

SPECIAL REPORT

**Weapons of mass
(economic) disruption**
Rethinking biosecurity in Australia

A S P I

Dr John Coyne and Dr Paul Barnes

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AUSTRALIAN
STRATEGIC
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Cover image: Foot-and-mouth disease virus © Science Photo Library / Alamy stock photo.

A detailed scanning electron micrograph (SEM) of biological cells, likely bacteria or fungi, showing various cell wall structures, pores, and internal organelles. The image is rendered in grayscale with a semi-transparent overlay, serving as a background for the report cover.

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EXECUTIVE SUMMARY

Today, the possibility of chemical, biological, radiological and nuclear attacks remains very real. While the Biological Weapons Convention and the Chemical Weapons Convention are widely observed, instances of the use or suspected use of such materials have been reported and investigated over many years. Between 2001 and 2003, the al-Qaeda leadership continued to attempt to acquire and weaponise biological agents.

International concern over the threatened use of weapons of mass destruction has continued unabated. The Islamic State of Iraq and Syria terror group was found to have used chemical weapons, including mustard gas, during the conflict in the Middle East. For the most part, though, while several groups have the intent to mount such attacks, they seem to have had no access to the necessary materials and knowledge to realise their ambitions in Western countries.

At least in part, that's been because of the work of governments and corporate sectors internationally. Successive Australian governments have been successful in limiting situations in which unintentional or negligent biosecurity practices could have affected the agriculture industry, causing disease or contamination, with the potential to affect both domestic food safety and economically important global export markets.

For Australia, one area of increased importance is the convergence of the threat of deliberate use of chemical or biological materials as weapons by criminals or terrorists and the natural occurrence of diseases in the agriculture sector. Each risk context is important, but their combination creates a suite of wicked problems that logically require greater collaboration among private- and public-sector agencies, along with new and different levels of attention to detail. While Australia no longer 'rides on the sheep's back', the nation has continuing strong economic and cultural links with agriculture. Arguably, Australia's economy remains intrinsically linked to agricultural production.

Biosecurity is an important operational, technical and policy construct with global relevance. Its application ranges from safety (security) in laboratories to the application of biotechnology to the diagnosis and treatment of human disease, animal and plant health, crop sciences and agricultural development.

Deliberate or accidental biosecurity breaches (incursions) present very real, perhaps existential, economic threats to Australia. Their potential long-term impacts range from harm to agricultural output to the manipulation of local or global agricultural markets.

The acquisition of the materials, equipment, information and expertise needed to manufacture super-toxic materials was once the domain of national programs. A concern for Australia, and other countries, is that it's becoming easier to get precursor materials and information on how to create super-toxic substances that can be used as weapons.

There seem to be few disincentives for state or non-state actors to not use pest species, chemical contaminants, emergent biotechnologies or diseases as a means of disrupting our economy. The acquisition and use of many biosecurity risk vectors doesn't require sophisticated knowledge or capabilities; such substances and organisms can be relatively easily used as weapons, made more dangerous, transported or deployed.

For those reasons alone, the overlap of biosecurity with customs, border security, agricultural production systems, animal and plant health, and broader national security deserves further thought.

While targeted biosecurity incidents aren't as spectacular as acts of mass murder, they can be used by state and non-state actors to punish their foes economically. Others, such as transnational serious organised crime groups, could use such incidents to shape markets and make profit from foreknowledge of disruptions to trade, changes in the value of commodities, or both.

This paper highlights how biosecurity incidents—accidental, natural or intended—may be a preferred means by which state or non-state actors can disrupt Australia, inflicting significant social and economic harm and both affecting and shaping the thinking of Australian government decision-makers.

INTRODUCTION

The threat of an attack using a weapon of mass destruction (WMD) on one or more targets in a Western country isn't new. Throughout the Cold War, governments on both sides of the Iron Curtain feared chemical, biological, radiological and nuclear (CBRN) attacks.¹ And for good reason.

Today, many countries have access to CBRN weapons, but international law and norms restrict the likelihood of their use. However, given the behaviour of some rogue states and non-state actors, such as terrorist groups, the possibility of attacks of this kind remains very real.

While the Biological Weapons Convention and the Chemical Weapons Convention are widely observed, instances of real or suspected use of such weapons have been reported and investigated over many years. Over the past 12 years, Western security agencies have judged that Russia has been responsible for the use of both a radioactive substance and chemical weapons against individuals in the UK.² North Korea's assassination of Kim Jong-nam using VX nerve agent was also notable.³ It's thus evident that some countries have both the capability and the intent to use CBRN weapons.

In the days and years that followed the September 11 attacks on the US in 2001, the Five Eyes countries and their allies were troubled by the possibility of terror groups attacking the West using WMDs. It's said that Australian state and federal police paid close attention to storage facilities in research laboratories across the country at the time.

That was for a very good reason. As early as 1998, Osama bin Laden had declared that acquiring such weapons was part of his Islamic duty.⁴ Between 2001 and 2003, the al-Qaeda leadership continued to attempt to acquire and weaponise biological agents such as anthrax.⁵ Considering terrorists' potential use of 'dirty' (radiological) bombs through to poisoning of water supplies, Western governments carried out thorough threat and vulnerability assessments focused on the non-state WMD problem.

Concern over the WMD threat has continued unabated. The Islamic State of Iraq and Syria (ISIS) terror group was found to have used chemical weapons, including mustard gas, in the Middle East.⁶ For the most part, it seems that most groups and individuals that intend to mount such attacks lack the materials, the knowledge, or both, to do so in the West.

This outcome has been at least partly the result of the work of governments and corporate sectors internationally. In the years since 9/11, Australia's border and biosecurity agencies and related industry groups have sustained effective counterproliferation and risk mitigation capabilities. Intelligence-enabled and targeted risk-reduction efforts have successfully restricted domestic access to the materials needed for WMD attacks and thus reduced the possibility of attacks.

But the detection and prevention of intentional uses of WMDs, and protection against them, isn't the only task. Historically, most state-based biological weapons programs have included an emphasis on zoonotic diseases (animal diseases that are communicable to humans), so biosecurity at a national scale has become increasingly important.

Successive Australian governments have successfully limited situations in which accidental or negligent biosecurity practices could have affected the nation's agricultural industry, its economically important global export markets, and domestic food safety.

Australia's track record in relation to the natural or human-enabled spread of pests and animal and plant diseases is a relatively positive one. Since federation, state and federal oversight of agricultural services has been developed and sustained as a mature capability to prevent, respond to and recover from outbreaks.

Sustaining that oversight has become an increasingly challenging and onerous task in a world of geopolitical tensions, technological asymmetries and globalised supply chains, in which the need to reduce red tape and facilitate greater imports and exports of commodities has become paramount.

For Australia, one area of increased importance is the convergence of the threat of deliberate use of chemical or biological materials as weapons by criminals or terrorists and the natural occurrence of diseases in the agriculture sector. Each risk context is important on its own, but their *combination* creates a suite of wicked problems that seems to require enhanced collaboration among agencies—private and public—along with new and higher levels of attention to detail.

This paper examines the implications of these convergent biosecurity risk contexts for Australia. The convergence is characterised by the historically established human intent to use biological or chemical weapons to cause harm combined with the more traditional threat posed by biological and disease threats to our agricultural industries.

The management of each of these themes has historically been overseen by different parts of state and federal governments. The convergent threat landscape warrants a new appraisal and a rethink of organisational and cross-sectoral approaches to the problem.

In recent times, the possible impacts on Australia's agricultural and food production industries from invasive pests and biological or chemical agents have arguably had less recognition than the 'hard security' threats posed by transnational organised criminals and terrorists.

This report makes a case that the Australian Government needs to ensure that conventional 'agricultural' frames for biosecurity are combined with a focus on biological criminality and biological terrorism as part of a forward-looking national capability.

THE VALUE AND IMPORTANCE OF AUSTRALIA'S AGRICULTURAL SECTOR

While Australia no longer 'rides on the sheep's back', strong economic and cultural links with agriculture remain.⁷ Our economy remains intrinsically linked to agricultural production. In 2016–17, agriculture and its related sectors contributed 12% of Australia's GDP, or \$155 billion.⁸ In 2017, the sector accounted for 3% of the national workforce.⁹ So, despite the contribution of the resources and services sectors, agricultural production remains extremely important to Australia's domestic consumption and international trade.

The agricultural sector also has intrinsic historical value for many Australians. The state, territory and federal governments' subsidisation and support of these industries, especially in times of drought, is as much a commitment to heritage as it is to economic continuity or development. Food security remains a key national security issue but is perhaps under-considered and under-discussed.¹⁰ Recent strawberry-tampering incidents across Australia clearly illustrate the national effect of quite low-level acts affecting food security.

Agricultural export trade operates in a highly competitive global market. Australia has a competitive advantage in many sectors of food production because of our credentials as a producer of high-quality products. The ongoing viability of our agricultural ecosystems and food security (the availability of safe and abundant locally produced food) is critically important, particularly for success in these markets. Australia's globally recognised freedom from many animal and plant diseases has tangible economic value.

Our access to global markets and sustained demand for our products are central to economic competition. As in any human endeavour, where competition and market forces are in play there will be commercial opportunities from speculation on future price variations on the part of non-state actors, creating the motivation for highly profitable manipulation of agricultural production.

The World Trade Organization (WTO) operates to regulate many aspects of international trade, including intellectual property rights, trade barriers, customs valuations and (importantly for this report) sanitary and phytosanitary measures covering food safety (bacterial contaminants, pesticides, inspection and labelling) and animal and plant health.¹¹

Given its global role, the WTO is a central plank in rules-based arrangements designed to limit biosecurity threats affecting not only food safety and trade but also, indirectly, national security.

A WIDER FRAME OF REFERENCE FOR BIOSECURITY

Biosecurity is an important operational, technical and policy construct with global relevance. Its contextual application ranges from safety (security) in laboratories to biotechnology applied to the diagnosis and treatment of human disease, as well as animal and plant health, crop sciences and agricultural development.

In this form, it also includes measures taken to reduce the likelihood of and manage the response to infectious diseases caused by viruses, bacteria or other micro-organisms on imported products or food.

This approach is detailed in the WTO's sanitary and phytosanitary and quarantine measures. It's applied to protect human, animal and plant life and health from the effects of the introduction, establishment and spread of pests and diseases, and from effects arising from additives, toxins and contaminants in food and agricultural feed.¹²

That intention is taken up and exemplified in the policy goal of the Australian Department of Agriculture and Water Resources (DAWR), which considers biosecurity to be 'a critical part of the government's efforts to prevent, respond to and recover from pests and diseases that threaten the economy and environment'.¹³

Deliberate or accidental biosecurity breaches (incursions) present very real economic threats to Australia. Their potential long-term impacts can range from reduced agricultural output to the manipulation of local or global agricultural markets.

For example, diseases such as foot-and-mouth disease (FMD) are significant threats to Australia's economy. A confirmed case of FMD would reduce both our ability to export many products and our international disease-free status. Other diseases could affect domestic food security.

A different security-focused meta-theme relates to the use of chemical agents, biological materials, or both, as weapons. Humans have a long history of using and threatening to use such agents as weapons, including in applications targeting people, livestock and crops and using insect vectors to spread disease. In the hands of state or non-state actors, biological weapons can be devastating.

International treaties and agreements such as the Biological Weapons Convention and the Chemical Weapons Convention¹⁴ have been in place for many years, and national approaches to biodefence have similarly been central parts of national security planning.¹⁵

This 'securitised' emphasis on biosecurity has become a key feature of security planning and operations (including preparedness and response) applied to mitigate the potential for the intentional introduction of disease or infectious biological material into Australia, including as an aspect of counterterrorism.

The safety and regulatory oversight of activities and pathogen-control measures in laboratories working in a range of applied sciences and technology areas has become increasingly important. New technical applications using synthetic biology and genetic manipulation, have emergent and obvious 'dual-use' characteristics.

Biosecurity as an operational and policy construct sits at the nexus of laboratory safety, human, plant and animal health regulation, and applied risk assessment for security purposes.¹⁶ There's considerable interest in the potential negative impacts of synthetic biology, especially in the context of biodefence.¹⁷

AUSTRALIAN GOVERNMENT RESPONSES TO BIOSECURITY

Biosecurity presents a strategic challenge in both its more conventional animal and plant health (APH) form and its ‘securitised’ form because of the diverse range of threats in each form. The two forms have competing perspectives and priorities, but they’re part of a continuum of strategic policy positions that have a common base.

Because Australia is an island, our agricultural ecosystems are free from many of the pests and diseases that are prevalent in other parts of the world. This has ensured that Australian agricultural products are seen as free of many of the pathogens seen elsewhere.

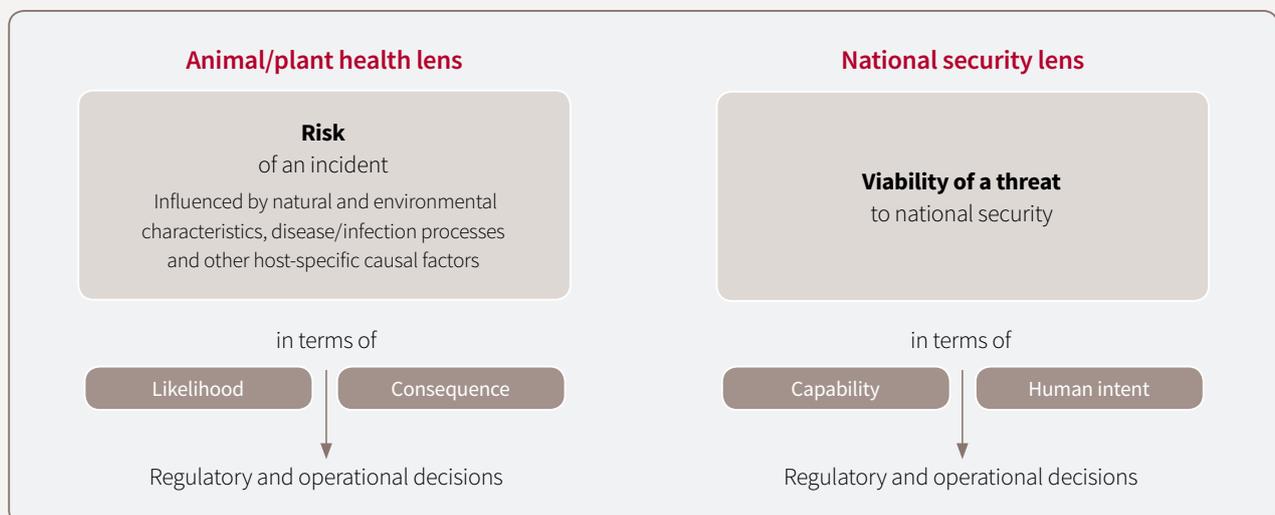
Unsurprisingly, one of the major aims of Australia’s biosecurity agencies is to reduce the entry of pathogens to the country and to detect and respond to the effects of a range of risk vectors within this closed ecosystem (including animals, plants, people, pests and diseases from outside the system).

DAWR’s approach is concerned with biosecurity risk exposures that can lead to diseases in the agriculture sector. This analytical ‘lens’ operates on the likelihood that a specific incident (the initiation of a disease process) will occur, with a series of consequential impacts.

For the APH lens, analyses and decisions may be made in the pre-import context, limiting the entrance of products into Australia, and within the country to reduce the likelihood of a disease becoming established (Figure 1).

The generic APH construct is applied in a range of regulatory settings. Given the legal and technical detail inherent in WTO sanitary and phytosanitary measures, there’s a requirement for the application of rigorous scientific analyses and evidence.

Figure 1: Generic biosecurity lenses



APH safety in Australia is well governed by the national approach constituted by a matrix of lead government agencies (DAWR and the Department of the Environment and Energy) and industry collaborative groups, such as Animal Health Australia and Plant Health Australia.¹⁸

This system is underpinned by several national frameworks, including the Intergovernmental Agreement on Biosecurity, which links federal, state and territory governments (other than Tasmania's). The agreement aims to strengthen the working partnership between governments to minimise the impact of pests and disease on Australia's economy, the environment and the community and to enhance the effectiveness of emergency responses to and recovery from disease outbreaks.

A key element of this partnership is the National Environmental Biosecurity Response Agreement, which details a framework for responding to national biosecurity incidents, including exotic pest incursions and diseases in terrestrial and aquatic environments. The response agreement operates alongside the Emergency Animal Disease Response Agreement,¹⁹ which is coordinated by Animal Health Australia, and the Emergency Plant Pest Response Deed,²⁰ which is overseen by Plant Health Australia.

In contrast with the APH lens, the 'securitised' lens (used in countering potential chemical weapons attacks, for example) focuses on the problem using a different (threat) analytical approach. The securitised lens is focused on assessing threats based on analyses of the capability and intent of a threat actor to use a chemical or biological agent. This lens primarily flows from the focus on national security taken by the National Security Committee of Cabinet and is managed by a range of federal agencies.

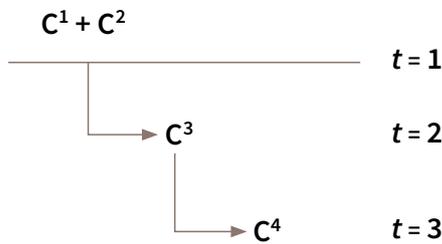
The securitised approach gauges and assesses levels of threat posed by state (rogue state) and non-state actors based on an intelligence-informed analysis of the various actors' assessed capability to undertake such attacks and their intent to do so. The aim is twofold: to provide opportunities for intelligence-enabled counterproliferation measures, and to provide advance warning of disruption and activate consequence-mitigation measures.

Individual human or state actor intent is often difficult to assess because it involves many different possible geopolitical and intelligence-based elements that are often unclear; for example, it can include the deliberate release of a biohazard to manipulate agricultural product prices, the malicious disruption of exports, or economic punishment for diplomatic purposes. The focus of national security thinking is on biosecurity threats that result from human intervention and decisions to cause harm or other types of impacts, such as damage to Australia's agricultural industries and reputation as a safe source of agricultural products.

While there was significant collaboration between government and private-sector agencies in the aftermath of 9/11 and in recent years given recent variations in geopolitical alignments and advances in dual-use technologies, particularly synthetic biology and gene manipulation technologies, it may be timely to rethink our needs for enhanced joint collaboration.

As shown in Figure 2, one of the other challenges in defining and managing biosecurity relates to the cascading ripple impacts of consequences over time. In many cases, this makes assessing the aggregated consequences of a biosecurity event, whether occurring naturally or enabled by human action, difficult to establish. Irrespective of the source of an incident, cascading impacts will accumulate with aggregated effects, requiring both rapid and scalable decision-making, usually under emergency conditions. Therefore, initial consequences (for example C^1 and C^2 at an initial time) can have secondary and tertiary effects through time. Cybersecurity and critical infrastructure often faces similar cascading and propagating effects.

Figure 2: Cascading impacts through time



After a natural disturbance in agricultural systems, an initial impact is likely to spread (especially if a disease is involved), with cascading consequences related to trade as well as socio-economic effects through time. Those effects will be managed by various agencies in both the public and private sectors and require the application of different strategies over long periods.

For deliberate biosecurity incidents, we could expect similar cascading effects, but the intent of the threat may be to achieve the aggregated or specific consequences, which makes estimating the intent challenging. In fact, differentiating an intentional release of some biological agent from its natural occurrence may take time after initial detection.

Decisions and management options in the securitised approach can be further complicated when assessing the source of a threat, and the scale of impact, against an ever-evolving screen of geopolitics.

One important factor in securitised biosecurity settings is the challenge of detecting the emergence of disease or the presence of hazardous chemical or biological material and then identifying the source or perpetrators. These factors are time critical, as is the response to detection.

Table 1 shows a threat typology, contrasting the scale of impact and generic sources of a securitised threat landscape. A key issue that emerges from this typology is the variety of plausible biosecurity threats that are based in actual occurrences with established sets of clear pre- and post-event evidence. Some threat sources can manifest in war-fighting contexts or relate to civil exposures sourced from the intentional effort of individuals and, of course, from natural means.

Table 1: A typology of securitised biothreats

Scale of impact	Source of threat		
	States	Non-state actors	Nature
State	Biowarfare (e.g. former Soviet bioweapons program)	Bio-terrorism (e.g. Aum Shinrikyo sarin attacks, Tokyo, 1995; anthrax letters, US, 2001)	Pandemics (e.g. pandemic influenza, bubonic plague)
		Dual-use research (e.g. genetic Engineering, synthetic biology)	
Society Community Individual	Bio-warfare (e.g. South African apartheid-era bioweapons program, UK Novichok incident)	Bio-crimes (e.g. poisoning via ricin)	Endemic & Epidemic diseases (e.g. SARS, cholera, West Nile virus)
		Laboratory accidents (e.g. creation of a killer mousepox virus)	

Should Australia be attentive to this threat and impact matrix? Arguably, yes. Beyond well-established concerns about state-sponsored WMD programs, European sources earlier this year raised concerns that ISIS affiliates were planning to produce and use ricin and anthrax in the UK, targeting food and water supplies.²¹

Reports from Cologne in Germany have detailed the discovery of evidence of a plot to acquire and manufacture ricin with a clear intent to cause harm in a terror-related attack.²²

Dual-use technologies applying genetic manipulation or forms of synthetic biology should also be on our collective threat radars. A research team at the University of Alberta examining enhanced vaccines for use against smallpox has published an open-source scientific paper on how the researchers recreated horsepox virus (HPXV) from scratch using large-scale gene synthesis.²³

HPXV shares a common genetic ancestry with smallpox and was considered to probably be extinct or at least unavailable to the researchers. By combining fragments of mail-order-sourced DNA, the researchers managed to generate a bioactive synthetic form of HPXV in a period of months. The study's lead researcher said he had alerted several Canadian Government authorities to his poxvirus venture, costing approximately C\$100,000, but seemingly 'no one raised an objection.'²⁴

The acquisition of the materials, equipment, information and expertise needed to manufacture super-toxic materials was once the domain of national programs. A concern for Australia, and of course globally, is that it's becoming easier to get precursor materials and to find information on how to create toxic or even super-toxic substances that can be used as weapons.

There's an adage that suggests that 'the street finds a use for new technologies.' That both the 'dark web' and, it seems, based on the horse pox example, the open scientific marketplace provide viable means for gaining 'how to do it' knowledge and for bringing vendors and unusual clients together should be ringing seriously loud warning bells. We need to improve our understanding of the nature and potential (mis)use of these materials and the ease with which knowledge can be accumulated in the wrong hands.

A key context is that biosecurity events can be triggered by natural or unintentional processes (accidents) or by deliberate intent across a range of scales. An important question for Australia is that there may be a need to reappraise current systems to ensure cross-agency capabilities of rapid detection and correlation to discern the source of an emergent biothreat, the aetiology of a disease, or both. In a nutshell, this means a capability to quickly identify a source as either natural or intentional and to mount suitable scaled multi-focused responses.

WHY SHOULD AUSTRALIA BE CONCERNED?

There can be no doubt that efforts to prevent, respond to and recover from incursions of pests and diseases that threaten the economy and environment are seen as critical by the Australian Government as well as by state governments and industry participants.²⁵ It's also obvious that this 'collective' applies existing capabilities to ensure continued market access for our agricultural products and to protect animal and plant health more broadly.²⁶ The importance of these capabilities is evidenced by several historical events.

Access to markets and market share can be fickle and may be affected by geopolitics as much as by biosecurity issues. On 17 July 2014, Malaysia Airlines Flight 17 (MH17) from Amsterdam to Kuala Lumpur was shot down over Ukraine, resulting in the death of 283 passengers and 15 crew.²⁷

In the days and weeks that followed the tragedy, the Australian Government, along with many other governments, held the Russian Government responsible for the downing of MH17.²⁸ Resulting sanctions against Russia were implicated in Russian import bans on a range of Western foods, including kangaroo meat, in which Russian authorities said they had detected residues of growth hormone.²⁹

In 2008, Russian Government authorities reported finding several samples of Australian kangaroo meat containing unacceptable levels of *E. coli* bacteria.³⁰ The meat was tested in Australia before it was exported and then tested by Russian authorities on arrival using different tests, which allegedly found *E. coli* in samples. Australia's kangaroo export industry was worth nearly \$180 million a year at that time.

The possibilities here are clear. While the contamination of consignments could have occurred by accident, the application of food safety standards would be expected to have been maintained throughout the full production and supply process.³¹ Despite Australia's history of delivering safe food products for export markets and consequent market share in other parts of Europe and elsewhere during this period geopolitical tensions were an issue of concern and a source of uncertainty.

Concerns about contamination can be as economically crippling to the 'safe' status of Australia's food exports as a real instance of contamination in pre-export parts of the supply chain. This example illustrates how non-state or state actors could damage Australian food exports by contaminating a small number of products at several stages of the export chain.

Of course, *E. coli* does exist in nature and may be relatively easy to obtain and even easier to introduce to export products at almost any stage of the supply chain. To make a point on unexpected possibilities, we note that for US\$159 anyone can legally order online a 'do it yourself' gene manipulation kit (employing the CRISPR/Cas9 technique),³² with instructions on how to bioengineer *E. coli* to survive in environments that would normally prevent its growth. The kit includes enough bacteria for up to five different experiments.

A second example focuses on how a disease could be introduced in a single geographical location, using infected biological material to manipulate established export markets and prices. A 2016 outbreak of white spot disease caused significant losses in the lucrative Queensland prawn industry.

White spot disease, also known as white spot syndrome virus, is a highly contagious viral infection that affects all crustaceans.³³ The virus was discovered in the early 2000s in prawn aquaculture farms in mainland China.³⁴ In prawn farm operations, white spot disease can result in 100% mortality of cultured stocks within a few days of the onset of visible signs of the disease.

It's believed that sometime in late 2016 several recreational fishermen used infected uncooked imported prawns as bait in the Logan River.³⁵ The outbreak led to the suspension of uncooked prawn imports to Australia for the first six months of 2017.³⁶

To date, the disease has cost:

- the Queensland prawn industry up to \$100 million
- the Australian Government \$22 million in assistance to control the spread of the disease
- the Queensland Government \$17 million in response measures and \$9 million in follow-up measures.³⁷

The incident also drove domestic prawn prices up by 16% over normal seasonal price variations.³⁸

A final report on the incident found that there had been a major failure of Australia's biosecurity system, due to:

- longstanding import conditions for uncooked prawns that were difficult to implement
- serious noncompliance by some major importers
- weak border inspection procedures
- variations in the interpretation of laboratory test results.³⁹

In this case, it seems that the event was generated by the unintentional introduction of a handful of imported prawns into the natural ecosystem of the Logan River.

The final report on imports of uncooked prawns illustrated how easy obtaining infected hosts and importing them could be.⁴⁰ It also showed how an outbreak such as this could be used to affect product importation, local prices, or both.

These two examples illustrate how a naturally occurring bacterium and disease could be used as a weapon of mass economic disruption against agricultural exports. In both cases, responding to the outbreak was primarily the responsibility of DAWR and its state and territory equivalents.

Other cases show how agricultural chemical residues could be implicated in similar damage scenarios. In May 1987, despite the operation of extensive quality-control procedures, several pesticide residue violations were identified in Australian beef exported to the US.⁴¹ Organochlorines, such as dieldrin, had for many decades been used widely in Australia as pesticides.⁴²

The problems were thought to have been caused by the persistence of organochlorines in soils, their illicit use or contaminated storage facilities. Over time, animals bioaccumulated residues in their tissues, which eventually exceeded maximum residue limits and triggered violations.⁴³

Despite there being no immediate public health risk, the Australian Government acted expeditiously to determine and eliminate the factors causing these problems.⁴⁴ For the most part, those responses involved rigorous animal and environmental testing regimes for organochlorines. Where either beast or environment was found to be infected, cross-contamination of livestock was prevented by trade controls. Substantial efforts were also made to remediate the environment.

The incident jeopardised Australia's \$2 billion a year beef exports to the US by highlighting the possibility that those exports were no longer safe and clean.

There are relatively low barriers to access/use organochlorines to deliberately contaminate Australian exports by introducing them into an agriculture or food supply chain. Both DDT and dieldrin were both widely used

organochlorines in Australia until they were banned. It's likely that there remain quantities of both products across Australia. While many primary producers were quick to participate in remediation programs, some may have been hesitant to identify historical usage or remaining holdings of these chemicals for fear of the economic impacts of remediation.⁴⁵

Other accidental contamination events are notable. A 2017 instance of chemical contamination by spray drift from one property to a neighbouring vineyard is a case in point.⁴⁶ The effects of a mix of the herbicide 2,4-D, glyphosate and metsulfuron-methyl, which are toxic to grapevines, resulted in a significant compensation award of more than \$7 million.

The crop-spraying incident wasn't intentional, but consider the implications of the use of drones to deliberately reduce agricultural viability by delivering damaging chemicals. Both al-Qaeda and ISIS have previously shown an interest in using drones and an appetite for using chemical weapons.⁴⁷ Poisoning or undermining confidence in food safety is likely to have 'appeal' to groups seeking to inflict asymmetric harm to an economy.

The cases discussed above were real occurrences, but, despite the significant costs involved, they might not be considered worst-case scenarios for Australian exports or the viability of our agricultural industries. While there may be any number of worst-case scenarios to choose from, a significant issue for Australia would be an outbreak of FMD.⁴⁸

FMD is a viral disease that spreads rapidly between animals (cattle, sheep, goats and pigs). The virus is excreted in breath, saliva, mucus, milk and faeces,⁴⁹ and can be excreted for up to four days before clinical signs appear. Animals can become infected through inhalation, ingestion and direct contact. The disease spreads most commonly through the movement of infected animals.

In sheep, symptoms can be absent or very mild, and undetected infected sheep can be an important source of infection. Of more concern, FMD virus can also be spread on wool, hair, grass or straw; by the wind; or by mud or manure sticking to footwear, clothing, livestock equipment or vehicle tyres.

The global agricultural export market, especially for food, is highly competitive and volatile.⁵⁰ Australia's competitive edge in this market is based on our capacity to provide affordable and consistently safe food products. Our status as an FMD-free nation is vital to our success in global export markets.⁵¹ DAWR estimates that a small FMD outbreak, controlled in three months, could cost around \$7.1 billion, while a large 12-month outbreak would cost \$16 billion.⁵²

Maintaining national FMD-free status is far from a given. There have been several outbreaks in FMD-free countries that have had large socio-economic impacts:

- The 2001 outbreak in the UK caused losses of more than £8 billion.⁵³
- An FMD outbreak in the Republic of Korea in 2010–11 is estimated to have cost the government US\$2.7 billion.⁵⁴

Obtaining and deploying a weaponised form of FMD virus in Australia may be difficult. However, several state actors are known to have weaponised the disease (as well as other damaging pathogens) and have reportedly field-tested them and delivery systems.⁵⁵

However, if highly contagious FMD were introduced to Australia intentionally, it would be likely to spread rapidly. The consequent impact on perception of food security and economic losses would be immense. But any actors introducing the virus don't need to create a large outbreak to have damaging impacts. It should be noted that Australia is one of the few world economies recognised as maintaining FMD-free status without resorting to animal vaccination.⁵⁶

These short case studies establish in a general sense why we should sustain support for national capabilities in biosecurity. The threat posed to Australia's enviable biosecurity status is very real. Such concerns also present very real, even existential, economic threats, which makes them particularly attractive methods to those who wish to cause harm or disrupt our economy.

There seem to be few disincentives for either state or non-state actors to not attempt to use pest species, chemical contaminants, emergent biotechnologies or disease as a means for disrupting our economy. The acquisition and use of many biosecurity risk vectors doesn't require sophisticated knowledge or capabilities. Access to chemicals, precursor material or infectious material isn't particularly difficult to obtain. They can readily be used as weapons, made more dangerous, transported or deployed.

For these reasons alone, the convergence of biosecurity (customs, border security, agricultural viability and health) with broader considerations of national security deserves further thought.

While we don't want to create undue concern, or belittle the ongoing oversight and capabilities of our APH biosecurity systems, the examples discussed here show how a handful of frozen infected prawns, an infected cow or chemical contamination could trigger significant cascading economic impacts to entire industries. In many cases, infection or contamination need not be widespread, but simply detected, to have the devastating impacts.

WHAT ARE WE DOING NOW TO MITIGATE THE IMPACTS OF BIOLOGICAL THREATS?

As detailed at the beginning of this paper, Australia applies two separate risk-based approaches to biosecurity: one conventional and the second a securitised form.

The securitised form operates within existing national security arrangements. It's an intelligence-led and threat-based approach focused on countering the proliferation of chemical and biological material that could be used in a highly destructive or mass-casualty attack.

Alongside the counterproliferation efforts are the law enforcement and security efforts focused on disrupting potential attacks by either state or non-state actors. For the most part, much of the focus of these agencies over the past 17 years has been on countering potential terrorist attacks involving chemical and biological material aimed at achieving mass casualties or damage and symbolic acts of destruction. And there's no shortage of intent to obtain and use chemical and biological materials on the part of organisations such as ISIS and al-Qaeda.

So, given the absence of chemical or biologically related attacks in Australia, our biosecurity arrangements should be considered as being, to a great extent, successful.

However, like nature, criminals and terrorist groups will continue to innovate, and it's likely that the breadth and depth of these threats will also continue to evolve. This process of continuous evolution and innovation in the threat space will require the Australian Government to regularly question the assumptions that underpin its agricultural, food safety and counterterrorism strategies and policies.

Australia's conventional biosecurity capabilities involve deep knowledge of disease causation in animals and plants and derive their effectiveness from well-established risk analysis protocols and practices. For the most part, this role is performed by DAWR, but it also involves state government agencies and a range of private-sector and industry groups.

We have some 60,000 kilometres of coastline, so DAWR prevention works on discerning and interrupting pathways for exotic pests and diseases. Its assessments are informed by an array of information sources, including research, shared international resources and intelligence.

Like the Australian Border Force, DAWR's preventive risk mitigation measures operate across a continuum from offshore and at-the-border measures to onshore measures. For the most part, DAWR's prevention and risk mitigation measures have focused on the accidental, unintentional or negligent introduction of pests and diseases.

Surveillance and monitoring of Australia's airports, seaports and international mail centres for biosecurity threats is critical to this overall risk mitigation strategy. Compliance by private-sector companies operating across global supply chains and by international travellers is also a critical pillar of the Australian Government's overall biosecurity strategy. DAWR operates a diverse range of tactical technical and non-technical inspection methods, including X-ray machines, surveillance and detector dogs.

When an outbreak is detected, DAWR coordinates the national response, which brings together industry, state and territory and federal government actors. On-the-ground management of an outbreak remains the responsibility of

the departments of agriculture or primary industry of the state or territory where it occurs. When more than one state or territory is involved, DAWR takes the lead in coordinating responses.⁵⁷

The Australian Government's Biosecurity Incident Management System is influenced by a range of better practice examples, including the Australasian Inter-service Incident Management System; the Australian Emergency Coordination System; New Zealand's Critical Incident Management System; and the US National Incident Management System.⁵⁸

It's been developed to provide all stakeholders with 'guidance on contemporary practices for the management of biosecurity incident responses and initial recovery operations' and focuses on an 'all hazards' model that standardises responses 'to pests and diseases that affect animals (including aquatic), plants, the environment (including the marine environment) or in response to vertebrate pest incursions'.⁵⁹

DAWR also operates a specialist group to assist state and territory partners in the event of a biosecurity incident: the National Biosecurity Response Team. Industry groups play important and critical roles in all phases of DAWR biosecurity assurance and response work.

IMPLICATIONS

This paper highlights how biosecurity incidents—be they accidental, naturally occurring or intentional—may be of interest to state and non-state actors, as they provide avenues to inflict significant social and economic harm and both affect and shape the thinking of Australian government decision-makers.

While biosecurity incidents aren't as spectacular as an act of mass murder, non-state actors might use biosecurity to punish foes economically, while others, such as transnational serious organised crime groups, could use such incidents to shape market futures and derive profit from foreknowledge of disruptions to trade, changes in commodity values, or both. State actors might also use such measures, or perceptions of an outbreak, to punish or shape Australia's activities with the same certainty as fake news.

The four examples of biosecurity harm examined above, along with historical instances, demonstrate that perpetrators could easily obtain the means to mount biosecurity attacks against Australian agricultural and wider national interests.

There are relatively low technological barriers to state and non-state actors accessing and deploying the kinds of technological threats discussed in this paper. While we have attempted to avoid creating a 'how to' guide for creating harm, it's evident that a state or non-state actor could trigger significant economic impacts on many Australian agricultural industries with a few infected prawns, an application of selective biotechnology, or a localised chemical release.

For traditional national security practitioners, conventional biosecurity efforts are hardly as confronting as the more kinetic threats from transnational organised crime or terrorist groups. Biosecurity, apart from those factors that might represent a threat of mass casualties or large-scale destruction, has been treated as an anomalous threat by many law enforcement and national security agencies.

To date, this hasn't been a problem for Australia, which has been effective in managing accidental or emergent conventional biosecurity threats. However, as we've learned from such landmark reports as the US 911 Commission's, failure often finds its origins not in so-called 'black swan' events, but in challenges or biases in intelligence collection, analysis and decision-making and even in constrained imagination or views on the likelihood of future contingencies.

Consecutive Australian Governments have made significant investments in agricultural and health-focused biosecurity outcomes. Australia has, on several occasions, faced biosecurity challenges that resulted in significant economic impacts, some with sustained consequences. To date, DAWR and its predecessors have had a great deal of success in preventing and responding to biosecurity disturbances.

On 29 June 2018, the Turnbull government made further investments in APH biosecurity to the tune of \$137.8 million over five years.⁶⁰ This new investment will reinforce current efforts with cutting-edge biosecurity technologies, data analytics and intelligence.⁶¹ However, given the increased recognition of the potential for deliberate and malicious incidents illustrated by the frequent and proven use of chemical weapons in the Syrian conflict, more could to be

done in ensure a sustained alignment of capabilities and systems within security-focused biosecurity activities to the current deep and practised capabilities of our APH biosecurity lens.

Figure 3 shows a prototypical continuum of threats against which future biosecurity policy coverage and capability development might be tested. While indicative of the evolving challenges, the variation in threat types is supported by evidence and technical plausibility.

Figure 3: A continuum of biothreats



The enhanced funding needs to be supported not just by a joining of national expertise to cover such a threat continuum. Australia needs to build on past knowledge and institutional memory but also needs to anticipate new and hybrid threats and challenges. The perennial issue of incorporating lessons learned and anticipating new technical threats by questioning longstanding assumptions and mindsets is critical.

More can be achieved than just a focus on experience and lessons management. In a 2011 review of national preparedness for outbreaks of FMD, Ken Mathews suggested that:

Australia currently lacks a systematic approach to foresighting, gathering information for early warning intelligence, and horizon scanning for animal diseases. In the Review Team's view it will be important to build in ('institutionalise') these capabilities within the Australian Government. Horizon scanning involves gathering information from various sources to produce intelligence about the animal pest and disease status of regional countries and trading partners, and identifying emerging issues and threats.⁶²

He further stated that:

Institutionalisation of horizon scanning and foresighting would provide a home for the latest information (at national and international levels) about FMD outbreaks, trends and developments in relevant science, risk-based priorities in border control, and international practices on border control and disease management. Strategic information and early warning of this type would enable Australia to apply a stronger risk–return approach to biosecurity activities.

It may be time to look forward as well as backwards with respect to this important national endeavour.

POLICY RECOMMENDATIONS

In response to the uncertainties of evolving agricultural and potential biosecurity threats, whether from state or non-state actors, the following recommendations are offered:

- DAWR, the departments of Home Affairs and Health (and affiliated institutions), law enforcement agencies and relevant public- and private-sector agencies should undertake annual red-teaming and horizon-scanning exercises to ascertain whether the scope of biosecurity threats, developments in synthetic biology and emerging technologies, and risk exposures, including vulnerabilities, are sufficiently understood and matched against current and future multiagency capabilities.
- The National Security Committee of Cabinet should consider whether the current arrangements for responses to emergent biosecurity threats are sufficiently coordinated to deal with deliberate attacks aimed at disrupting Australian biosecurity or food security.
- The National Intelligence Committee should examine whether current intelligence priorities and sense-making capabilities, especially with respect to biosecurity indicators, adequately address the challenge of deliberate biosecurity attacks with an economic and societal disruption goal.

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ACRONYMS AND ABBREVIATIONS

APH	animal and plant health
CBRN	chemical, biological, radiological, nuclear
DAWR	Department of Agriculture and Water Resources
DDT	dichlorodiphenyltrichloroethane
FMD	foot-and-mouth disease
GDP	gross domestic product
HPXV	horsepox virus
ISIS	Islamic State of Iraq and Syria
WTO	World Trade Organization

Weapons of mass (economic) disruption
Rethinking biosecurity in Australia