possible expansion into new areas, further challenging the biosecurity system.

There are limitations to technology even with advancements in areas like drone detection and check-in apps. It is acknowledged that technology alone cannot replace the expertise and capacity provided by experienced field scientists.

Findings

The following key themes draw on project findings captured through a desktop review, interviews with industry stakeholders and focus group sessions with extension personnel and industry program managers.

Strong awareness of biosecurity among producers

High level of awareness of biosecurity, but its status as a priority varies: The majority of producers and all industries are very aware of the role and importance of, and need for, biosecurity, in general terms. However, understanding and implementation of detailed biosecurity practices on-farm varies due to a range of reasons, as discussed previously, including the producer's own operating environment, the markets they pursue, their industry and social networks, and their personal background and decision-making style.

Perception biosecurity is a government responsibility: There is a perception among some farmers that biosecurity is primarily the responsibility of the Australian and state governments, rather than individual farmers. However, some producers unknowingly implement 'good' biosecurity practices without explicitly recognising them as such.

Variable understanding of shared responsibility and compliance: Understanding that biosecurity is a shared responsibility is variable across industry stakeholders and producers. Compliance with general biosecurity obligations or duties can be a challenge for businesses, and the lack of enforcement or incentives for adoption can hinder uptake. In addition, where producers believe others may be 'freeloading' and have not implemented on-farm biosecurity practices to the level expected, this can be a disincentive. Creating clear guidelines, incentives and consequences can drive adoption of biosecurity strategies.

Limited risk perception and awareness: Producers, agronomists and other service providers have limited awareness or understanding of the biosecurity risks beyond their own operations or immediate control. There is a need for broader education and awareness efforts to help stakeholders recognise and address risks on the perimeter of their properties.

Variable extent of adoption of on-farm biosecurity practices

Varying levels of on-farm adoption of biosecurity practices: Large-scale producers usually have the resources and ability to implement biosecurity measures compared to small-scale producers and hobby farmers. In addition, the different drivers and barriers faced by a producer, their perception and tolerance of risk, and the nuances in their decision-making processes mean adoption of biosecurity practices varies. Often, implementation of biosecurity practices is less structured and irregular, and more 'opportunistic' rather than strategic, i.e. implemented in response to a potential biosecurity threat.

Challenges and barriers to implementing biosecurity practices: The perceived (and real) costs, time, effort and potential impact on production reduces the willingness of producers to fully implement biosecurity practices and management systems. Some producers view biosecurity practices as an additional challenge rather than an integral part of their daily decision-making and operational processes.

Adoption of biosecurity practices driven by other production drivers: In many industries, certain on-farm practices are implemented for production and/or sustainability reasons, though they may also support or lead to improved on-farm biosecurity. For instance, monitoring for pests and diseases and IPM practices are often adopted to minimise, and be more targeted with, chemical use, while farm hygiene is adopted to prevent the spread of endemic pests, weeds and diseases.

Improved adoption where biosecurity practices are integrated with existing management systems: Industries and individuals that have attempted to integrate biosecurity practices into existing management systems, programs and daily operations note it supports consistent implementation and increased adoption. It is important to move away from treating biosecurity as a standalone concept and instead incorporate it into broader agricultural management approaches.

Variation in biosecurity practice adoption between sectors

Greater awareness and adoption across intensive animal industries: Members of intensive animal industries are acutely aware of the risk of a biosecurity incursion, and the impact on their livestock and business operations should there be one. Experience with biosecurity incursions, awareness of impacts from overseas and other operating drivers, such as community expectations regarding animal welfare, all contribute to producers from these industries being more engaged and responsive to biosecurity measures within their production system.

Need for continued market access and trade requirements: The need to meet current and changing market access requirements, especially for export-focused businesses, plays a crucial role in driving awareness and adoption of biosecurity practices among producers.

Previous exposure to biosecurity incursions and events: Recent biosecurity incidents and incursions have a significant impact on producers' attitudes and practices, and can lead to increased vigilance regarding transmission pathways on farm and adoption of monitoring practices, though in some cases they may have less trust in government-led biosecurity efforts.

Balancing consumer and market demands: Integrating biosecurity measures with existing practices, such as animal welfare, can be a driver for adoption. However, some consumer or market pressures may expose producers and their operations to greater biosecurity risks. For example, free-range poultry are potentially more exposed to pests and diseases from wild or native bird populations and other transmission pathways (e.g. windborne).

Increasing role of technology

Increasing interest and use of technology to support integration of on-farm biosecurity practices: There is increased interest among individual producers and industries in using technology (e.g. digital platforms, apps, drones) to support efficiencies and adoption of biosecurity practices. Technology that serves numerous purposes (e.g. integrating biosecurity and worker health and safety requirements, using remote IPM monitoring systems) will have significant appeal to producers looking to make their overall production systems more efficient.

Impact of skills and capacity within the biosecurity system

Patchy biosecurity capacity and expertise: Many stakeholders recognise that specific skills (e.g. entomology, pathology) and experience across different industries and in state government is variable, and this may contribute to diminishing trust among producers and the broader community in the system.

Important role of regulatory tools and incentives: The existing regulatory framework and lack of incentives are seen as barriers to effective biosecurity implementation. There is a perception that only regulatory intervention or market pressure will drive those who are complacent about biosecurity to act. Some believe incentives, whether in the form of rewards or penalties, are needed to support greater adoption of biosecurity practices.

Balancing the tension between the greater 'good' and the personal impacts from reporting: Producers and other agricultural professionals are often reluctant to report biosecurity incidents or unusual findings, particularly where the consequences are unknown or where there may be significant personal and business impacts. Issues with reporting methods and requirements from government, lack of trust in data, and concerns about personal and financial consequences hinder willingness to report. The importance of reliable data collection and analysis is highlighted.

Importance of relevant education and training for producers and service providers: Essential training, such as knowing what pests and diseases to monitor or look for, and how to monitor, is needed on an ongoing basis to ensure capacity is retained across the agricultural sector. Training is also needed to ensure consistent understanding and adoption of biosecurity protocols across an industry.

Complexity of the biosecurity system leading to unintended consequences: The biosecurity system is complex, may be unknown to some producers, and may unintentionally create an 'us and them' narrative. This subsequently may drive producer behaviour that is not conducive to shared responsibility.

Reliable biosecurity information sources for producers

Access to reliable biosecurity information not the issue: There is readily available information for producers to access via various platforms, in many formats and delivered by a range of actors in the system (e.g. industry organisations, government biosecurity agencies, PHA, AHA, universities). However, the issue may be the timeliness of when the information is delivered, whether it's relevant to a producer's context and whether it's in a fit-for-purpose format, e.g. can the information be easily integrated into their current practices and management system?

Important role (and behaviour) of trusted sources: Intermediary service providers, such as agronomists, stock agents, vets, industry development officers and extension personnel, play a crucial role in supporting producers and promoting biosecurity practices. They are often seen as instrumental in providing support, training, monitoring services and trusted information. Engaging with and empowering service providers can lead to better adoption of biosecurity practices.

Important role of peer networks, social norms and leadership: The complex social networks and expected behaviour and norms can play a significant role in supporting greater adoption of on-farm biosecurity practices. There is value in identifying leading producers or champions who may demonstrate how to be a good producer, manager or industry member through adoption of specific biosecurity practices, and who can highlight why this is good for business.

Role of language and communication

Crucial role of effective communication in promoting biosecurity practices: Producers need clear, understandable and relatable information on how and why to implement biosecurity measures. It is important to understand the audience for biosecurity 'messaging' for it to be targeted and effective. It is also important to use an agreed, common language across biosecurity agencies and avoid using a perceived patronising approach.

An overload of communication and information creates confusion: The challenge with an abundance of biosecurity information and resources provided by a range of sources is that producers can become overwhelmed, confused and even apathetic. Clear, targeted and effective communication strategies are needed to ensure producers are not deterred in using available information. 'Bureaucratic' language should be avoided.

Importance of overcoming language and cultural barriers: Language barriers and cultural diversity can pose challenges in effectively communicating biosecurity information to culturally and linguistically diverse (CALD) producers and/or their workers. Translating information into different languages and using visuals, images and practical demonstrations can help overcome these barriers.

Impact on individual producers

Fear of reporting and misunderstanding the implications: The fear of personal, social and financial repercussions from reporting exotic pests and diseases, and a lack of real incentives for producers to report, are challenges. Notably, the fear of not knowing what will happen after reporting a biosecurity issue deters reporting. Building trust and providing tangible benefits or support for those who report incidents is important in overcoming this barrier.

Impact on individuals' mental health: Reporting biosecurity incidents and preparing for, or going through, a biosecurity outbreak has a significant impact on a producer's wellbeing, and that of their family. The emotional impacts, such as fear, stress and being overwhelmed, can be immense and should be addressed through supporting systems.

Recommendations

Insights from this behavioural analysis have informed the following high-level recommendations that could be considered by AgriFutures Australia and other actors in the biosecurity system, such as government biosecurity agencies, industry organisations, extension officers and communication specialists.

The system should be designed with producers in mind, as they interact within a system they trust

For a particular industry, region or production area, consider identifying who and where that trust sits with, particularly for biosecurity information. Acknowledge the significant role professional advisors and other services providers have in supporting producers, and consider whether they could be included more effectively in the biosecurity system to support on-farm biosecurity efforts.

Communications should be nuanced and targeted for each sector and industry

The style, timing and source delivering biosecurity messaging should be tailored to target a particular sector or industry for a particular purpose. Clear and consistent communication is required to minimise confusion and misunderstanding by producers and industry stakeholders; ideally, messages should be in 'producer speak' and not regulatory terms.

Biosecurity practices should be able to be integrated into broader production systems

Identify those industries and individual producers who have fully integrated on-farm biosecurity practices with their daily operations and broader management systems, and identify common elements and what has worked to support others in improving integration. Further, ensure biosecurity measures, such as QA, training, monitoring and WH&S, can be integrated into existing on-farm systems.

Other 'cracks' in the biosecurity system should be acknowledged

It is important to acknowledge issues in the biosecurity system that are beyond the farm gate, to support transparency and therefore trust in the system. This may include:

- Identifying where capacity and skills may be under-resourced, e.g. some state government biosecurity agencies and or diagnostic services.
- Breaking down silos, such as between agencies or organisations, that may exist in the system.
- Improving data capture management, i.e. all states and Australian agencies using the same system.
- Improving the agility of the system to reduce response times.

In acknowledging these issues, communicating how they may be addressed will also maintain support for the system. An example is improving inter-agency collaboration or sharing information between the National Biosecurity Communication and Engagement Network, industry organisations and extension networks.

On-farm biosecurity case studies

1 Case study: Biosecurity apps/platforms

As technology advances, farmers have more tools at their disposal to manage and monitor biosecurity risks on-farm.

Farm biosecurity platforms are emerging as one of the most valuable tools available to farmers today, with multiple options available for producers ranging from whole farm management tools with biosecurity models to specific biosecurity apps.

Biosecurity apps have been developed to address the biosecurity risk of visitors to farms. One such app is Exoflare, which creates a digital record of movement of people on properties to prevent and trace diseases. This app allows farmers to assess risks in real time by pre-authorising visitors and creating automated risk mitigation actions.

New technology apps are being adopted across several agricultural industries, in both intensive and extensive production systems. These apps have a check-in and checkout feature that can be used without internet or cellular service.

As well as delivering biosecurity assessments, the technology has a range of multi-purpose benefits for quality assurance program requirements, including APIQ, Livestock Production Assurance (LPA) and National Feedlot Accreditation Scheme (NFAS). The platforms also have communication tools, contact information and property inductions that can help producers fulfil work health and safety requirements. Management tools are also incorporated into the platforms to enable task and job management, allowing assessment and tracking of work.

Onside is another example of a digital biosecurity management tool that provides producers with a digital toolkit with features such as visitor records, check-in questions and property rules to help manage and track visitors on farm. Feedback from users has been positive.

> *"The app has proven to be an easy-to-use and practical tool for keeping track of people visiting your property."* – Mixed cropping, vegetable production and beef farmer

> *"The amount of time and effort it [the app] saves is amazing. It makes us feel likes it is making us much more efficient." – Poultry industry quality assurance coordinator*

Biosecurity platforms and apps allow producers to have a consistent approach to biosecurity, allowing all industry participants to access the platform and capture data electronically for record keeping, reporting and contact tracing. An important aspect of these platforms is their ease of use in the field, with a mobile device reducing the need for physical notebooks and clunky Microsoft Excel sheets.

> *"The biggest benefit is the fact that it stores all that data in an app. You can go through and look at the history of who's been on your site, and follow that up really easy, really quickly."* – Pork industry production manager

The apps have also been labelled as affordable for producers, and even free in some industries.

> *"It's good for big companies as it's cost effective."* – Pork industry animal health manager

> *"It [the app] gives me control over my visitors before they gain entry. We used to have trouble with people turning up at the site, almost getting in the door and suddenly realise 'uh-oh, there's a problem'."* – Pork industry production manager

2 Case study: Agricultural biosecurity lessons from COVID-19

The COVID-19 pandemic increased awareness among agricultural producers that Australia as a country is not immune to exotic pests and diseases, and that, as one Queensland beef producer put it, "the unthinkable can happen".

For many industries, such as the wine industry, there were unlikely positives stemming from the pandemic, and good on-farm biosecurity practices were being maintained after lockdowns ended.

> *"I do think the COVID experience around interstate travel and borders has highlighted to the entire global population the concept of transmissibility, and this is one positive to come out of a really challenging situation."* – Vine health case study

> *"Ironically, many are now finding themselves using the farm gate as an important conduit to help mitigate the COVID risk to their staff and business. This knowledge can be carried forward to management of other biosecurity threats."* – Vine health case study

The COVID-19 measures put in place in Australia and more general biosecurity measures can be compared because the Australian Government applied the overarching *Biosecurity Act 2015* during the pandemic, which is also applied for incursions of other types of pests and diseases, including those that affect agriculture.

The pandemic prompted producers to increase their awareness of biosecurity. Where there were similarities in the response to the pandemic and an exotic disease outbreak, one wool industry participant noted "COVID was a reminder of this".

But with this increased awareness came the inevitable drop-off in interest, which was experienced the longer the pandemic continued. To avoid this complacency, it is recommended producers take a similar approach to farm biosecurity as the nation did during the pandemic, including:

- **Prevent** with your boundary fences, which can act like state borders restricting movement and keeping pests and diseases out.
- **Prepare** with a biosecurity plan, alongside regular monitoring and testing.
- **Respond** if there is a notifiable or exotic disease outbreak – everyone in the livestock industry is responsible for ensuring a disease is contained and managed or, where possible, eradicated.

If we learnt anything from the COVID-19 pandemic, it is that practising and maintaining good hygiene, and minimising the spread of disease is essential. This same lessons can be applied to the plant and animal industries; pest and disease management though monitoring, good hygiene and minimising the spread will help maintain on-farm biosecurity.

3 Case study: Biosecurity lessons from the strawberry industry

Charcoal rot disease, caused by the soilborne fungus *Macrophomina phaseolina*, is a major strawberry disease that can cause significant plant deaths and crop losses. Following the halt of soil fumigation with methyl bromide, the disease has increasingly occurred in strawberry fruit crops across Victoria, Queensland, South Australia, Tasmania and Western Australia.

In 2017, a study funded by the Victorian Strawberry Industry Development Committee (VSIDC) found 80% of all strawberry farms in Victoria had *Macrophomina* in the soil, and that losses due to charcoal rot were costing the Victorian strawberry industry $20 million per year.

Following this study, successive projects conducted by the VSIDC, Berries Australia and Hort Innovation established best management practices for charcoal rot, and delivered extension and communication.

> *"There is a clear correlation between adoption of on-farm biosecurity practices and reduction in level of disease."* – Dr Scott Mattner

> *"Every biosecurity practice you put in place reduces your risk incrementally. For example, putting a biosecurity sign at the farmgate will reduce your risk marginally, but you do that in addition to other biosecurity practices, you reduce your risk significantly."* – Angela Atkinson, Strawberry Industry Development Officer

Included in the extension activities was a roadshow across Victoria that facilitated small group discussions between growers and researchers.

> *"Through utilising small groups, the roadshow got a good discussion happening between researchers and growers, including those growers who tend to sit back and talk less. The small groups were valuable in building relationships and encouraging participation by everyone."* – Dr Scott Mattner

Growers participating in extension events gave researchers and extension personnel in-depth insight into what information would be valuable to growers.

> *"You can lead a horse to water but they won't drink unless they see a benefit. Researchers worked very closely with growers to tailor their research so that growers could clearly see how the research would help reduce losses."* – Angela Atkinson, Strawberry Industry Development Officer

Extension activities sought to ensure the findings were accessible to all growers. In Western Australia, where there are several growers with English as a second language, a respected local grower was engaged to translate the messages among their peers. The respected grower was specifically chosen as commercial language translators have no knowledge of the industry, and the existing trust in this grower gave credibility to the open discussion during the session.

One piece of research related to using a different type of plastic mulch to cover crop rows when fumigating. The new type of plastic mulch better insulates the fumigant and therefore keeps the fumigant in the soil for a longer time period. The researcher quantified the cost per hectare of the new plastic mulch, the corresponding theoretical reduction of disease incidence, and therefore the cost saving per hectare from using the new plastic mulch.

> *"Within a season, everyone changed [plastic covering] products."* – Angela Atkinson, Strawberry Industry Development Officer

Other key insights from the roadshows were barriers to adopting biosecurity practices on farm that seemed beyond the control of growers. One barrier was difficulty getting utilities and contractors to follow biosecurity practices.

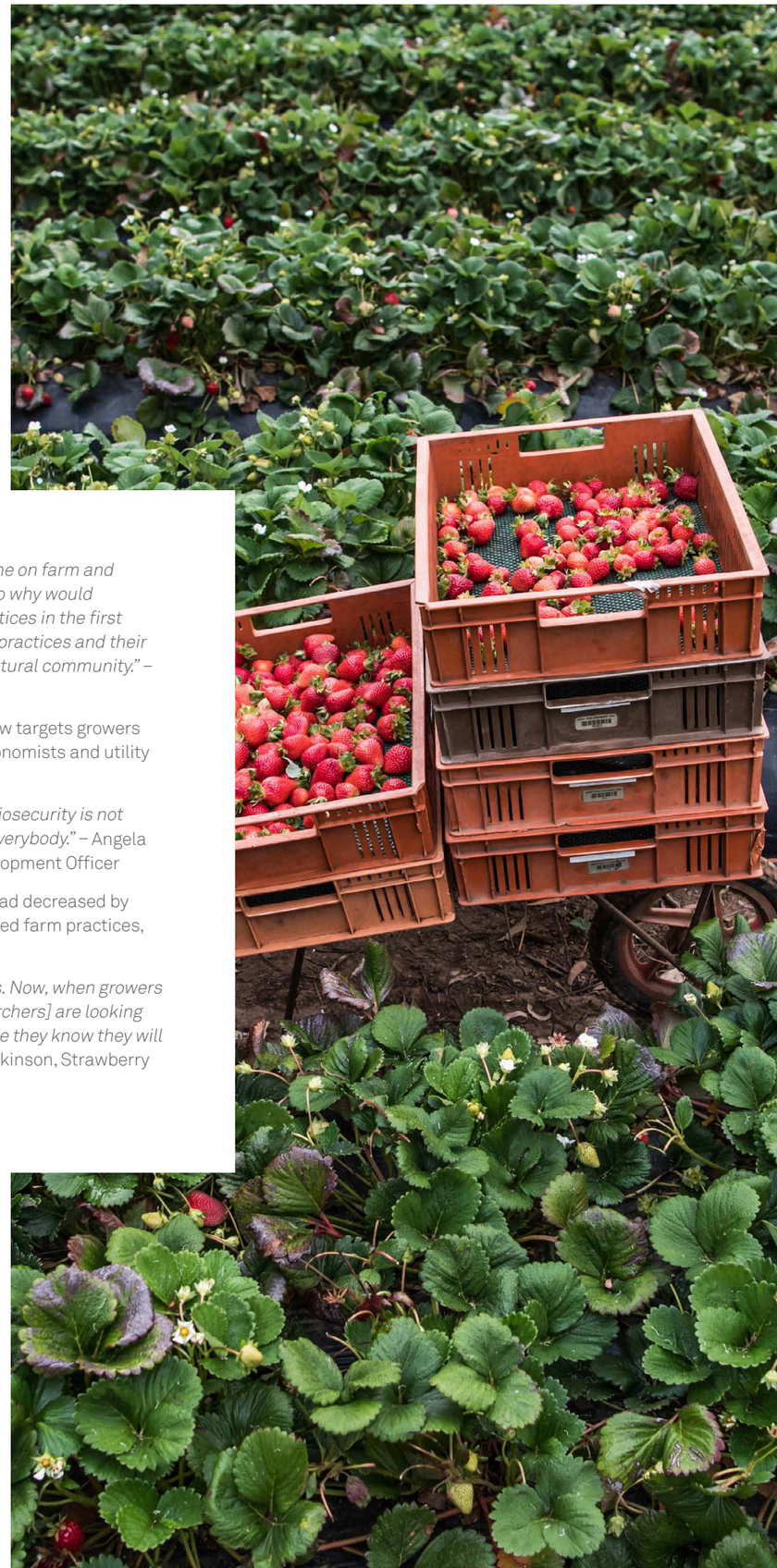
> *"They [utilities and contractors] come on farm and disregard biosecurity procedures, so why would growers undertake biosecurity practices in the first place? The extension of biosecurity practices and their importance goes beyond the agricultural community."* – Dr Scott Mattner

Extension in the strawberry industry now targets growers and intermediary services, such as agronomists and utility personnel.

> *"We're really pushing the fact that biosecurity is not just a concern for growers, but for everybody."* – Angela Atkinson, Strawberry Industry Development Officer

By 2021, the incidence of charcoal rot had decreased by 20% due to industry adoption of improved farm practices, including farm biosecurity.

> *"Extension is all about relationships. Now, when growers see that Scott and Dylan [the researchers] are looking into a topic, they participate because they know they will get practical outcomes."* – Angela Atkinson, Strawberry Industry Development Officer



4 Case study: Increased biosecurity risk in animal industries

Animal industries that perceive a higher risk of pests and diseases have heightened awareness of biosecurity practices. A prime illustration of this is the poultry industry, which remains vigilant against disease threats to its livestock, as evidenced by three avian flu outbreaks in Victoria in 2020.

These outbreaks comprised two low-pathogenic incidents (H5N2 and H7N6) and a high-pathogenic outbreak of H7N7, resulting in the deaths of 450,000 birds across the state. Consequences included risks to export markets and increased costs associated with moving stock and eggs within the country.

In response to these outbreaks, a housing order was enforced, mandating that all bird owners in affected areas keep their stock indoors. Infected birds on farms were euthanised and infection sites underwent decontamination procedures.

Due to the high risk of contamination in these industries, based on the density of animals, strict measures are implemented regarding the movement of people and machinery to and from sites. Typically, only one entry point is allowed and comprehensive record keeping is maintained. Once onsite, contact with livestock is limited and PPE is worn to minimise the likelihood of disease transmission. Robust biosecurity borders are also established to mitigate the transmission of diseases from wild birds to livestock. Consequently, producers in these industries have strong awareness of biosecurity risks and employ best management practices to safeguard their livestock.

However, this commitment to biosecurity can sometimes clash with consumer expectations. As market trends increasingly favour sustainable and ethical farming practices, demand is growing for free-range options in both egg production and meat. Yet, free-range poultry are more susceptible to diseases through transmission from wild birds; this represents an animal welfare concern.

Similar to poultry farms, the pork industry confronts risks posed by exotic diseases such as African swine fever (ASF). Given the absence of treatment options, the pork industry faces heightened vulnerability in the event of an incursion. Models indicate an ASF outbreak could cost the industry between $101 million and $263 million if eradication is possible, and up to $2.5 billion if ASF was to become endemic. This awareness of increased risk has prompted the pork industry to adopt more intensive biosecurity practices compared to other livestock sectors. These encompass controlling vehicles, individuals and equipment onsite, as well as maintaining meticulous record keeping.

These industries serve as exemplars of how the elevated risk to livestock and the broader industry can shape producers' approach to implementing biosecurity practices on their farms.

5 Case study: The role of intermediaries in on-farm biosecurity

Farms are complex and ever-changing systems, with multiple people involved in the decision-making process. Some decision makers at the table include trusted intermediaries, who advise farmers on markets, animal and plant health, and consequently the biosecurity of their farms.

Intermediaries can be organisations, groups or individuals who help achieve change by channelling information towards target groups. These stakeholders are likely trusted and well-respected by farmers and members of the community as they are generally in close or direct contact with them. Therefore, while intermediaries are not directly making decisions for farmers, they are a trusted source for advice and information, and their advice carries much weight.

Stock agents, agronomists, resellers and veterinarians are examples of intermediaries involved in the biosecurity system in agriculture. These trusted sources have relationships with their clients and have localised knowledge often built up over years.

> *"Older generations or newer people to the industry may struggle with online certifications and go to their stock agent for help."* – Victorian beef producer

> *"There is expertise with stock feed, agents and local truck drivers with skin in the game – at the interface with farmers. How can we connect with them to provide ideas to inform legislation?"* – Insight detailed in *Victoria's Biosecurity Roundtable 2022 report*

> *"As a stock agent, they do trust you and would ask for advice, and I also have trust in them [the vendor], and I would talk to them if I saw something and suggest maybe it doesn't look right and refer [them] to their local vet."* – New South Wales stock agent

> *"We are a source of confidence and enjoy being there for the farmers."* – New South Wales stock agent

The knowledge base of these trusted sources in knowing the difference between exotic and endemic diseases in the region is also highly regarded.

> *"If it was foot rot, we would call it up and refer the vendor to someone who knows, but if it was foot and mouth disease, there would be more drastic action with immediate referral to the local government vet."* – New South Wales stock agent

The opportunity for intermediaries to further biosecurity in agriculture is considerable, as they are members of the community who already have the respect and trust of the region they operate in.

AgriFutures®
National Rural
Issues

AgriFutures Australia

Building 007
Tooma Way
Charles Sturt University
Locked Bag 588
Wagga Wagga NSW 2650

02 6923 6900
info@agrifutures.com.au

agrifutures.com.au