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Summary		
The objective of this project is to provide the framework for the design and testing of compliance-based inspection protocols, both in experimental situations and the field. This study places considerable focus on the strategic issues around importer and supplier behaviour in responding to system rules. It also considers options for the department to design intervention protocols which can better align the objectives of import-supply chain participants with those of the Australian Government. This study employs three strategies to inform the design of intervention protocols that might encourage higher levels of alignment between government biosecurity objectives and import-supply chain participants: i) use of administrative data; ii) interviews with relevant biosecurity stakeholders; and iii) insights from economic theory. The project team has identified two plant product pathways as candidates for field pilots in the next phases of the project (CEBRA Projects 1404C and 1608C): subsets of the *peat* and *vegetable seeds for sowing* pathways. For both pathways it is recommended that a 'menu of regulatory contracts', with refined pathway definitions, be applied.		
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CEBRA Project 1304C:
Incentives for Importer Choices

Final Report

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Table of Definitions

Approach rate: an estimate of the likelihood of entry of pests and diseases determined through inspection results.

Bill of lading: Commercial import documents that provide detail of cargo or goods that include invoices and packing lists.

Clearance number: A key parameter of the CSP method. Census CN is the clearance number (number of consecutive clean lines) that must be reached before a CSP target's goods can be switched to a reduced inspection rate (i.e. switched to monitoring mode).

CSP: stands for continuous sampling plan. A CSP is a method for determining whether or not to inspect a consignment, based on the recent inspection history of the pathway and some parameters the pathway manager sets.

Consignment: a consignment consists of all the goods for a single consignee that arrives on the same voyage of a vessel. Note that a single consignment can consist of many container loads of goods.

Inspection: Examination of product or systems for the biosecurity of animal, plant, food and human health to verify that they conform to requirements (Beale)

Intervention: Legally enforceable obligations (through legislation or regulations) imposed by government on business and/or the community, together with government administrative processes that support the obligations. In the biosecurity context, this includes requirements related to: prescribing specific actions that must be completed before goods can be brought into Australia; giving notice of goods to be unloaded in Australian territory; providing information, including documents, about the goods if requested by biosecurity officers; allowing for the goods to be physically inspected; allowing for samples of the goods to be taken; and prescribing treatments for rectifying the presence of biosecurity risk material in a consignment.

Monitoring fraction: The state in the CSP model where sufficient compliance has been demonstrated to enable a different or reduced direction rate to be applied (e.g. inspection of less than 100% of consignments).

Pathway failure: A pathway failure is any kind of non-compliance associated with a consignment on a pathway, including failures that do not necessarily represent a direct biosecurity risk e.g. inadequate documentation for a consignment is a pathway failure, as is contamination by a pest or disease.

Quarantine failure: A quarantine failure is a non-compliance associated with a consignment that poses a direct biosecurity risk. For example, contamination by an actionable pest or disease is a quarantine failure, but inadequate paperwork is not.

Quarantine Approved Premises: places where post-entry quarantine requirements may be carried out on a wide range of plants, animals and plant and animal products, and approved by the Department of Agriculture and Water Resources.

Tailgate inspection: performed to visually identify and address a range of quarantine risks associated with containerised cargo, involving the inspection of external container surfaces and inspection of internal surfaces and **goods** through opened container doors. If the visual assessment identifies the presence of infestation/s or

contamination, or if the tailgate inspection does not resolve commodity, packing or documentation issues, the container will require further intervention.

Unpack inspect: The process of unpacking a consignment prior to undertaking an inspection.

1. Executive Summary

1.1 The biosecurity game – How to use importer behaviours to influence biosecurity compliance

This report considers how the department can use microeconomic theory, including the theory of incentive and information economics, to design intervention protocols that encourage participants to reduce the likelihood of biosecurity risk material entering Australia.

Changes to the rules of the biosecurity "game" may induce changes in behaviour from import-supply chain participants. Some rules might lead participants to take actions that potentially undermine the Australian Government's biosecurity objective; other rules may lead participants to take actions that are beneficial to the national biosecurity objective. Economics provides a framework to test which policy settings (including rules, incentive structures, monitoring practices etc.) align the actions of import-supply chain participants with the objectives of government.

The project employed three strategies to inform the design of compliance-based inspection protocols to improve the alignment between government biosecurity objectives and the commercial objectives of import-supply chain participants, namely:

i. use of administrative data;
ii. interviews with relevant biosecurity stakeholders; and
iii. insights from economic theory.

1.2 Key findings

Industry cost structures and protocol effectiveness: The behaviour of import-supply chain participants on pathways where the costs of biosecurity interventions represent a larger share of total costs is more likely to be influenced by rewards from complying with the government's biosecurity objectives.

Role of process assurance and equivalence in biosecurity: Encourage systems-based approaches to reducing the likelihood of biosecurity risks by shifting the focus of interventions away from prescribing pre-border requirements on consignments towards an approach based more on outcomes.

Improving the relative rewards for compliant parties: A priority queuing system based on compliance history could reduce delay costs for importers with a strong record of meeting Australia's biosecurity requirements.

Departmental communication and providing information to boost compliance:

- Providing inspection-failure information to importers could encourage them to implement processes that seek to reduce the likelihood of future contamination from similar biosecurity risk material.
- Providing information to importers on their recent history of biosecurity compliance, with a focus on gains or losses incurred as a result of their supply choices, may encourage importers to improve compliance.
- Greater communication of the performance benchmarks that the department seeks to meet in delivering its services to biosecurity system stakeholders would improve stakeholders' confidence in the biosecurity system.

Field trial recommendations: The project team has identified two product pathways as candidates for field pilots: subsets of the *peat* and *vegetable seeds for sowing* pathways. For both pathways it is recommended that a 'menu of regulatory contracts', with refined pathway definitions, be applied. Three menu items have been recommended for the contract and these involve:

- applying adaptive algorithms (i.e. CSP-1 and CSP-3) for inspections (changing frequency);
- using other information on biosecurity risk (encouraging information revelation on external accreditation/endorsement of processes); and
- priority queuing (reducing delay costs).

Well-designed pilots for these treatments on each pathway are thus recommended for the next phases of the project (CEBRA Projects 1404C and 1608C). The exact configuration of the menu of contracts examined in the pilot will depend on practical considerations, given that existing departmental systems may present significant barriers to using some of the options in the short term.

2. Introduction

To maintain Australia's biosecurity status, the Department of Agriculture and Water Resources (the department) uses a range of measures to reduce the risk of entry, establishment and spread of exotic pests and diseases to Australia that may threaten human, animal and plant health and life. The actions available to the department encompass pre-border, border and post-border interventions, with pre-border and border interventions the main options for reducing the likelihood of biosecurity risk material entering Australia.

This report documents CEBRA Project 1304C, *Incentives for Importer Choices*, which investigates opportunities to design biosecurity system protocols that encourage compliant behaviour by stakeholders by harnessing the incentive structures inherent in these protocols. In particular, it considers how the department can target its pre-border and border intervention activities[1] in an efficient way to reduce overall system costs while balancing other competing government objectives associated with Australia's biosecurity system. Enabling trade in goods is one objective which improves access to higher-quality (or lower-cost) goods for Australian businesses and consumers. However, a larger volume of trade goods could increase the likelihood of biosecurity risk material entering the country and expose Australia to a greater range of pests and diseases. The analysis draws on insights from microeconomic theory, including the theory of incentive and information economics, to consider how import-supply chain participants can be encouraged to act in a manner consistent with the Australian Government's primary biosecurity objective of maintaining the country's high biosecurity status.

This report builds on the analysis in previous projects by the Australian Centre for Excellence in Risk Analysis (ACERA), namely Project 1001J *AQIS Quarantine Operations Risk Return* (Robinson et al., 2012) and Project 1101C *Plant Biosecurity Inspection and Auditing Across the Biosecurity Continuum* (Robinson et al., 2013). Those studies assessed opportunities for reducing intervention on plant-product pathways based on statistical methods to assess past compliance and the impact on biosecurity risk interceptions. The risk-return methodology of assessment that is now being rolled out can be further enhanced by considering the impact that different incentives and interventions have on the behaviour of import participants, and the resulting biosecurity risk of their consignments.

Assuming self-interest on the part of participants, changes to the rules of the biosecurity "game" will likely induce changes in behaviour from import-supply chain participants. Some rules might lead participants to take actions that potentially undermine the Australian Government's biosecurity objective; other sets of rules might feasibly lead participants to take actions that are beneficial to the national biosecurity objective. Economics provides a framework in which these types of problems can be framed and opens-up the prospect of discovering the policy settings (including rules, incentive structures and monitoring practices) that align the actions of import-supply chain participants with the objectives of government. The project methodology combines economic theory with structured observation, a laboratory

[1] Chapters 5 and 6 of the recently published edited collection *The Handbook of Plant Biosecurity* (Gordh and McKirdy (eds), 2014) provides a valuable overview of other considerations in pre-border and border interventions beyond the direct scope of this project.

test-bed and real world pilots to discover new regulatory settings that are practical, implementable and cost-effective.

2.1 Objectives

The objective of this study is to provide the framework for the design and testing of compliance-based inspection protocols, both in experimental situations and the field. This study places considerable focus on the strategic issues around importer and supplier behaviour in responding to system rules. It also considers options for the department to design intervention protocols which can better align the objectives of import-supply chain participants with those of the Australian Government.

2.2 Methodology

This study employs three strategies to inform the design of intervention protocols that might encourage higher levels of alignment between government biosecurity objectives and import-supply chain participants: i) use of administrative data; ii) interviews with relevant biosecurity stakeholders; and iii) insights from economic theory.

2.2.1 Administrative data on biosecurity inspections

Data from the department's AQIS Import Management System (AIMS) and Incident databases were used to create profiles for a range of candidate plant-product pathways. Descriptive statistical analysis of these data sets enabled the project team and department to develop an understanding of key pathway characteristics, including:

- the distribution of consignments on the pathway for importers and suppliers;
- the distribution of inspection failure rates between importers, suppliers and countries of origin;
- the reasons for consignments failing inspection and patterns associated with inspection failure;
- the relationships between importers, customs brokers and suppliers; and
- the transportation methods and ports used for entry into Australia.

This statistical analysis, together with assessments of product characteristics associated with candidate case-study pathways nominated by the department, allowed the department and project team to select six plant-product pathways for further analysis. The chosen pathways were:

- green coffee beans;
- cut flowers;
- vegetable seeds for sowing;
- peat;
- dried vegetables; and
- plant-based stockfeed.

The administrative data sets also allowed the project team to identify import-supply chain participants who could be suitable for interviewing as part of the project. Use of the Department's administrative data is discussed in Section 4.1; statistical summaries for the six pathways investigated were provided in a separate (confidential) document directly to the department.

2.2.2 Interviews with biosecurity system stakeholders

Through semi-structured discussions with stakeholders, the project team was able to elicit an understanding of the qualitative aspects of the six pathways considered for further analysis. Stakeholder discussions focused on importers and customs brokers for the various pathways, with some industry associations and suppliers with a local presence also consulted. Key biosecurity issues discussed with stakeholders included:

- communication in the pathway between importers, customs brokers and suppliers;
- stakeholders' understanding of the biosecurity system;
- communication with the department as perceived by importers and customs brokers;
- the factors importers consider when choosing suppliers and customs brokers;
- the measures which importers or suppliers have made to reduce the likelihood of biosecurity risk material entering Australia; and
- the experience of importers and customs brokers with Australia's biosecurity inspection system.

Stakeholder consultation is discussed in Section 4.2 with a qualitative analysis of interviews for themes common across a range of pathways investigated given in Chapter 5. Pathway-specific themes were provided separately to the department.

2.2.3 Economic theory

A key part of the project was to consider how to design intervention protocols in ways that could encourage import-supply chain participants to take steps to reduce the likelihood of biosecurity risk material being present in their consignments. Insights from the theory of incentives, incentive regulation and the economics of auditing offer some general themes that can be applied to design biosecurity intervention protocols that might reduce system costs through improved incentive structures within the import, declaration and compliance system. Relevant economic theory is discussed in Sections 3.4 and 4.3.

The more technical material is discussed in Appendix C of this report and in Rossiter and Hester (2016). Their specific focus is on the design of inspection protocols, including better understanding of the incentive properties of continuous sampling plan (CSP) inspection rules, which are applied by the department on several pathways. Such rules can be assessed using game-theoretic models that capture the strategic behaviour of import-supply chain participants. Rossiter and Hester (2016) includes a comparative analysis of the different incentive structures induced by different continuous sampling plans, with a particular focus on considering how the incentives affect the uptake of process improvements that incur fixed costs.

3. Objectives and Options for Biosecurity Intervention Reform

Trade is widely understood to create value for both exporting and importing countries. Value is created because importers can source goods at lower cost than available from the domestic market and exporters can sell at higher prices than are available in the country of origin. To create value from traded goods, importers must interact with regulators of the biosecurity system in order to meet regulatory requirements imposed by the importing country. These interactions involve importers sharing information (e.g. about the origin, status and destination of goods) that could reveal their biosecurity risk status. Ideally this information could be used by the government to efficiently target its interventions according to risk status, to achieve its objectives. However, importers may not have the incentive to reveal this information, particularly if it may result in them as being classed as high risk or involve the release of commercially sensitive information. Understanding how the system rules constrain the operation of enforcers and participants allows some understanding about how the inspection system could be modified to improve compliance.

In this chapter we detail the objectives and interactions of the key participants in the import-supply chain. Understanding motivations is a necessary part of understanding the incentives currently faced by participants, and how they may respond to any future changes to inspection rules. This chapter also details regulatory models for inspection and where Australia's current inspection regimes fit within these frameworks.

3.1 Government objectives in intervening for biosecurity purposes

The Department of Agriculture and Water Resources is responsible for both the design and implementation of rules that govern importing processes. The primary consideration of Australia's biosecurity system is to preserve "Australia's reputation as a producer of reliable clean, green and safe premium products" (Commonwealth of Australia, 2015, 121). Australia's animal and plant health status allows access to lucrative overseas markets and assists the competitiveness of Australia's agricultural exports. A high biosecurity status also supports other aspects of Australia's unique environment, which provides benefits to other sectors, including tourism.

The Australian Government has a mission statement that influences how its biosecurity system should operate, that in some sense poses a challenge for the primary objective of maintaining Australia's high biosecurity status. Enabling trade in goods is one objective which improves access to higher-quality (or lower-cost) goods for Australian businesses and consumers.[2] However, a larger volume of trade in goods

[2] As a member of the World Trade Organisation (WTO), Australia is also under international obligations to promote trade. This means ensuring technical regulations on products, including those relating to biosecurity status, do not represent an unnecessary barrier to trade, as per the *Agreement on Technical Barriers to Trade* and, more specifically in the biosecurity context, the *Agreement on the Application of Sanitary and Phytosanitary Measures* (henceforth SPS Agreement). See, for instance, http://www.wto.org/english/tratop_e/tbt_e/tbt_info_e.htm and http://www.wto.org/english/tratop_e/sps_e/spsund_e.htm for explanations of these requirements. Were a signatory country to these agreements to implement regulations considered by others as an intervention not founded on scientific evidence but ostensibly a barrier to trade, other governments may challenge these regulatory requirements through dispute settlement mechanisms convened under the WTO or any other international agreement. A recent example

could increase the likelihood of biosecurity risk material entering the country and expose Australia to a greater range of pests and diseases.

At the same time, the Australian Government is seeking to reduce the burden of regulation on individuals, businesses and community organisations (Commonwealth of Australia, 2014a). Intervention activities by government increase costs on various import-supply chain participants, which may be direct financial costs or costs associated with delays in the time taken to get products to market.[3] At least some of the costs imposed by government interventions, such as an inspection process, will be passed on to the Australian public through higher costs associated with imported products and, in some cases, limited access to certain goods.

However, the societal costs associated with biosecurity risk material leaking into Australia can be very high if such incursions affect the natural environment, public places and/or agricultural industries. When incursions affect agriculture, productivity is reduced, the saleability of products in the domestic market may be affected and access to overseas markets is often restricted. Recent examples of incursions affecting local agricultural industries include banana freckle disease (*Phyllosticta cavendishii*) and the cucumber green mottle mosaic virus, both of which have been targets of eradication responses in the Northern Territory in 2014.

Designing appropriate regulation requires a balance between these often competing objectives of government and understanding the relative benefits of intervening in the importation process. This involves an understanding of the trade-offs involved in the inspection system as a whole, including how entities in the import-supply chain will respond to different regulatory requirements.

For the purposes of this study, the project team characterised the Australian Government's objective as minimising the sum of:

- the expected costs of leakage of biosecurity risk material into the environment, which could result in exotic pests and diseases becoming established; and
- the regulatory burden faced by businesses in complying with biosecurity requirements.

It is noteworthy that this interpretation of the objective function excludes the reduction in consumer surplus from reduced access or higher prices paid for internationally traded goods resulting from the pass-through of inspection costs to Australian consumers and businesses. While a more fulsome economic analysis of the inspection problem would consider these costs explicitly,[4] the objectives of the

involving Australia of these types of mechanisms was Dispute DS367 relating to the importation of apples from New Zealand; see https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds367_e.htm for more details of this case.

[3] In line with other government activities, biosecurity interventions by the department operate on a cost-recovery basis. The focus of these arrangements is to ensure the department's direct costs associated with administering biosecurity assurance activities are collected from entities who benefit from the department's operations (i.e. importers) so that appropriations from consolidated revenue are not required to fund these services. See Commonwealth of Australia (2014b) for more discussion of the cost-recovery framework and Australian Government Department of Agriculture (2014) for the department's principles adopted to guide future reviews and administration of these arrangements.

[4] The framework developed in Rossiter and Hester (2016) is sufficiently flexible to capture these costs that could be included in a regulator's objective function by combining them with the regulatory costs faced by business.

legislative framework underpinning biosecurity interventions, including the recently passed *Biosecurity Act 2015*, are silent on this aspect. Furthermore, consultation with departmental officers suggests that the biosecurity consequences and regulatory burden reductions are the main factors they consider in administering the biosecurity inspection system.

In a sense, the project team is also assuming that full cost-recovery of inspection costs from import-supply chain participants occurs. This means that the regulatory burden faced by businesses fully captures the department's costs associated with administering, implementing and managing biosecurity inspection services.

Further details on the theoretical treatment of the regulator's objective function can be found in Rossiter and Hester (2016) and Appendix C of this report.

3.2 Regulatory models for biosecurity interventions

3.2.1 Traditional regulation

Under the current system, the department has assessed that the biosecurity risk on many pathways necessitates that all consignments on those pathways are subject to a mandatory inspection at the border. This is a "traditional" (or "command and control") regulatory model, where every consignment on the pathway is treated as having the same risk potential, and is subject to mandatory inspection at the border. For some pathways, consignments may also be subject to multiple types of pre-border interventions, which may involve import-supply chain participants needing to apply specific biosecurity measures at different stages along the value chain for the imported product. Under this regulatory approach, the same types of interventions are applied to all consignments on the pathway, regardless of the risks that a particular individual consignment may pose to maintaining Australia's high biosecurity status.

This traditional regulatory model is a one-size-fits-all approach with respect to product pathways and to participants in the import sector. Applying one inspection regime to all products in a biosecurity category, means that some consignments are over-inspected while others are under-inspected. Similarly, applying the same approach to all importers, irrespective of their investment in pre-emptive investment in biosecurity or history, means that some companies are over-regulated while others will be under-regulated. Traditional regulatory models tend to increase the cost of achieving the biosecurity objectives set by government. Such a system is also very costly from a social perspective, with increased costs from importing goods borne by final consumers of the product. These costs are incurred by importers regardless of the threat to the regulator's objective posed by the imported product.

For importers, this form of intervention reduces the cost advantage from sourcing goods from suppliers with processes that aim to reduce the likelihood that their products contain biosecurity risk material. Furthermore, prescribing the approaches which importers and suppliers must use in producing the products can act to stifle innovation and increase potential costs of supply. In particular, importers and suppliers are not rewarded for developing mitigation options that may be achieved at lower cost under this system.

3.2.2 Risk-based regulation

Increasingly the department is moving towards a risk-based approach to biosecurity regulation, as advocated in previous reports on Australia's biosecurity system (e.g. Beale et al., 2008). Risk-based regulation has been proposed as a strategy for reform of regulatory systems more broadly (Black and Baldwin, 2010). This approach involves, as a minimum, applying inspection resources according to assessments of the risks posed by the consignments to maintaining Australia's biosecurity status. This would involve an understanding of both the likelihood of biosecurity risk material entering on particular pathways and the consequences for Australia's biosecurity status for the leakage of risk material.

Risk-based regulation also involves a regulator selecting the risks it seeks to control and monitor and determining the tolerance for certain risks. The focus in this approach is on mitigating risks, rather than prescribing particular rules for enforcement. The level and frequency of interventions allow the regulator to devote appropriate resources to clients that pose different levels of risk (resource-efficient regulation).

Risk-based approaches to regulation are characterised by a focus on the regulator's objectives and displaying a greater focus on outcomes. In the biosecurity context, this would imply structuring inspection rules to reward importers for 'good' importing behaviour – complying with the rules and bringing in clean consignments – relative to those who demonstrate a lower level of compliance with biosecurity requirements established by the regulator.

One risk-based mechanism adopted by the department is CSP-3 (continuous sampling plan-3). This algorithm has focused on introducing lower inspection frequencies for pathways with relatively low failure rates for inspections. These protocols posit that the likelihood of biosecurity risk material being present in a consignment is related to past compliance, with lower inspection frequencies afforded to entities with a strong compliance record.[5]

3.2.3 Incentive regulation

Incentive regulation provides a further layer of sophistication on top of risk-based regulation. In risk-based regulation, a regulator bases their assessment of the required regulatory intervention on the *expected* impact of a regulated entity on the regulator's objective. However, risk-based regulatory regimes often do not consider the feedback loop from the way regulations are set to actions taken by regulated entities in response. Such actions will reflect the regulated entity's own motivations and their actions may or may not be in line with the government's regulatory objective.

Incentive regulation considers the behavioural response of regulated entities, with the regulator using both rewards and punishments to induce behaviours consistent with the regulator's objective. In a sense, the regulator seeks to design an incentive scheme which allows the regulated entity's objective, which is often taken as maximising

[5] To be eligible for a lower inspection frequency, an importer must receive several consecutive inspection passes. The number of passes required is the clearance number in these type of algorithms. For more details on the continuous sampling plan algorithms, see Robinson et al. (2012) and Rossiter and Hester (2016).

profits, to be aligned with the regulator's objective.[6] This becomes a problem of *mechanism design*, where the regulator seeks to choose the rules for the strategic interaction to maximise their own objective.

While the CSP-3 algorithm, discussed in Section 3.2.2, is a technical rule derived from the quality control literature in Dodge and Torrey (1951), it also has inherent incentive properties because it may provide cost and/or time advantages to those importers and/or suppliers with a good inspection record. It also benefits the regulator through reducing the costs of administering the inspection system. The challenge with incentive regulation is to fine-tune the intuitive incentive structures that currently exist in the continuous sampling plan algorithms to utilise the information and expertise of system participants in ways that make the biosecurity system more efficient and effective.

Such an inspection system may create incentive structures that encourage importers to choose suppliers with better biosecurity compliance records or lead importers to try and influence suppliers to improve their mitigation efforts. However, whether such an inspection system affects import-supply chain behaviour depends on the value of the cost advantages induced by the system. In situations where mitigation involves large fixed costs, ongoing benefits would need to be realised to ensure that firms in the import-supply chain would adopt this technology or process; otherwise, it would be in their best interests to maximise expected profits to use the less effective existing mitigation strategies.

3.3 Import supply-chain participant objectives and interactions

From the perspective of understanding incentives in the system, the key participants in the import-supply chain are the department, overseas product suppliers, importers, and customs brokers. Each participant has distinct and separate objectives, has numerous interactions with other participants, and will respond to the incentives provided by Australia's biosecurity inspection system in different ways (Figure 1).

[6] As noted earlier, the profit-maximising objective of an importer is likely to diverge from the department's objective of maintaining Australia's biosecurity status. Sappington (1994) explains that the regulator's objective needs to diverge from that of a regulated entity for incentive regulation to be appropriate.

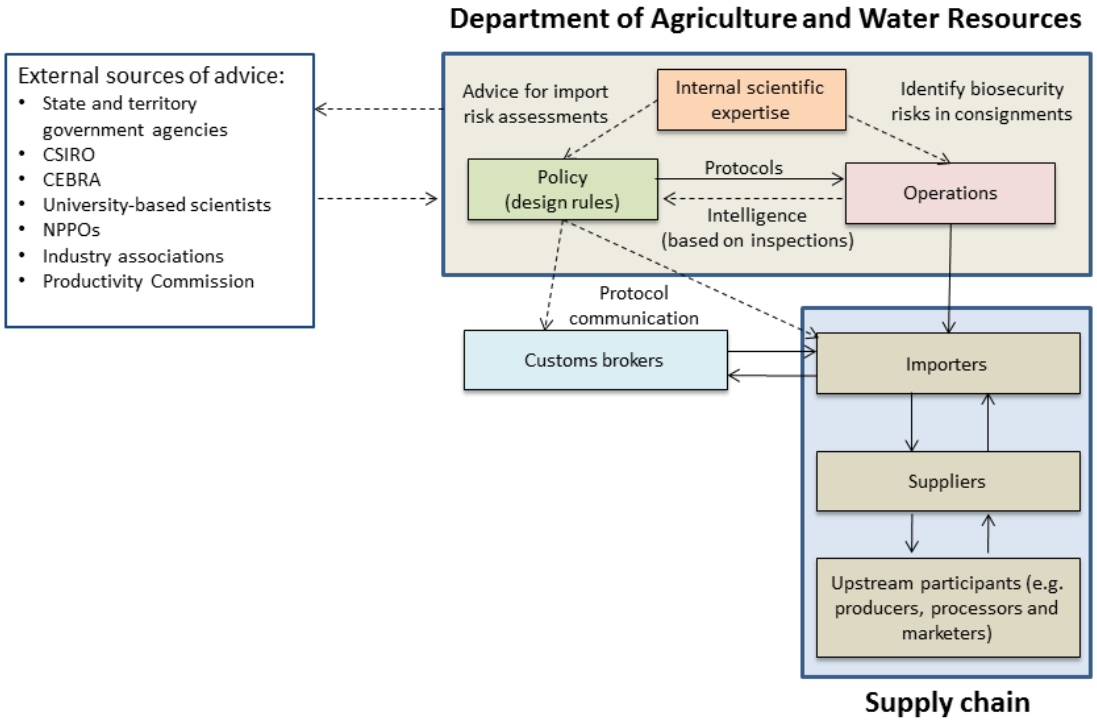

Figure 1. Schematic representation of information flows (dashed lines) and relationships (solid lines) in the biosecurity inspection system.

3.3.1 The regulator

The Department of Agriculture and Water Resources, acting on behalf of the Australian Government, is responsible for both the design and implementation of rules that govern importing processes. The mechanisms available to the department involve a range of pre-border[7] and border interventions, which can be applied according to various combinations.

The primary objective of the department is to minimise the risk of pests and diseases entering Australia and this objective is implemented through regulatory intervention. At the heart of all import rules is the consideration of the likely presence of biosecurity risk material on particular pathways and their potential consequences should they become established post-border.[8] Central to this process are risk assessments by the department, which "assist in considering the level of biosecurity

[7] As noted earlier in the chapter, pre-border interventions may involve developing protocols that require specific biosecurity measures to be applied at different stages along the import-supply chain.

[8] Part of the difficulty in trying to penalise importers and/or suppliers for bringing in consignments containing biosecurity risks that lead to introducing a new pest or disease is that, in most circumstances, it is very difficult to trace an incursion or outbreak back to the consignment that was the source of the biosecurity risk. In particular, post-border surveillance may not be able to identify the initial source of the outbreak if it has spread beyond a single site. As a consequence, the biosecurity regulator can only readily institute incentive structures that target compliance in pre-border or border parts of the biosecurity continuum. A partial solution to this issue may be something akin to the European Union's "plant passport" scheme maintained under Council Directive 2000/29/EC (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32000L0029). However, the administrative and compliance costs incurred from implementing such measures may be orders of magnitude larger than the potential benefits of such a scheme.

risk that may be associated with the importation of a good, and to identify ways to manage those risks" (Australian Government Department of Agriculture, 2015a, 5).

There are several information sources that the department can take into account in designing system rules (Figure 1). Advice around the pests and diseases that may be associated with particular pathways and potential consequences of establishment may come from scientific expertise available within the department. As noted in discussions of the department's import risk analysis framework (Australian Government Department of Agriculture, Fisheries and Forestry, 2011), evidence underpinning the department's risk analyses may also be drawn from:

- relevant experts in state and territory government agencies;
- the Commonwealth Scientific and Industrial Research Organisation (CSIRO);
- Australian and international scientists based in universities;
- national plant protection organisations (NPPOs) in other countries; and
- industry stakeholders, such as representative associations and individual firms.

Such information is important for understanding the consequences of incursions.

3.3.2 Importers

In general, importers are Australian-based firms, local subsidiaries of multinational organisations or individuals whose primary objective is to maximise profits associated with the reselling of their product in the domestic market. Importers are responsible for ensuring their suppliers are aware of and comply with Australian import conditions, obtaining the relevant Import Permits, ensuring all Supplier Declarations are complete and correct, and in some cases providing their own declarations to the Department of Agriculture and Water Resources. The importer is subject to Australian legislation and regulations that govern the importing of goods into Australia and, in a legal sense, is ultimately responsible for the goods being imported and ensuring all import conditions are met.

Importers may possess private information about the biosecurity status of the goods they import. For example, they may have information about what processes the supplier uses, or potentially could use, to improve the biosecurity status of the goods. Importantly, if the implementation of processes that are highly effective in reducing the likely incidence of biosecurity risk material being found in consignments is costly, they may not be put in place unless there is a reward for doing so.

3.3.3 Product suppliers

Product suppliers in exporting countries provide goods to importers. They may directly produce the goods, source the goods from processors, or consolidate the goods from a range of producers. The production, sourcing or consolidation choices made by suppliers may involve trade in goods between countries or regions that result in products being mixed at the processing or packaging stage. These upstream choices can significantly influence the likelihood that consignments from particular suppliers may contain biosecurity risk material.

Suppliers are not directly subject to Australian law, though the consignments they send to Australia will only be accepted if they adhere to requirements established by the department. This includes ensuring consignments meet any import conditions

specified by the department[9] and taking steps to ensure consignments are free from biosecurity risk material.

As part of clearing customs and biosecurity checks, suppliers need to provide documents for the importer or their agent to present in relation to the goods and their packaging. This may include declarations and written evidence to demonstrate that the goods comply with any import conditions required for entry into Australia. However, under Australian law, the onus is on the importer to furnish the required documents to allow a consignment to be released by the department to the importer.

Suppliers are likely to have the most information of all import-supply chain participants about the possible processes could be put into place to ensure products are exported free from biosecurity risk material. This is particularly the case when the suppliers themselves have end-to-end control and oversight of the production, processing and packaging processes.[10] Where products are sourced from multiple producers or countries, the suppliers may have information about which of these are most likely to provide clean or contaminated product.

3.3.4 Customs brokers

Customs brokers are licensed agents[11] based in Australia and subject to Australian law who are able to coordinate the goods importation process on behalf of an importer.[12] Customs brokers can lodge declarations with both the Department of Immigration and Border Protection (Customs) and the Department of Agriculture and Water Resources on behalf of importers and may attend biosecurity inspections as the importer's representative.

Customs brokers are typically remunerated on a fee-for-service basis. Stakeholder interviews (discussed further in Chapters 4 and 5) confirmed that brokers do not directly influence the biosecurity status of the consignments or control circumstances under which a consignment is likely to be compliant or not. Thus the key players whose behaviour the Department of Agriculture and Water Resources should aim to influence through its inspection rules are product suppliers and importers.

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9 As noted earlier in this chapter, the effect of import conditions stipulated by the department may extend beyond the purview of the supplier to import-supply chain participants further upstream in the value chain. Suppliers are responsible for this level of biosecurity assurance from the production side, though the legal incidence for failing to comply with import conditions falls to the importer.

10 Some stakeholders interviewed for this project noted that their suppliers had this level of control and oversight of activities occurring overseas. This type of arrangement seemed particularly prominent for peat production in Europe, but also featured in other pathways investigated, such as vegetable seeds for sowing and cut flowers.

11 Since 1 July 2015, the Department of Immigration and Border Protection (referred to as Customs in this report) has been responsible for granting customs broker licences in accordance with Part XI of the *Customs Act 1901*; these functions were previously undertaken by the Australian Customs and Border Protection Service. There are three categories of customs brokers (corporate, sole trader and nominee), though the distinction between these categories is not important for this project. Further details of the licensing process and requirements can be found on the Department of Immigration and Border Protection website: http://www.border.gov.au/Busi/Lice/Cust.

12 Under the *Customs Act 1901*, an owner of goods (i.e. the importer) may authorise an agent to act on his or her behalf for the importation of goods into Australia.

3.4 Key considerations when introducing incentive-based interventions

Previous reports into Australia's biosecurity system, such as Beale et al. (2008), have highlighted the need to balance the likelihood and consequences of leakage against the potential system-wide savings from changing the nature of government interventions. This has translated into a move to focus border activities on pathways where consignments have a higher likelihood of containing biosecurity risk materials. This suggests a transition from the less efficient, one-size-fits-all approach to intervention on many pathways, towards more risk-based approaches.

Before any changes are made to existing inspection regimes it is crucial to gather as much information about the pathway as possible. This includes, but is not limited to:

- the market structure, in terms of the relationships between importers and suppliers, and between suppliers and upstream decision-makers in the product value chain;
- the cost of complying with biosecurity requirements;
- options for suppliers and importers to mitigate biosecurity risk; and
- information flows between participants.

This information will provide the basis of understanding existing incentive structures facing participants and how they are likely to respond to any changes in inspection rules.

3.4.1 Market structure

For incentives to be effective, importers must have options to change suppliers or coerce the supplier to improve biosecurity mitigation if particular supplier's consignments routinely fail biosecurity inspections. Whether this occurs will largely depend on the market structure of the pathway, how competitive it is, the nature of contractual arrangements between importers and suppliers, and the capacity to change product characteristics through treatment, choice of processing and packaging techniques, sourcing decisions and so on.

For many pathways, an importer's ability to influence the biosecurity risk status of the products may be limited. Given Australia is a relatively small market, the costs of meeting different requirements in Australia may be large relative to the commercial benefit available to suppliers.[13] An importer's influence may be particularly limited if they are one of many possible purchasers of a product in global markets, since suppliers may offer particular products on a "take it or leave it basis" rather than seek to adapt their approach to satisfy Australian Government requirements. Furthermore, if suppliers are separated from upstream decision makers in the value chain, the scope for importers to influence production choices in stages of the process critical for managing biosecurity risks in the end product may be negligible. In light of limited power to influence upstream decisions, it then becomes a commercial decision for

[13] Stakeholders interviewed on the vegetable seeds for sowing pathway highlighted that Australia's small market and strict biosecurity requirements meant that sufficient commercial incentives were often not there for seed producers to produce seed adapted to Australian growing conditions. Instead, Australian seed importers would have access to seed designed for larger markets, such as California, that had broadly similar, but not identical, growing conditions to those experienced in Australia.

importers to wear both inspection and treatment costs for non-compliant products or choose not to import those types of goods at all.

Where the suppliers keep information from importers about the biosecurity mitigation possibilities or biosecurity status of goods – an example of information asymmetry – vertical integration in the supply chain, whereby production choices are internalised within a single entity, may be one solution to the information problem. Another option is to build up trust through long-term supplier-importer relationships.

Switching between suppliers may not always be an option for importers – this could be a costly process, there may be few alternative suppliers, and it may be that there are few options for biosecurity risk mitigation regardless of the supplier chosen.

3.4.2 Participants' compliance costs and mitigation options

Gathering information on the costs of compliance and the mitigation options available for industry is desirable when the regulator seeks to determine appropriate import rules. The biosecurity enforcement system is currently structured to place the onus on importers for meeting biosecurity obligations required of their consignments. If biosecurity risk material is found in imported products, the importer is legally liable for costs involved in treating or destroying the products.[14] Importers have the opportunity to choose which supplier (or suppliers) they source products from and the conditions under which they source them.

Importers, together with other participants in the import-supply chain, can be assumed to act in their own self-interest. This implies importers take into account the expected costs associated with meeting biosecurity requirements, together with the landed costs of goods, in terms of maximising the profitability of their operations. From a practical perspective, if there are significant costs associated with inspecting a consignment or treating goods containing biosecurity risk material, an importer may seek to influence the supplier to improve their processes to reduce the risk of biosecurity risk material being present. Alternatively, the importer might want to choose a supplier who has implemented processes aimed at reducing the likelihood that biosecurity risks are present in a product, even if the cost of goods themselves will be higher as a result.

An important consideration is that it may not be possible for import-supply chain participants to remove sources of biosecurity risks from every single consignment they seek to import. For some import pathways it is likely there will always be some risk of contamination, regardless of the efforts put in by importers, suppliers and transport companies to reduce contamination. However, increasing effort, such as through instituting new cleaning or containment processes, is assumed to reduce the

[14] In practice, the economic incidence of these costs can fall on parties other than the importer. Some insurers in Australia offer marine insurance policies that will cover, among other things, damage to packaging and containers, reshipping costs, fumigation costs and costs associated with the removal of debris; see, for example, http://www.cgu.com.au/insurance/Business/Products/Marine-(cargo-commercial-hull)/Marine-(cargo-commercial). Discussions with stakeholders revealed that costs associated with treating, re-exporting or destroying consignments may be borne by the supplier or transport operator under certain circumstances. Furthermore, some pathways have agreed rules for international trade issued by industry associations to clarify and standardise contractual relations between buyers and sellers. For example, the current rules applying to internationally traded seed for sowing are available from the International Seed Federation website: http://www.worldseed.org/cms/medias/file/Rules/Trade/ISF_Trade_Rules_2013.pdf.

likelihood of biosecurity risks being present in the consignment. In this sense, an importer will be making choices to influence the *expected* total cost of landing a consignment in Australia, taking into account inspection and potential treatment costs.

The strength of the incentives created to ensure "clean" consignments depends on the extent to which expending effort translates into a lower contamination rate.[15] If certain pathways have the characteristic that the rate of contamination is little influenced by supplier or importer effort, then it is difficult to incentivise "good" behaviour in the import-supply chain.

3.4.3 Information flows

The behaviour of importers and suppliers may not be fully observable by the Department of Agriculture and Water Resources. While some information is routinely requested from these participants as part of the import permit process, and there is a reasonable expectation that it is revealed truthfully, other important information is private and would be difficult to ensure that it is revealed truthfully.

In a practical sense, the information the department is able to glean about biosecurity control measures applied along the import-supply chain will in part depend on the product's characteristics. For some pathways, the department may be limited to observing the outcomes of inspections; for instance, it may not be able to observe the range of actions undertaken by import-supply chain participants to reduce the likelihood of biosecurity risks being present.[16] In these situations, the indirect incentives for the importer to act in accordance with the Australian Government's biosecurity objective must be based on the outcome of biosecurity inspections.[17]

For other types of products, the department may have a range of ways in which it can directly verify activities across the supply chain or obtain a credible "signal" that specific actions have been undertaken. These may include offshore audits, offshore pre-inspection, phytosanitary certificates, treatment certificates and NPPO arrangements. These other activities may represent the control point for certain commodities, with the border inspection conducted as a double-checking mechanism. Alternatively, an inspection at border must be a check for some specific requirements

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15 Analogous arguments are made by Sappington (1994) regarding general properties affecting the implementation of incentive regulation.

16 Since the importing process is a repeated interaction, the department may learn over time which are the compliant and non-compliant importers and suppliers. However, changes in technology, costs of production or other circumstances may mean that an importer's ability to reduce biosecurity risk material contamination in their products could also change over time. The working assumption used throughout the analysis in this report assumes a constant ability and cost structure for reducing the likelihood of biosecurity risk material being present in consignments.

17 Previous investigations of the Australian biosecurity inspection system (e.g. Robinson et al., 2012) have acknowledged that border inspection outcomes are an imperfect mechanism through which to assess regulatory compliance. The framework considered in Rossiter and Hester (2016) allows the biosecurity regulator to make errors in the inspection process which involve either failing to detect biosecurity risk material in a consignment where it is present or requiring treatment for consignments that do not contain biosecurity risk material. Theoretical and simulation results indicate that decision-errors by the inspector reduce the importer's incentive to exert effort to reduce the likelihood that consignments contain biosecurity risk material. For a given inspection rule, this implies a higher approach rate for biosecurity risk material and a greater number of instances where risk material leaks into the local environment. These factors need to be taken into account when choosing appropriate inspection rules for a pathway.

that could not be easily assessed at another point in the import-supply chain, such as potential cross-contamination while being transported from the country of origin to the Australian border.

Because many importers and suppliers within and between pathways have unique cost structures, each will be impacted differently by a given set of rules. Therefore, it is important to understand what pieces of information would allow an understanding of how biosecurity risk will change as incentives change, and how that information might be collected.

3.4.4 Commitment to a changed inspection regime

From the regulator's perspective, commitment to a particular regime can also be an issue. Faithful and consistent execution of a particular regime is crucial for allowing the incentive scheme to have the desired impact on import-supply chain behaviour. Being realistic about long-term commitment to a particular regime must be recognised when the incentive programs are formulated. If the purpose of the incentive scheme is to introduce processes or technologies that are not easily reversible and have high implementation costs, then commitment by the regulator is critical to encouraging the uptake of such mechanisms to reduce the likelihood of biosecurity risk material contamination.

However, in practice the regulator's knowledge and understanding of risks and consequences of incursions is changing regularly through receiving new scientific advice and other information. This poses a trade-off for the regulator between committing to a particular set of inspection protocols and regularly changing inspection protocols in response to updated threats to its objective. Overall, flexibility in inspection protocols is desirable, though changes need to be communicated and implemented in a way that does not undermine the regulator's credibility. This may require providing up-front advice to importers and suppliers on changes to the Department's view on the appropriateness of existing protocols.

In practice, it may also be useful to periodically review inspection protocols to determine their suitability. Over time, the ability for importers and suppliers to reduce the likelihood of biosecurity risk material being present in their consignments can change, depending on technology and production costs. In light of this, the regulator may seek to recalibrate the inspection protocols to new information about the production process, so as to incentivise import-supply chain participants to adopt new production approaches. The timing of such reviews is critical, since they should allow sufficient time for the intended incentives to become operational to see how importers and suppliers are performing under them. The benefits of commitment to the regulatory regime can be maintained provided such reviews are communicated clearly in advance, so as to guide expectations.

4. Designing Incentive-based Intervention Protocols

In chapter 3 we identified the importance of gathering as much information as possible about a pathway and participants within that pathway in order to allow an understanding the likely impacts of any proposed changes to the biosecurity system. This includes determining the costs of inspection and consequences of leakage. We now discuss relevant sources of information and relevant methods for analysing this information.

4.1 Administrative data on inspections

4.1.1 Potential candidate pathways for investigation

All imported cargo is subject to Customs control and is screened prior to any biosecurity assessment conducted by the Department of Agriculture and Water Resources. Customs administers the Integrated Cargo System (ICS), which is an electronic platform which allows brokers and/or importers to provide information electronically to Customs and the department. An international system of tariff codes and other key words in information lodged using the ICS are used to identify goods which may pose a biosecurity risk. Once a profile has been 'hit', the system automatically generates an electronic AQIS Import Management System (AIMS) entry, making the goods subject to biosecurity inspection.

The department's Plant Division supplied administrative data to the project team on thirteen plant-product pathways they identified as potential candidates for further investigation as case studies for this project. The thirteen pathways[18] reviewed for case-study suitability for this project were:

- green coffee beans;
- cut flowers;
- vegetable seeds for sowing;
- peat;
- dried vegetables;
- plant-based stockfeed;
- plant-based fertiliser;
- dates – dried (all countries of origin) and fresh (from United States of America only);
- herbal teas;
- legumes for human consumption;
- kiwifruit (France and Italy country of origin);
- fresh mangosteen; and
- plant-tissue cultures.

The data provided merged characteristics from the department's AIMS and Incident databases and included a range of fields relating to:

- the nature of the goods imported;

[18] The Sea Container Hygiene System (SCHS) was also considered a potential pathway for this project. However, given the control mechanisms available under the SCHS differ significantly from the other candidate pathways, the project team and the department agreed to restrict the project's focus to pathways based on plant products.

- the parties involved in bringing the goods to the Australian border;
- the inspection outcome;
- the nature of any biosecurity risk material detected through the inspection process; and
- any treatments applied or other rectifications required to bring the consignment across the border.

This statistical analysis, together with assessments of product characteristics associated with candidate case-study pathways nominated by the department, allowed the department and project team to select six plant-product pathways for further analysis. The chosen pathways were:

- green coffee beans;
- cut flowers;
- vegetable seeds for sowing;
- peat;
- dried vegetables; and
- plant-based stockfeed.

The administrative data sets also allowed the project team to identify import-supply chain participants who could be suitable for interviewing as part of the project's next phase. Statistical summaries of inspection data for the six plant-product pathways chosen for further investigation in CEBRA Project 1304C were provided separately to the department.

4.1.2 Criteria for selecting case-study pathways

In selecting pathways as case studies for this project, insights from administrative data and economic theory needed to be used in choosing the most appropriate pathways to assess. Based on the broad incentives facing participants in the biosecurity inspection system, "ideal" pathways for project case studies would be those where, at the very least, the costs being inspected or failing inspections are significant.

Importers need to have an incentive to minimise overall costs (direct and indirect) associated with inspection or failing an inspection. For pathways where costs of inspection are small relative to other costs associated with sourcing consignments, there may be little reward for importers or their suppliers to ever respond to failed inspections by reducing the likelihood of biosecurity risk material being present in consignments. Choosing a pathway where the costs of inspection are relatively small may result in subsequent fieldwork finding limited benefit from introducing compliance-based protocols on pathways with these features.

For inspection protocols to be effective in encouraging behaviour change by import-supply chain participants, importers must have options to explore if a particular supplier's consignments routinely fail biosecurity inspections. This will in large part depend on the market structure, how competitive it is, the nature of contractual arrangements between importers and suppliers, and the capacity to change product characteristics through treatment, choice of processing and packaging techniques, sourcing decisions and so on.

It is important to also consider the consequences of system leakage in choosing case studies. From a practical point of view, any future field experiment may result in variation in the likelihood of biosecurity risk material leaking through the system. Of course, a heightened likelihood of leakage needs to be balanced against the potential

cost savings from reduced inspection intensity in deciding the form of protocols adopted on a pathway. For the field trial and future implementation, this may require choosing pathways where the typical biosecurity risks would have limited consequences for local industries and consumers.

Some degree of variability in inspection outcomes for the selected pathways is useful from a statistical viewpoint. When this is the case, the effects of protocols with designed incentive structures are likely to be better revealed as importers reducing (or increasing) the biosecurity risk associated with their pathway. A product that never fails inspection will not be very informative on behavioural responses that might occur in response to changes in inspection rules; neither is one that always fails. Something closer to the middle may allow a more robust statistical analysis of inspection data.

The project team also considered it worth exploring a suite of pathways where third-party customs brokers were used to different degrees. This would allow the project team to investigate whether information flows (including with respect to costs) between the importer, supplier and customs broker differed between pathways where customs brokers appeared to be brought into the clearance process in different ways.

Six criteria were proposed for determining the suitability of pathways as case studies for this project. These are explained in more detail in Table 1, which also provides guidance on mapping these broad aims into specific pathway characteristics. An ideal plant product pathway for case study purposes would satisfy at least one of criteria 1 or 2 and satisfy criteria 3, 4 and 5. For criterion 6, some variation in characteristics is required between the pathways so that the influence of customs brokers can be examined.

Criteria 1, 2 and 4 are largely qualitative in nature and based on the characteristics of the product, whereas criteria 3, 5 and 6 can be informed by inspection data. Following discussions with the Department of Agriculture and Water Resources, all candidate case studies offered exceeded Australia's appropriate level of protection (ALOP). Hence, criterion 4 was not considered explicitly in determining which candidate pathways to choose as case studies.

Table 1. Criteria for selecting case-study pathways

Criterion	*Practical pathway characteristics*
1. Significant costs in being inspected	• Has a relatively limited usable life • Cannot be stored easily or conditions under which can store are costly • Physical inspection can take a long time or requires specialist equipment/personnel
2. Significant costs in failing an inspection	• Treatment for consignments that fail inspection is expensive (time and/or direct cost) • Cannot be stored easily or conditions under which can store are costly
3. Importers have some scope to respond to inspection outcomes	• Several/many potential suppliers for product pathway • Several countries/regions that could supply product • No dominant supplier/s in market with overwhelming market share • Alternative production, processing, packaging or sourcing arrangements are available • Technologies that can reduce biosecurity hazards before leaving country of origin are available • Can verify pre-departure treatments have been completed • Failure history differs between potential suppliers/countries of origin
4. Consequences of leakage are relatively low	• Types of biosecurity hazards present are not likely to affect local industries and/or represent a significant threat to human health
5. Reasonable variability in inspection outcomes	• Enough failures on pathway to make informed assessment of whether outcomes have changed • Failure history differs between suppliers, product countries of origin and/or importers
6. Differing reliance on third-party customs brokers	• Share of importers/consignments which come through third-party brokers is high/low • Usage of brokers differs between importers

4.1.3 Insights from analysing administrative data

From the department's perspective, analysing this administrative data in a structured way can provide information about:

- the market structure of the import-supply chain;
- the relationships and linkages between import-supply chain participants;
- the likelihood of biosecurity risks entering Australia based on past inspection results;
- the types of biosecurity risks identified in previous inspections;
- the distribution of inspection failure rates, particularly how they vary across importers, suppliers and countries of origin; and

- the entry methods and locations of the main ports of entry of pathway consignments to Australia.

This type of analysis can be useful for risk profiling,[19] so that the department may be able to better target its interventions, allowing it to reduce intervention on pathways where compliance has been very high historically. During the course of analysing pathway data for this project, investigation of dried onion products (tariff code 0712.20) – a subset of the more broadly defined dried vegetables pathway – revealed this pathway had a pathway failure rate of 2.8 per cent over the period 1 July 2008 to 30 June 2013 and a quarantine failure rate of only 0.1 per cent.[20] Pathways with low failure rates and where the consequences of biosecurity-related inspection failures likely to be relatively low are ideal candidates for compliance-based inspection protocols, such as the CSP-3 algorithm.

Another valuable insight for the department from analysing the administrative data relates to the internal allocation of resources for inspections. The administrative data provides evidence around where the main points of entry for certain pathways are, but can also identify which ports are recording the inspection failures and, to some extent, patterns in detection of the causes of failures.

While analysis of the administrative data identified some interesting and valuable findings for department, it also revealed some issues with departmental information and business systems that are of concern. As expected with administrative data, a significant amount of data cleaning was required to analyse the data for the purposes that the project team sought to examine. In particular, duplicate records represented a significant issue that needed to be accounted for in the analysis to avoid double-counting of entries; duplicate records existed when consignments had to be re-inspected, possibly on more than one occasion. A non-trivial percentage of the inspection records also had missing fields, with varying degrees of incompleteness. In some instances, this hampered the extent to which assessments could be made as to why consignments on particular pathways failed inspection.

Furthermore, it was clear that different regions, and even different officers within regions, adopted alternative ways of recording free-text fields in the database. The lack of structure in the data records made it impossible (even using text processing capabilities in the R statistical package) to identify the reasons behind why consignments were classified as requiring further investigation. The Incident database provided some fields that allowed for identifying whether consignments contained biosecurity risk material, though improving the database structure could allow for a more fulsome analysis of the types of biosecurity risks identified through inspections on the pathways.

Similar limitations also apply to data entered into ICS by customs brokers. In particular, the goods description entered by the customs broker will not necessarily provide useful information to classify the type of good within a given tariff code.

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19 Risk profiling need not be restricted to looking at pathway-level information, but may be valuable for identifying information that can be reported back to individual firms on their performance in the biosecurity inspection system. The types of information of relevance to stakeholders is likely to include that related to the regulatory burden they bear associated with completing inspections, which is discussed later in this chapter.

20 This represented only three identified quarantine failures in more than 2 000 consignments over the five years to 30 June 2013.

Discussions with customs brokers confirmed that they tend to use the goods description provided on the goods invoice or bill of lading when preparing their ICS entries. Since the way consignments are subject to biosecurity interventions under the mandatory inspection regime is based on the tariff code, there is little incentive for suppliers or importers to include further detail on their consignments that could assist classification at a finer level. For example, on the vegetable seeds for sowing pathway, the description "vegetable seeds" or "seeds for sowing" is frequently used in preference to descriptions that could indicate the botanical or common names of the seeds. If the latter were used, the goods description could be more useful in alerting biosecurity officers to the potential risks of a consignment, enabling biosecurity effort to be better targeted.

An important observation from the data analysis in this project is that the biosecurity process applied (as defined by AIMS) should not be based solely on tariff codes. The tariff code is one, but not the only, determinant of the appropriate biosecurity strategy for different products. This was particularly important for plant-based stockfeed, where department staff and the project team applied successive refinements to this pathway's definition, which resulted in a complex pathway definition involving multiple database fields. For the purposes of the department, such a complex definition is workable, provided that the department's business information systems are sufficiently flexible to check whether a consignment falls into a particular pathway and can then apply the appropriate inspection rule for the given pathway.

However, the main issue with this construction is in trying to communicate the pathway definition to external stakeholders, such as importers and the customs brokers who represent them. If such a definition is not well-understood by key stakeholders, the potential for inadvertent consignment misclassification on the part of the system stakeholders becomes greater. As a result, importers could perceive that their consignments have been subject to the "wrong" set of pathway protocols and lose confidence with the way in which the department is overseeing the biosecurity inspection system. Such considerations underscore the importance of ensuring pathways are not only clearly defined but that the definition is well-understood by the department and the biosecurity system stakeholders.

4.2 Stakeholder consultation

Interviews are an important way to gain an understanding of the scope for import-supply chain participants to respond to changed inspection regimes. Rather than being a statistical exercise where a hypothesis is being tested formally, the interview process could be considered a 'fact finding' mission, where a limited number of participants from each pathway are interviewed. Results from the interview will assist in confirming or refuting expectations about behaviour, some of which may have been suggested by the administrative data collected by the department.

Most of the information collected through this process will be of a qualitative nature, describing the 'how' and 'why' of the importing process. Some quantitative information may be available around aspects that are not captured in existing administrative data sources, such as estimates of indirect costs borne by the importers associated with the inspection process or the time taken for particular types of goods to arrive in Australia. It may also be desirable to include questions that provide a "cross-check" on responses from the interview process, so that these types of information can be verified against the administrative data.

The following sections detail key considerations for designing an interview that would allow useful and relevant information to be gathered from import-supply chain participants. It also describes how some of these principles were applied in the stakeholder consultation process as part of this project.

4.2.1 Which information should be collected?

To understand how import-supply chain participants are likely to change behaviour in response to a changed inspection regime, it is necessary to establish a minimal set of useful information that should be collected during an interview. In this case, the project team decided to focus its data-collection efforts on the following issues:

- the nature of the contracts entered into between import–supply chain participants;
- whether reputation of import-supply chain participants is important and when;
- participant knowledge of the market structure (e.g. the number of alternative suppliers and importers);
- the nature of information flows between each of the import–supply chain participants regarding biosecurity requirements and inspection outcomes;
- the types and magnitudes of costs faced by each import-supply chain participant in complying with Australia's biosecurity requirements;
- the costs of failing a biosecurity inspection and who bears that cost;
- how behaviour of each participant might have changed following failed biosecurity inspections in the past; and
- the potential for biosecurity and/or pathway risk abatement/mitigation by participants.

As illustrated in the importer and customs broker questionnaires in Appendices A and B of this report, other supporting information was also collected during the process. If this exercise were to be repeated in future, there could be some reduction in the scope of questions asked about particular topics. For example, evidence from consultations undertaken for this project suggest there is little need to follow up on information about financial and information flows between importers and customs brokers. This was because all importer interviewees reported timely and effective communication between brokers and themselves about inspection outcomes and delays, with brokers issuing itemised invoices to importers that clearly break down charges due to customs checks, quarantine checks and their own fees. Instead, studies on other pathways in future may benefit from focusing on the role of customs brokers as an agent able to see the end-to-end inspection process who, in general, have much closer engagement with the department's frontline staff.

4.2.2 Practical aspects of consultation

Designing a questionnaire

There are many good references to assist in the design of questionnaires (e.g. Bradburn et al. 2004; Brace, 2013) and we do not provide exhaustive instructions here. Briefly, once there is a list of the information that is required, questions may be developed from these. Consideration needs to be given to the order and format of questions. It is important to ensure questions are not vague, biased, or unnecessary, so as to give the best opportunity to provide reliable information.

It may be important to focus questions to a particular context in order to be able to make meaningful comparisons across interviews. For example, questions such as:

> *Have you ever queried a particular invoice from a customs broker? If so, what resulted from your query**?***

are likely to lead to multiple answers and even biased answers if the interviewee decides to only give the best or the worst examples. Furthermore, you may not know whether they are recent examples or very rare cases. It would be better to rephrase the second part of the question as**:**

> *In the most recent instance where you queried a customs broker's invoice, why did you do so and what resulted from that query?*

Open-ended, vague questions, for example:

> *Could you explain how you interact with customs brokers in clearing consignments through inspections?*

are also unlikely to lead to answers that allow meaningful comparisons across interviews. It would be better to phrase the question as follows:

> *Do you use in-house brokers, external customs brokers or a combination of both?*

As part of the question refinement process, members of the project team consulted a questionnaire design expert to test the validity of the questions and provide more robust questioning approaches to establish better comparability of responses between interviews.

Once a final draft of the questions has been developed, trial interviews should be undertaken to assess both the length of time the interview is likely to take and to check whether questions need any further refinement. Experience in this consultation round suggests being very conservative about the time taken. While pre-testing of the questionnaires suggested they would take around 30 to 45 minutes for stakeholders to answer, many interviews lasted for at least an hour. As such, being more specific about the information that will be valuable for the department will allow shorter and more focused interviews.

Selecting and engaging interviewees

When attempting to understand the potential for behaviour change amongst import-supply chain participants, it will be necessary to interview customs brokers and importers, and possibly Australian-based suppliers and industry organisations. For a given pathway, there are likely to be a very large number of customs brokers and importers and only a subset of these may be needed for interview to have some confidence in the key themes for a particular pathway. This subset may be chosen based on the number of consignments handled in a particular time period, for example. From this group, a smaller number of customs brokers and importers would then be selected for interview.

For this project, a list of potential interviewees was formed from the analysis of the administrative data from the AIMS database described in the previous section. This data provided, among other things, information on the number of consignments associated with each importer, customs broker and supplier that had been subject to inspection over the period 2008-09 to 2012-13. To be considered eligible for interview, an entity had to be "experienced" on that particular pathway by being

associated with at least a given number of inspections on that pathway over the five-year period.[21]

Contact details for these shortlisted entities were sourced from publicly available sources, such as the Australian Business Register, the White and Yellow Pages and from organisation websites. In the experience of the project team, the Australian Business Register was an important source of information, as trading names are often very different from business names recorded in the AIMS database. Phone calls were then made to establish the most appropriate person within each organisation to approach. Letters of invitation were then sent to each organisation by post and/or email, based on the preferences of the particular organisation.

As the stakeholder consultation phase was designed to look at six pathways, there was a need to limit the number of invitations sent to potential participants.[22] Initially, invitations were sent to five eligible importers and five eligible customs brokers on each pathway, chosen at random from the shortlist. The benchmark established by the project team was to interview at least three importers and at least three customs brokers for the project's six case-study pathways.[23] For some pathways, there were more than what was believed to be the minimum number of interviewees required of each type from the initial approach; for others, the project team needed to contact more entities from the shortlist to attain the desired minimum number of participants to interview.

Because the interviews were done for the purpose of research, the process needed to be approved by a human research ethics committee to ensure it adhered to the National Statement on Ethical Conduct in Human Research (NHMRC, ARC and AVCC, 2007). Among other things, this meant that informed consent was required of all participants, that participation was voluntary and that a plain-language description of the research objectives and procedures need to be provided to potential participants. While investigations of this sort are generally considered to be "low risk", this approval process can take several weeks or even months to complete. In this case, the approval process delayed commencing the recruitment process by almost two months.

A consequence of the voluntary nature of participation means that the number of organisations the researcher needs to approach may be significantly more than the number of organisations interviewed. While the project team ended up interviewing 43 organisations, the project team invited 80 organisations to participate in the consultation phase of the project.

Conducting the interviews

Both face-to-face and phone interviews are options for consultation. Owing to the location of the available interviewers, a mix of these two approaches was used in this

21 This minimum number of consignments was determined separately for each pathway, based on the total number of inspections conducted on the pathway and advice from departmental officers familiar with each pathway.

22 Since relatively few Australian-based suppliers and industry associations were identified for the case-study pathways, all relevant organisations in these categories formed part of the initial approach for interview.

23 This primarily reflected timing and resourcing constraints, given interviews were being conducted and organised by only two project team members and because repeated stakeholder contact and scheduling difficulties were encountered in arranging interviews.

consultation process. No noticeable differences in the quality of information supplied was detected between these two forms, though telephone interviews tended to be shorter.

When there are multiple interviewers it is important that each has the same interpretation of each question and which question in any given set is the crucial one. The questionnaire can be designed to help the interviewer understand how to interpret the questions, through providing notes on specific follow-up points and prompts that may assist eliciting targeted information from interviewees. As a further control measure in this process, the two interviewers were in close contact for the first few interviews conducted to resolve any interpretation difficulties as they arose in the interviews.

Analysing results

Interviews from each pathway should be analysed in order to find common themes across and/or within pathways. While a small amount of quantitative data may be obtained from interviews (e.g. costs of delays and inspection fees), most of the data will be qualitative in nature and thus a robust, transparent qualitative analysis will be required. This may be undertaken using a number of software packages, for example NVivo (QSR International, n.d.) and MaxQDA (VERBI GmbH, n.d.).

Ideally themes will emerge on the key information identified earlier in this section and results will allow identification of important points of influence in the biosecurity inspection chain, where system changes could be made to improve incentives. Results from the interviews will also serve to support or refute inputs to theoretical assessments of the inspection process analysed in Rossiter and Hester (2016) and the analysis of administrative data.

Given there were relatively few interviewees of each type per pathway, it is not clear whether the stakeholders who responded to the requests for interview represent the full range of importers and customs brokers associated with the pathway. From the human research ethics point of view, there is also a requirement to avoid identifying particular respondents in reporting on interview themes to the greatest extent possible. This approach was designed to encourage greater participation from import-supply chain stakeholders, though it means that the analysis of results had to be done carefully to avoid revealing firm-specific behaviours that could identify the interviewees to those with industry knowledge. To accommodate these concerns, the researchers have chosen to use descriptors (e.g. “most”) rather than count information (e.g. “seven out of nine stakeholders on this pathway reported”) to indicate the extent of agreement with certain statements.

4.3 Economic Theory

Economics offers insights from the theory of incentives, incentive regulation and the economics of auditing about general themes that can be applied to design biosecurity intervention protocols that might reduce system costs through improved incentive structures within the import, declaration and compliance system. The potential control measures derived from theory are discussed in the first subsection. The latter two subsections consider how to value the costs and benefits of the inspection process, given these are critical parameters into decisions as to what are appropriate (or potentially the “best”) intervention protocols to select in different situations. For a

more detailed discussion of theoretical considerations related to the border inspection process, see Appendix C in this report and Rossiter and Hester (2016).

4.3.1 Control measures identified from economic theory

One of the most important observations of human behaviour is that incentives matter. Humans respond to even small changes in incentives that collectively can make a significant impact on the outcome produced and on the value created from transactions. Where interactions (transactions) are one-off, incentive structures evolve or are designed to encourage participants to behave in ways that maximise value created from each transaction. Simple incentive structures, often involving the distribution of risk between buyers and sellers, are observed in this context. Where there are repeated interactions between the same buyer and seller, other options can come into play. For example, the recorded reputation of a market player may become an important way of promoting behaviours that are beneficial across all market participants.

In a general regulatory setting it may be desirable to utilise the repeated nature of interactions in designing the incentive environment. Listed below are possible ways that inspection rules could be modified in the future. In choosing between control measures the regulator would need to be mindful of a pathway's market structure. The following measures have been suggested because they are supported by both interview responses and economic theory.

1. Focusing inspections on compliance history and outcomes

Inspection rules from the continuous sampling plan family[24] provide the department with opportunities to develop reactive detection systems that use information gained from recent inspection outcomes to guide the frequency of intervention on pathways. More information about this family of rules is given in the box on the next page.

Numerical simulation results from Rossiter and Hester (2016) suggest that the CSP-1 algorithm is likely to be more beneficial for the department to meet its biosecurity objectives when taking into account the potential for strategic behavioural responses by import-supply chain participants.[25] The penalty structure of the CSP-1 algorithm is more "hard-edged" and results in the biosecurity regulator inspecting a higher percentage of consignments than under the CSP-2 or CSP-3 algorithms with the same base parameters. The greater level of intervention implies there are fewer incidents where biosecurity risk material can leak into the environment.

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24 The CSP algorithms are described in detail in Robinson et al. (2012) and their incentive properties are discussed in Rossiter and Hester (2016).

25 In recommending to use the CSP-3 algorithm over the CSP-1 algorithm, Robinson et al. (2012) notes that "CSP-3 [algorithm] allows for the possibility of isolated leakage incidents, or random once-off non-compliance, without shifting immediately to an enhanced inspection mode and penali[s]ing suppliers with concomitant 100[per cent] inspection rates" (Robinson et al., 2012, 13). If the incidence of biosecurity risk material being contained in a consignment is assumed to be independent of history (within a particular regime) and follows a Bernoulli distribution, as assumed in Rossiter and Hester (2016) and implicitly assumed in Decrouez and Robinson (2014), then the more "forgiving" penalty structure of the CSP-3 algorithm is less appealing. On the other hand, if incidents of biosecurity risk material contamination tended to be clustered or are very infrequent, then the CSP-3 algorithm may be more appropriate.

Continuous sampling plan algorithms

In this box, we introduce the three continuous sampling plan (CSP) algorithms considered in previous studies for implementation by the department. The most basic of the CSP family rules is the CSP-1 algorithm, which was introduced in Dodge (1943) and is illustrated in Figure 2.

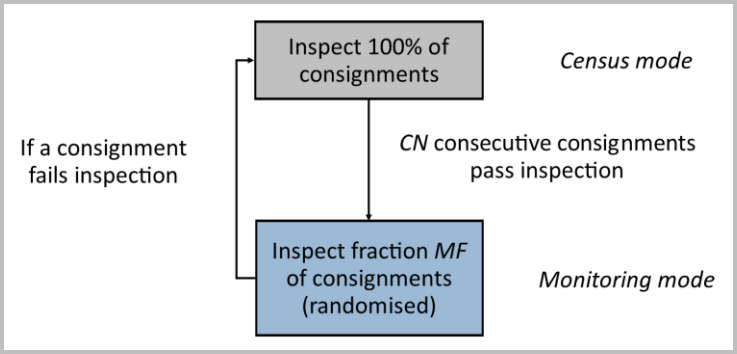

Figure 2. Schematic representation of the CSP-1 algorithm.

When a new importer starts on this algorithm, they are usually subject to mandatory inspections (in "census mode") until they build up a good compliance record. Two key parameters for the regulator to choose in this rule are:

- the clearance number (*CN*) – the number of successive consignments that must pass inspection for the importer to be eligible for a reduced inspection frequency; and
- the monitoring fraction (*MF*) – the reduced inspection frequency and probability that a given consignment is inspected in "monitoring mode".

If an importer's consignment fails inspection when the importer is in "monitoring mode", their subsequent consignments are subject to mandatory inspection in "census" mode. The importer only receives the reduced inspection frequency again after another *CN* successive consignments pass inspection.

The CSP-2 and CSP-3 rules documented in Dodge and Torrey (1951) have less severe consequences for occasional non-compliance when an importer is on the reduced inspection frequency *MF* relative to the CSP-1 rule.

In the CSP-2 algorithm (Figure 3), if an importer's consignment fails inspection in monitoring mode, then they continue to be inspected at the reduced rate (*MF*) while the regulator keeps track of the number of inspections passed since the last recorded failure. This part of the algorithm is usually referred to as "failure detection mode". Provided the importer passes inspection *CN* times since their last failure, they remain eligible to be inspected at the reduced rate of inspection; otherwise, on recording another failure within *CN* consignments of the previous one, the importer's consignments revert to mandatory inspection until they pass inspection *CN* times in a row. Intuitively, this provides less of a "cost" to the importer if recording a failure in one inspection does not increase the probability that future consignments will be more likely to fail.

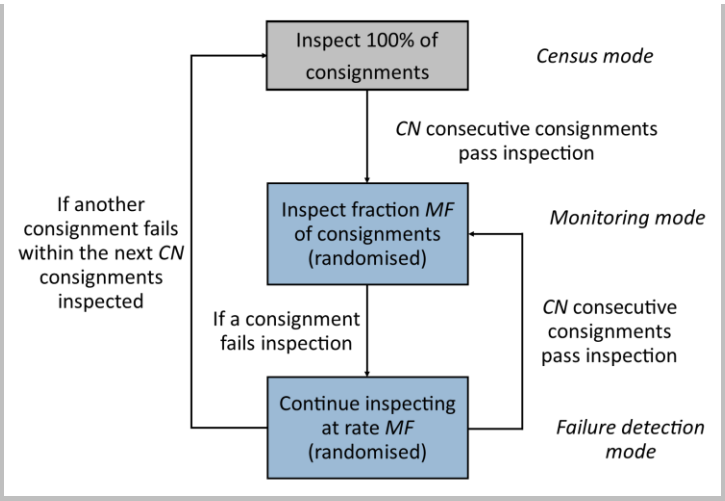

Figure 3. Schematic representation of the CSP-2 algorithm.

The CSP-3 algorithm, shown in Figure 4,[26] adds another layer of complexity to the CSP-2 algorithm. This is designed to provide extra protection to the regulator against a sudden systematic problem that would significantly raise the likelihood of a consignment failing inspection. It does this by making the next four consignments following a failure subject to mandatory inspection in what is referred to as "tight census mode". The other features of the CSP-2 algorithm, such as ignoring past failures if they occurred more than *CN* inspections ago, are retained by the CSP-3 algorithm.

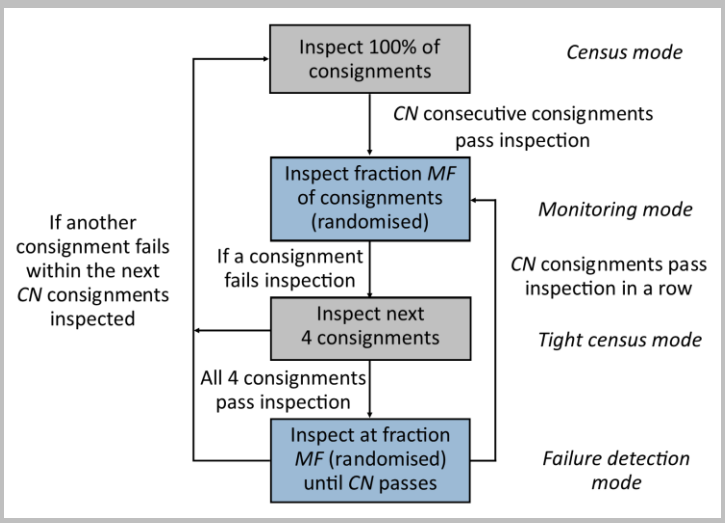

Figure 4. Schematic representation of the CSP-3 algorithm.

In the biosecurity context, it may be possible to base the protocols experienced by biosecurity system stakeholders, such as importers, on their entire compliance history, rather than focusing on atypical incidents. Relative to the findings of Rossiter and Hester (2016), where the focus is on investigating inspection protocols guided by a limited subset of an entity's compliance history, this may encourage the department to consider somewhat more "forgiving" inspection protocols.[27] However, so that

[26] The version of the rule used in this paper follows the practical simplification suggested by Robinson et al. (2012).

[27] In the CSP rule context, this would be akin to favouring the CSP-2 or CSP-3 algorithm over the CSP-1 algorithm.

incentives for compliance are not dampened too much, these types of allowances should only be made in situations where the observed frequency of inspection failure is very low, with non-compliance reflecting idiosyncratic factors unrelated to the entity's effort in seeking to manage biosecurity risks.[28]

An outcome-based focus would give importers more choice in how they meet their biosecurity requirements and provide assurances of their biosecurity standards to the Australian Government. For example, a home-country process audit relating to production, processing and transportation of plant-based products could be offered to an importer or supplier. If biosecurity system stakeholders can demonstrate their internal control mechanisms result in the effective pre-border management of biosecurity risks, this could mean consignments may be eligible for alternative border inspection protocols (relative to those applying to other importers on the pathway) through a compliance agreement.

For high-volume pathways, it may be commercially and operationally feasible for both the department and the exporting country to focus biosecurity assurance activities on pre-clearing consignments in the country of origin.[29] Because Australian law requires offshore inspections to be completed by department officers, the expense of administering these arrangements means they are only currently viable for high-volume pathways where stakeholders are willing pay additional fees to reduce delay costs. If pre-clearance arrangements could be established for several pathways for a given country of origin, the administration costs may be reduced to the point where a wider roll-out of these arrangements may be possible.

Focusing on inspection outcomes and rewarding compliance could also foster innovation in how biosecurity risks are mitigated and managed by importers and suppliers. By encouraging importers, suppliers or other industry representatives to investigate alternative risk mitigation strategies and demonstrate that they yield equivalent (or potentially superior) biosecurity outcomes to current mandated standards, the department can harness the incentives for import-supply chain participants to reduce their compliance costs while maintaining Australia's high biosecurity status.[30] Different treatments may then be applied to offer an equivalent standard of biosecurity assurance. Furthermore, if the alternative mitigation strategies are developed by or supported by a representative body, the department may be able to use third-party accreditation schemes to verify adherence to those strategies.

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28 Violations of compliance would also need to be associated with situations where the consequences of biosecurity risk material leaking into the environment are low relative to the regulatory burden imposed on stakeholders from conducting inspections.

29 Australia has established offshore pre-shipment inspection arrangements with New Zealand and the United States of America for select varieties of fresh fruit and vegetables. Pre-clearance programs are used extensively by some countries, including the United States, to allow faster movement of goods, reduce the burden of border intervention activities and decrease the rate of interceptions of biosecurity risk material at the border (Myers and Hagerstrom, 2012, 298).

30 The notion of equivalence in sanitary and phytosanitary protection is established in Article 4 of the SPS Agreement. Private-sector incentives for establishing equivalence arise from being able to replace mandated import conditions with other requirements (that deliver equivalent biosecurity outcomes) which have lower implementation costs. As part of implementing this type of assurance model, care would need to be taken to collect and evaluate appropriate evidence to demonstrate equivalence. The charging mechanism associated with assessing and establishing compliance agreements in this context would also need to be carefully designed so as to appropriately recover departmental costs while not undermining the incentives for innovation in biosecurity risk mitigation measures on the pathway.

2. Menus of regulatory contracts

Another insight from the literature, as highlighted by Sappington (1994), is that offering a suite of options to the regulated entity can use the entity's information advantage to extract improved performance. While offering a *menu of regulatory contracts* can make the regulatory task more complicated, the expected gains from "win-win" situations may more than offset this cost. The menu of contracts idea was developed to allow market participants to reveal information that can assist the market to work efficiently.

The simplest explanation of this idea can be seen when we take out motor car insurance. The buyer of insurance is asked to choose between a menu of contracts including at one extreme, a high excess but low premium and at the other a low excess with high premium. Confronted with these options, the driver maps in private information about their driving habits and capabilities (influencing the probability of making a claim) and the premium. The driver chooses the excess/premium setting that maximises their wellbeing.

In a biosecurity context, it should be possible to design a reward structure that provides increasing benefits to an importer for higher levels of biosecurity compliance, with the options offered as part of the menu being interdependent in terms of trade-offs to induce better behaviour. Given biosecurity inspections form repeated actions over time, it is critical to avoid providing importers the incentive to switch between various menu options too frequently to their advantage but at the detriment of the societal objective underpinning biosecurity interventions.

From an operational perspective, menus of regulatory contracts may also be a useful way for the department to construct "tiers" of compliance agreements to use on different pathways. Developing standardised form compliance agreements would significantly simplify administering a more flexible outcomes-based system for biosecurity risk management, allowing "off the shelf" agreements to be available to a larger number of importer clients with low to moderate import volumes. Higher tiers in the compliance agreement hierarchy, corresponding to lower levels of intervention at the border, could be offered to importers who:

- demonstrate routine compliance through border inspections;
- are integrated with sophisticated systems for monitoring and reducing biosecurity risks through the value chain; and/or
- demonstrate adherence to effective biosecurity control measures through mechanisms such as internationally accredited and independent audit programs.

The uptake of such arrangements will be assisted ensuring the menu options are appropriately calibrated so as to encourage actions and behaviours consistent with reducing the approach rate of biosecurity risk material to Australia. The Australian Government would also benefit from focusing its biosecurity services towards activities for managing risks which pose the greatest threat to the nation's primary biosecurity objective.

3. Modify AIMS and pathway definitions according to biosecurity risk profiles

AIMS could be modified so that pathways are defined according to comparable biosecurity risks. This would ensure that protocols for testing and treatment would apply to products with similar risk profiles. In some cases, products fall under the same tariff code and thus inspection regime, when the risk profile of each product is quite different. For example, peat, sphagnum moss and coir all fall under the Harmonized System (HS) tariff code *2703*.

4. Changing relative costs of inspection

The relative costs of importing can be changed by varying: the inspection frequency; the intensity of inspections; the delay costs incurred by changing a consignments priority in the queue; and the level of fees and charges. If enacted correctly, all these measures may be used to give a relative advantage to 'good' importers. Changing inspection frequency is the focus of CSP-type algorithms. Inspection intensity, where inspections could range from a cursory check to a full unpack and inspect, might be chosen based on previous compliance history. Giving a high priority to importers with a good compliance history will result in lower relative costs and provide an incentive for remaining importers to improve compliance in order to also reduce delay costs.

5. Inspect according to different dimensions

It is important to identify where the biosecurity risk comes from and who in the import-supply chain can influence this risk. Rather than focusing on a single dimension, such as country of origin, importer or supplier, on which to differentiate the potential risks that consignments could pose to the primary biosecurity objective, there may be stronger incentives for compliant behaviour among import-supply chain participants from using multiple dimensions to better target intervention activities. For instance, this could mean treating the importer–supplier combination as a pair for the basis of targeting border inspections.

6. Leveraging across products

Where importers import across more than one pathway there may be opportunities to leverage compliance history on one pathway with that on another, especially where the history of failure varies.

4.3.2 The regulator's costs and benefits of undertaking inspections

Governments routinely invest in biosecurity activities such as quarantine inspections because the outcomes of these activities are considered to be public goods; that is, once undertaken, no one can be excluded from their benefits. Undertaking quarantine inspections is an expensive process and a limited budget for this activity means that not all consignments entering Australia can be, or are currently, inspected. Deciding what to inspect, when to inspect, how to inspect, and how much to inspect, is largely based on an estimate of the likelihood that particular pest is present in a consignment and the consequences of such a pest establishing in Australia. When the likelihood of an incursion is high, and consequences of any incursion large, the government may choose to spend a proportionate amount on the inspection process. Indeed, understanding the benefits (in terms of avoided damages) and costs of inspection is a key part of understanding the resource allocation process.

The range of costs associated with the department undertaking border inspection activities include the variable costs of labour, travel and consumables involved in

undertaking the inspection, including the time spent and materials used determining quarantine directions and outcomes. There may be additional direct costs incurred by the department when product destruction is required as a result of inspection failure. Indirect costs related to policy advice provided around the development and implementation of inspection regimes, together with advice around managing and monitoring biosecurity risks, also form part of the services provided by the department.

To a large extent, these costs are recovered from businesses through levies and fees for biosecurity services provided to importers. As such, these charges can at least approximate the cost to the government of undertaking an inspection. However, there may be some costs that cannot be readily recoverable from the department's importer clients and are thus provided through government appropriation. As far as this cost is material and related to changes in the volume of imports of potential biosecurity concern, it should be apportioned as part of identifying costs for the "marginal inspection activity". The Australian Government's focus on reducing the burden of regulation on business suggests that some weight should be given to burden placed on businesses from inspections over and above the department's charges. These costs associated are discussed in more detail in the next subsection.

The benefits of undertaking inspections include the avoided damages from preventing a new pest or disease entering and became established in Australia, which in some sense is related to the opportunity cost of choosing not to inspect a consignment. These benefits can be difficult to value when the pest or disease has an impact on biodiversity and recreational values and/or on human health. Depending on the nature of the pest, the effectiveness of post-border detection mechanisms and pest management arrangements, the opportunity cost of not inspecting a consignment could be related to costs associated with:

- containment to a small, isolated region;
- the slow spread of the pest in a somewhat controllable way;
- the cost of full eradication; and/or
- a host of broader economic costs, including the loss of a "trade premium" attached to Australia's high biosecurity status, should the introduction of the pest or disease be unable to be rectified and become endemic.

For a given pathway, estimating the benefits and costs is a challenging exercise, particularly given the considerable uncertainty attached to estimating the avoided damages arising from the inspection process. In addition, the types of decisions policy-makers and regulators need to make in the sphere are complex, given the department needs to be consider allocating its limited budget across the range of pests and diseases, likely entry locations and types of inspections. Other pertinent methodological challenges include:

- how to value the benefits of an inspection of a plant-product when it is carried out to detect multiple pests;
- how to value avoided damages when inspectors are unsure of which pests and diseases they will find;
- how to determine the likely location of a pest or disease establishment in order to calculate avoided damages; and
- accommodating that not all pests are 'pathogens', as some are 'contaminants'.

A range of tools are available to the department which could be used to assist with gauging the consequences of biosecurity risk material leaking into the environment. Cacho and Hester (2013a, b) provide a spreadsheet tool whose intended use is to assess the value of containment and eradication, but which could be easily used to calculate the costs of inspections and avoided damages from preventing new incursions. In some more involved situations, a detailed spread model considering the heterogeneity of the pest's habitats and the geographic spread of host crops may be needed. In assessing the potential consequences of leakage, the department can also leverage the tools it has available to inform resource allocation decisions in its biosecurity inspection regime. These include:

- the Risk Return Resource Allocation (RRRA) model. This recently developed model allows exploration of the effect of alternative biosecurity control scenarios (e.g. border inspection, pre-export certification and stakeholder engagement), with their associated costs, on the management of biosecurity risk. The model currently describes around 60 entry pathways by which the organisms of biosecurity concern can enter Australia and more than 130 pathway-specific biosecurity controls;
- the Emergency Plant Pest Response Deed, of which the Department of Agriculture and Water Resources represents the Australian Government as a party to the deed, which categorises plant pests into one of four categories which are a measure of the public versus private benefit of eradicating them. The categories also reflect the relative cost-sharing of affected industry and governments in the event of an incursion (http://www.planthealthaustralia.com.au/biosecurity/emergency-plant-pests/pest-categorisation/);
- the Department's risk estimation matrix,[31] which provides a qualitative tool for assessing biosecurity risks based on assessments of likelihood (ranging from remote, at less than 10 per cent probability of occurring, to almost certain, at greater than 80 per cent probability of occurring) and consequence (ranging insignificant to catastrophic); and
- information about the pests and diseases likely to be associated with particular pathways, and an understanding of the likelihood of these biosecurity risk material spreading if they were to arrive in Australia. This could be drawn from the department's internal scientific expertise our available from a range of external bodies, such as the CSIRO, scientific researchers in Australian and overseas universities and national plant protection organisations (NPPOs) in other countries.

4.3.3 Stakeholder costs of undergoing inspection

It is also important to value the costs and benefits that import-supply chain participants, particularly importers, face from changed inspection regimes. Depending on the pathway, changes in the inspection regime may change:

- delay costs from changes to the time taken by the inspection process;

[31] The risk estimation matrix plays an important part in defining Australia's Appropriate Level of Protection (ALOP) under Article 5 of the SPS Agreement (see Australian Government Department of Agriculture, 2015). Section 5 of the *Biosecurity Act 2015* defines Australia's ALOP as "a high level of sanitary and phytosanitary protection aimed at reducing biosecurity risks to a very low level, but not to zero".

- the cost of storage at the port and/or inspection facility;
- transport costs; and
- third-party costs that change as the need for physical inspection changes.

Of current interest to the department is the potential savings in regulatory burden on biosecurity system stakeholders when their consignment is not inspected, given this is the focus of the Compliance-Based Inspection Scheme (CBIS) which currently operates for select plant-product pathways.[32] Such information can assist the department in reporting against their contribution to the Australian Government's deregulation agenda (Australian Government Department of Agriculture, 2015b). This type of information also forms one of the crucial parameters to use in Rossiter and Hester's (2015) model to calibrate the choice of appropriate parameters for continuous sampling plan rules to a particular pathway.

Discussions with stakeholders as part of this project identified a number of aspects from which regulatory burden savings could accrue, primarily to importers and customs brokers. Depending on the pathway, these savings could include:

i. direct inspection costs charged by the Department;
ii. the opportunity cost of time for the importer to attend the inspection (or attendance fees paid by the importer to the broker if they attend the inspection on their behalf);
iii. the opportunity cost of time for the broker/importer booking the commodity in for inspection;
iv. the opportunity cost of any product destroyed during/rendered unsaleable resulting from inspection;
v. additional storage costs associated with delays with booking in for and completing the inspection;
vi. additional transport costs associated with taking consignments to/from an inspection point (e.g. Quarantine-Approved Premises) for inspection;
vii. savings resulting from holding lower inventories by business (e.g. lower rental expense from storage at depots/warehouses) due to reductions in the amount of time required to get the product to market; and
viii. improvements to product quality at the point of sale for products with a limited shelf-life.

For each pathway, the estimated regulatory burden savings can be estimated by working out the savings per consignment (or line item) based on the above avoided cost dimensions and then multiplying this by the number of consignments not inspected on a particular pathway.

All of these regulatory savings parameters would have to be "guessed at" in the first instance. Estimates for each component could then be validated and refined through consulting with affected firms to indicate whether the cost savings were reasonable or through interrogating the department's own administrative data sources. From the regulatory perspective, cost items i) to vi) are likely to be the most relevant and less contentious. The last two aspects of regulatory burden savings are likely to more difficult to quantify and lend themselves more to being included as part of a

[32] As at 10 November 2015, 17 plant-products were eligible for reduced intervention based on past compliance under the CBIS (http://www.agriculture.gov.au/import/goods/plant-products/risk-return).

qualitative assessment of the benefits of reducing intervention on plant-product pathways.

The discussion below illustrates how the regulatory burden savings can be built up from the components of cost items i) to vi).

Direct inspection costs

The average time spent on inspections per consignment for a given pathway is available from the department's administrative databases. This component of the cost of being inspected can then be estimated at the current applicable charge-out rates at the time the evaluation is conducted.

Inspection attendance costs

Whether this cost is relevant will depend on the pathway, as sometimes the customs broker or importer will be required or advised to attend the inspection. As a crude estimate, an off-site inspection could add an extra 30 minutes to an hour to allow for travel time for the importer or their customs broker to attend the inspection and added to the average inspection time for a consignment on the pathway. A default calculation could be for this opportunity cost, given the time attending the inspection could be spent by the importer or customs broker in activities that would increase their business's profitability. The opportunity cost could be valued based on a default hourly wage rate (inclusive of on-costs) for a professional or manager. Based on the Victorian Government's Time-Cost Calculator[33] for regulatory change measurements and regulatory impact statements, a rate of around $100 per hour would be appropriate.

Inspection booking opportunity costs

To estimate this cost, the department would need to consult with customs brokers and importers would be required to estimate of the time taken to book in an inspection through the department's system. As an initial guess, a figure of 10 minutes could be used, taking into account that importers and customs brokers noted consignments frequently needed to be re-booked into the inspection process due to delays beyond their control. The value of the opportunity cost of time associated with booking inspections could then be calculated using the wage rate discussed above for calculating inspection attendance costs.

Goods destruction/unsaleable goods opportunity costs

Whether this cost is relevant will depend on the nature of the goods involved. It may be possible to proxy for these costs by estimating the costs of the additional items importers need to bring into the country to cover goods destroyed or made unsaleable as part of the inspection process. Sometimes this will be something that occurs only for the occasional consignment, as may be the case with vegetable seed imports being tested for viroids; in other cases, each consignment may be affected, such as with the inspection techniques used to assess cut flowers for biosecurity risk material. Details on the consignment invoices presented to the department as part of the documentation checks could be used to estimate this cost.

[33] See http://www.dtf.vic.gov.au/Publications/Victoria-Economy-publications/Victorian-guide-to-regulation for a description of the methodology and Excel spreadsheet for calculations.

For example, with 600 units of cut flowers, the inspection process often renders those stems unsaleable. If each stem costs the importer 10 cents to purchase from the supplier, then the importer would save $60 in expenses is a consignment of cut flowers was not subject to inspection.

Storage cost savings

There are two main components of the information required to estimate the storage costs saved, namely:

- estimates of the time saved (in days) in storage by avoiding inspection; and
- estimates of the daily charge for storage at the QAP or port facility.

For example, green coffee beans importers interviewed as part of the project suggested that avoiding a physical inspection typically saved one to two days in storage for a consignment. Intelligence from stakeholders gleaned through the consultation process also indicated that storage charges were typically between $80 and $130 per day for a full-container load consignment. Assuming an average of 1.5 days saved in storage at a daily rate of $100 would imply regulatory burden savings of around $150 on average per consignment not subject to a physical inspection on the green coffee beans pathway.

Transport cost savings

For this cost component, the department will need to compare the difference in costs of transporting the goods:

- from the port to the importer's depot (by avoiding inspection); and
- from the port to the inspection point and then from the inspection point to the importer's depot.

Direct estimates of the differences in costs associated with this component were not gleaned from stakeholder interviews as part of this project. Estimates of these types of costs may be best tested with customs brokers and transport operators, including freight forwarders.

5. Broad Themes from Stakeholder Interviews

As highlighted in Chapter 3, biosecurity system stakeholders are an important source of information when considering how to design intervention protocols that encourage import-supply chain behaviour consistent with government biosecurity objectives. The information that can be obtained through such processes is largely qualitative, supplementing the quantitative information available through administrative data. Such discussions can highlight aspects that can point to the potential success of incentive-based protocols on the pathway, such as the influence of importers in the supply chain, available mitigation options and the costs involved in meeting current biosecurity requirements. Stakeholders' suggestions on how the system could be improved, both in supporting biosecurity outcomes and reducing the burden on regulated entities, are reflected within this discussion.

Members of the project team interviewed 43 stakeholders over June to September 2014 from six case-study pathways:[34] green coffee beans; peat; vegetable seeds for sowing; cut flowers; dried vegetables; and plant-based stockfeed.[35] The majority of interviews were completed over the phone, with around one-third of interviews conducted in-person in Melbourne.

The principal focus of the interviews was to speak with importers and customs brokers, with the aim of interviewing at least three importers and three customs brokers on each case-study pathway.[36] Industry associations and Australian-based suppliers were also consulted where possible. Project team members also met with staff in the department's Rosebery office and at Quarantine-Approved Premises in Sydney and Melbourne to understand the system's operations from their perspective. Findings relating to changes that may improve the efficiency and effectiveness of the biosecurity system interventions drew on both stakeholder and departmental feedback.

5.1 Import-supply chain relationships

While administrative data through AIMS can provide evidence of commercial relationships between parties in the import-supply chain, stakeholder interviews enable a greater understanding of the reasons why such relationship structures are chosen. From a biosecurity perspective, both the forms of import-supply chain relationships and what motivates them influence the types of actions importers may be able to perform in response to different interventions or incentive structures. This can affect the suitability of pathways for trialling protocols and their likely effectiveness in encouraging changes in relationships or behaviour through the import-supply chain.

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34 The six case-study pathways were selected by the project team, in consultation with the department, based on the characteristics of the products and a preliminary analysis of administrative data collected for thirteen candidate pathways put forward by the department.

35 The interview period coincided with the rolling out of the department's National Service Delivery Model for document assessment, quarantine fee increases and the consultation on new biosecurity requirements for carrot and celery seeds in response to the biosecurity risks posed by *Candidatus Liberibacter solanacearum*. (http://apps.daff.gov.au/icon32/asp/ex_topiccontent.asp?TopicType=Quarantine+Alert&TopicID=26274.). This meant that issues around document assessment, the timing of departmental communications and emergency risk responses were some of the items raised by stakeholders.

36 This was met in each pathway, except for plant-based stockfeed, where only two customs brokers were interviewed.

5.1.1 Importers and customs brokers

Analysis of the inspection data suggested the majority of importers chose to use a customs broker external to their organisation for their quarantine clearance requirements. More than half of importers chose to use only one broker, while the remainder used more than one. This pattern of broker usage was confirmed through the stakeholder interview process. Importers interviewed as part of this project pointed to commercial or operational reasons, such as particular brokers having greater experience with certain ports or freight methods, as to why they chose to use more than one broker.

Both importers and customs brokers interviewed for this project suggested that external customs broking relationships tend to be long-term, with several interviewees reporting associations of more than two decades. Very few importers interviewed reported switching their customs brokers in the past five years.[37] Several importers discussed the adjustment costs associated with getting a broker familiar with the importer's business operations and understanding the products they imported as some of the reasons behind why switching was so rare. Importers cited that their choice of broker was influenced by factors including:

- the cost of brokerage services;
- good service, such as providing timely responses on the status of consignments, attention to detail and the ability to deal appropriately with errors or issues in the clearance process;
- reliability in the provision of services;
- ability to operate in particular locations across the globe;
- knowledge of the product and associated quarantine procedures; and
- understanding the importer's business model.

Importer and customs broker interviewees noted that the relationship between the respective parties was usually informal and based on trust, with few cases of formal contracts between the parties.[38] Customs brokers tended to be engaged by importers just through a letter of authority, which allowed them to act on behalf of an importer during the customs and quarantine clearance processes until revoked by the importer. Some importers engaged customs brokers per consignment or per time period. In a couple of cases, customs brokers were engaged via a third-party freight forwarding firm, which resulted in limited direct contact between the importer and customs broker.

The exception to using external customs brokers was the cut flowers pathway. Some of the importers interviewed on that pathway chose to employ accredited customs brokers as part of their business operations. Importers with in-house brokers stated that this reflected the sizeable number of shipments received by cut-flower importers each week and perceptions that in-house brokers improved the timeliness of information about where consignments were at in the clearance process.

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37 Limited switching of customs brokers was also supported by the administrative data examined as part of this project.

38 Feedback from customs brokers suggested that contracts were mostly used by larger importers who put their customs broking service requirements out to tender every few years.

5.1.2 Importers and suppliers

Stakeholder interviews confirmed broadly four types of supply-chain models, namely:

- vertically integrated relationships, where the importer exclusively (or almost exclusively) sells products from one supplier and effectively operates as that supplier's Australian subsidiary;
- importers who are independent operators but choose to source their product directly from one or only a few key overseas suppliers;
- importers who dealt with a handful of overseas supplier contacts, say one in each major country or region of origin (henceforth referred to as aggregators), whose role was to facilitate the access of Australian-based importers to a range of products from a network of suppliers in the exporting country or region and coordinate the exporting of these goods to Australia; and
- importers who source products from a large number of independent suppliers through direct contact with those suppliers. In some cases, the number of active suppliers used by importers within a 12-month period was as high as 80.

According to importers who adopt vertically integrated supply chains, advantages include improved communication as well as greater control of production processes through the system. These importers were dealing with specialty products within the pathway and needed security of supply, in addition to requiring consistently high quality products.

Importers who sourced from only one or a few key suppliers either had limited suppliers to choose from because of the nature of the product, or there were only a small number from those (sometimes high number) available who could meet quality and cleanliness standards required.

Importers that sourced from a large number of suppliers cited supply continuity, maintaining product quality and satisfying particular customer demands for the range of different products within the pathway (e.g. cut flowers and green coffee beans) among the reasons for choosing this type of supply chain.

Some importers used aggregators for historical reasons, but they were mostly used when importers were large and required multiple goods from a range of countries. It was most cost-effective to deal with one supplier in each country who could fill a large order from a range of local suppliers. This was particularly the case for importers of cut flowers and green coffee beans.

Suppliers were engaged by importers both with and without formal contractual agreements. In both cases some of the arrangements involved an exclusive right to distribute the product in Australia, and this applied over a range of pathways. Some vertically integrated importers even engaged suppliers through commercial agreements, since they operated as separate business units within a larger corporate entity. Contractual arrangements often specified dimensions over quantity, product quality and delivery standards. Some importers also included Australia's biosecurity requirements as part of the contractual terms and sent permit conditions to the supplier as one way to ensure compliance.

A number of factors influencing the choice of suppliers were common to all pathways. In order of importance these were product quality, the ability to consistently supply the particular quantity required, adherence to industry standards, biosecurity considerations and price. For some industries, including peat and

vegetable seeds, importers chose to restrict their focus to industry-accredited suppliers or members of an industry body that shared common standards. For particular pathways, timeliness of supply (cut flowers), good communication (cut flowers), labour practices and political stability in export country (green coffee beans), were also mentioned as factors considered when choosing a supplier.

5.2 Information and financial flows

Because of the nature of commercial agreements, an understanding of what information and financial signals pass between different participants in the import-supply chain is usually not directly observable to outside parties. Discussions with stakeholders can reveal broad information about the nature of information and financial flows between participants. Importantly, these types of flows can demonstrate how influential importers can be in addressing biosecurity concerns, their willingness to act in response to inspection failures and their knowledge of the costs involved in meeting biosecurity requirements under different outcomes.

5.2.1 Importers and customs brokers

All importers using external customs brokers noted that information about the status of consignments at various points throughout the importing process was provided in a timely manner and that there was a free flow of information. The level of communication is influenced by the interests of the importer and the pathway. Some importers receive frequent updates because of tight turnaround times for their consignments, while others simply want to know when the product is cleared and ready for collection. When products were cleared at Quarantine-Approved Premises the importer was provided with information on clearance before the customs broker. Most communication between importers and brokers is through email or tailored software packages provided by their brokers, though some importers also receive verbal briefings in advance of official communications from their customs brokers.

Customs brokers relayed information to importers about delays, testing or treatments associated with their consignments, or whether additional documents are required for clearance. Some customs brokers also told importers about quarantine procedures or charges change or when import permits are due for renewal. Occasionally, customs brokers may also contact the product supplier if a consignment needs treatment or re-export.

All customs brokers provide importers with fully itemised invoices for each consignment. These invoices separate out customs, quarantine and broking charges, together with any associated charges, such as freight, terminal and storage charges. A consequence of this is that importers have a good understanding of their quarantine-related charges, including document assessments, inspections and for any treatments required.[39]

5.2.2 Importers and suppliers

Many of the importers interviewed by the project team noted open and frequent communication with suppliers, with communication most frequent in the cut flowers, green coffee bean, peat and plant-based stockfeed pathways. In addition to email and

[39] From this project's perspective, the separate identification of quarantine-related charges is critical for allowing importers to understand the direct costs associated with current biosecurity protocols.

phone contact, importers of peat, cut flowers, vegetable seeds and green coffee beans made regular visits to production areas to understand their suppliers' production systems first-hand.

Importers in a number of pathways, including peat and vegetable seeds for sowing, noted the commercial value of a reputation for delivering a product that was free of biosecurity risk material.[40] This means both suppliers and importers were keen to understand the reasons for failing inspection so processes and procedures could be improved. Across the case-study pathways, notifying suppliers about quarantine inspection failures was routine, with reasons for failure or delays, often relayed to suppliers by importers.

In most cases, importers had a good understanding of who would bear the cost of quarantine inspection failures, even if this did not feature in a commercial agreement. Who paid for the failure often depended on the reason for a consignment failing inspection, though importers were able to outline several scenarios under which suppliers would wear the financial burden of failure.

5.3 Biosecurity awareness

The vast majority of interviewees understood the imperative for a strong biosecurity system and many suggested how the entry of a new pest or disease could affect their businesses. Consequently, importers' awareness of how biosecurity concerns can be addressed and their knowledge of the system can influence their choice of actions. As in the previous section, this type of qualitative intelligence is not available without speaking directly with those who can influence that decision-making process in importing businesses.

5.3.1 Risk mitigation potential

In part reflecting good communication between importers and suppliers, many importers understood ways in which their suppliers sought to reduce the likelihood of biosecurity risk material being present in their consignments. These measures included:

- carefully inspecting raw materials for contaminants at the point of delivery;
- developing control systems in processing facilities;
- choosing transport arrangements that lowered the risk of post-production contamination, such as putting production facilities close to the port or ensuring containers go in particular parts of the vessel;
- preparing shipping containers to reduce contamination during transit from moisture, dust or other container contents;
- pre-shipment testing as part of an established quality assurance mechanism; and
- applying treatments such as chemicals to products pre-departure and on arrival in Australia.

For some pathways, importers understood it was incredibly difficult, if not impossible, to remove biosecurity risk material for some consignments. This was

[40] See Appendix C for a discussion the importance of reputation and its ability to provide additional incentives for compliance with biosecurity requirements.

particularly the case for some types of cut flowers, including roses. Furthermore, strategies used overseas for reducing the likelihood of biosecurity risks, for example adding biocontrol agents such as "good" mites to boxes of flowers to remove other insects, was itself likely to result in failing inspection if some mites were alive on arrival in Australia.

5.3.2 Finding information about biosecurity protocols

Importers used a range of information sources to understand biosecurity protocols or changes made to them. For more than half the importers interviewed, their customs brokers were the source of information on conditions for importing products. Several importers consulted the department's website and/or the import conditions database, ICON, and in two cases importers received notification from the department of changes. Those that did not rely on customs brokers or the department's website found information from automated alerts, other stakeholders including industry organisations, conversations with departmental staff in Canberra (in Plant Import Operations) or by chance. In one instance, an importer first heard of a change to biosecurity protocols through their supplier.

Most customs brokers saw keeping up-to-date with biosecurity protocols as a core part of their business. In addition to consulting ICON, subscribing to the department's industry notices, searching the department's website, attending seminars organised by industry bodies, and notices from the Customs Brokers and Forwarders Council of Australia (CBFCA) were seen as key sources of information.

5.4 Biosecurity system experiences and system enhancement options

Part of the stakeholder engagement process related to the experiences of importers and customs brokers with current biosecurity protocols. Of particular interest to the project team was stakeholders' perceptions around why consignments typically failed inspections and the costs of complying with protocols and of failing inspection. This type of information differed considerably between the case-study pathways and was discussed separately with the department, in part due to confidentiality concerns.

The discussions also highlighted some aspects of the system that could be enhanced to enable improved compliance and/or reduce the costs to import-supply chain participants. The types of options relate to two broad categories – communication and service delivery – which are discussed below.

5.4.1 Department communication with stakeholders

Many importers and customs brokers expressed concerns around the way the department provided updated system information to stakeholders. A particular concern among several importers was that information on protocol or fee changes was often received very late, with some only hearing about changes after they were implemented.

As many importers appear to rely on customs brokers for advice about biosecurity requirements, adopting targeted communication to licensed customs brokers could increase the effectiveness of disseminating information about system changes. Customs brokers perceived that industry associations representing customs brokers and freight forwarders, namely the Customs Brokers and Forwarders Council of Australia and the Australian Federation of International Forwarders, could be more

actively used by the department in consulting with importers on changes and protocols. Industry associations whose membership includes importers may also be a source of further engagement around protocol changes.

Expanding communication channels to improve protocol awareness

To assist the department when amending protocols or preparing for system changes, consultation and notification processes could routinely include:

- licensed customs brokers and their peak bodies; and
- industry associations for which pathways where importer clients represent a significant share of their membership. Such organisations could be identified through discussions with high-frequency importers on the pathway.

For changes on pathways not subject to permits, administrative data could be used to identify importers who have brought in consignments on that pathway in the previous 12 to 24 months to notify them of changes.

There may also be the potential to link the department's administrative data on inspections as part of its communication strategy. As noted in Chapter 4, administrative data from AIMS can be used to identify importers and customs brokers who service particular pathways. The status of being a "current" importer or customs broker could be determined through a threshold, such as having brought in a consignment on the pathway in the past 12 or 24 months. Using administrative data in this way can augment the department's understanding of its likely audience for communications, expanding on information available through the permit system that applies on some pathways. Supporting a more active communication strategy may provide benefits to the department from reducing the time spent dealing with situations resulting from stakeholders lacking awareness of changes.

Widespread concerns among stakeholders around the timing of communications by the department could also be dealt with through better grounding the expectations of importers and customs brokers.

One approach to grounding stakeholder expectations could involve describing the types of circumstances under which protocols may be changed or refined, including the types of scenarios where risks are deemed too high to avoid immediate action. Explanations could draw on the scientific advice underpinning the department's actions and the department's risk assessment framework. Such an approach also has theoretical support, since import-supply chain participants have greater awareness of the system when choosing their preferred approaches to reducing the likelihood of biosecurity risk material being present in their consignments. Changes in processes in support of the biosecurity objective may be costly and the willingness of participants to invest in these technologies may be lower if changes to rules are not communicated adequately.

In cases where risk assessments suggest that protocol changes can be made without immediate effect, standardised notice periods are another way of grounding stakeholder expectations around changes. The Department already has a standard 30 to 60 day period before a change comes into effect. In situations where consignments may have already left their port of origin and are in transit to Australia, there may be merit in considering how to "grandfather" changes to accommodate these consignments to the new protocols. This reflects discussions with importers which confirmed that suppliers had the greatest ability to reduce the likelihood of biosecurity

contamination and provide documentary evidence relating to consignments. Introducing grandfathering arrangements could reduce adjustment costs for import-supply chain participants under the new protocols and improve their willingness to comply with future adjustments.

Preparing system stakeholders for protocol changes

The department could provide clearer guidance to biosecurity system stakeholders around the circumstances under which it may seek to make operational changes. This could encourage understanding by stakeholders in situations where the risk to Australia's biosecurity status warrants immediate response to potential risks.

Minimum time periods for notification of changes to protocols, fees and other arrangements where immediate redress is not deemed necessary need to be applied consistently. Transitional arrangements could also be clarified for consignments already in transit to Australia.

As noted earlier in this chapter, many importers acknowledged a willingness to ensure their products maintained a high biosecurity status as part of maintaining a reputation for clean products. Importers and their suppliers then valued information about why consignments failed inspection, so that they could investigate ways to mitigate them in future. However, a common concern was that information on reasons for inspection failures was either not provided by the department or was too general for importers and their suppliers to track down the potential source of problems. This was particularly the case for the cut flower pathway.

Importers provided several instances where they were able to provide feedback to suppliers that resulted in process improvements to reduce the likelihood of finding biosecurity risk material in consignments. Developing and implementing standards for providing feedback on pathway or quarantine failures to importers is likely to be an important step to encourage taking up opportunities to "clean up" the pathway. Making feedback a routine part of the physical inspection process, when combined with incentives for good compliance, is likely to encourage greater compliance, particularly if this fosters innovation on the pathways to further reduce quarantine-related costs.

Departmental officers noted that there were often difficulties in providing specific information to identify biosecurity risk material, such as identifying insects down to species level or assessing plant pathogens. Resource constraints, including the availability of specimens for diagnostic purposes, together with further effort in identification being unlikely to change the available treatment options for the consignment were seen as key drivers of this practice. While inspection samples are already made available in some circumstances to third parties for further diagnosis at the importer's cost, wider use of these provisions may support process improvements throughout the supply chain to mitigate biosecurity risk material being present in consignments.

Encouraging compliance through enhanced feedback on outcomes

To boost biosecurity compliance for future consignments, the department could:

- develop and implement standards around providing feedback to importers, either directly or via customs brokers, as to why consignments fail inspection. Standards may also relate to follow-up clarifying requests; and
- broaden options for allowing importers to undertake further investigation at their own cost with approved third-party organisations.

5.4.2 Department service delivery

A concern common across several pathways was the perception of importers and customs brokers of different standards being applied between officers and regions on both document assessments and physical inspections.[41] Interviewees suggested that this could reflect a lack of experience and specialist knowledge, with officers not understanding features of the commodities in some pathways. While judgement is important in the biosecurity assessment process because of the potential for ambiguities, from a theoretical standpoint, perceived inconsistencies by import-supply chain participants could undermine efforts to boost compliance by decreasing the expected benefits of introducing new processes or technological solutions to reduce contamination.

The department's National Service Delivery program goes some way to addressing concerns about potential inconsistent application of protocols and assessments. In terms of document assessments, a feature of the department's Cargo Online Lodgement System (COLS), currently in trial phase, is its use of triaging to separate document assessment categories based on complexity. This approach allows for accredited and experienced entry management officers to perform particular pathways, which is likely to improve consistency for more complex assessments.

Triaging practices may also be useful in the physical inspection process. To the extent that specific skills or judgement is required for particular pathways, allowing for different levels of accreditation and training officers to complete inspections of certain pathways is likely to result in a more standardised approach to inspections. This can provide greater certainty to import-supply chain participants about the way in which their performance against expected outcomes is to be assessed.

Enhance use of triaging for promoting service consistency

To accommodate specific features and complexities in certain pathways, triaging could be used to ensure pathways inspection and entry management officers with specialist knowledge and experience can assess or inspect consignments of particular types.

Another feature that COLS addresses is reports from customs brokers around receiving different responses from different entry management officers through the centralised document email system. These responses, together with the perceived lack of ownership of requests and the inability to contact officers directly to resolve issues

[41] See Appendix C for a more extensive discussion of the implications of procedural justice and other notions of fairness on stakeholders' attitudes to compliance.

promptly, led to delays in document clearance processes. Several brokers contended that these delays and multiple communications significantly impinged on system efficiency.

COLS provides for direct ownership of document cases through its allocation mechanism, which means that follow-up requests are routinely processed by the initial officer. Such mechanisms allow for greater accountability on operational staff and could also allow officers to understand alternative options to resolve issues, such as direct phone contact with brokers, to explain or highlight issues to be resolved.

This type of approach represents one way in which the department's credibility as a regulator can be improved. Another option would be to develop, publish and report against service standards so that import-supply chain participants have expectations around responsiveness to requests. Together with providing additional information to importers on their performance against others in the system, this approach could highlight benefits that could be obtained by importers from encouraging more effort throughout their supply chain to reduce the likelihood of biosecurity risk material being present in consignments. Such standards may also be helpful for the department in determining resource allocation across border interventions.

Encourage mechanisms that increase regulator credibility and accountability

To ground client expectations around service delivery, the department could investigate developing performance indicators. This could also serve to demonstrate the benefits of stakeholders having a good compliance record.

The department could also encourage the adoption of measures to enhance the ownership and accountability of officers in decision-making, including judgements around how to resolve issues to minimise departmental and stakeholder costs from compliance.

In addition to the benefits described above, this may also assist the department deal with perceptions that officers are not cognisant of the costs of compliance imposed by parts of the system on their stakeholders.

Several importers raised concerns around situations where current mandated measures added significantly to compliance costs without, in their opinion, a clear link to a biosecurity outcome. Stakeholders could also not comprehend the reasons as to why some directions, such as a different class of inspection, were instituted in different circumstances, nor the results of some inspection outcomes.

These types of concerns have both communication and service delivery implications for how the effectiveness of biosecurity system operations could be improved. Part of the strategy to deal with stakeholder concerns may be to explain the purpose of particular intervention measures in terms of the biosecurity concerns they seek to address and highlight what assessors and inspectors are looking to rule out as part of these measures. For example, inspectors may be looking for evidence of contamination, infestation or anomalies in the particular product which may require further investigation to determine if they represent a risk for biosecurity. In addition, the department could also seek to address stakeholder concerns around unexpected directions through highlighting the interdependencies between various requirements, such as whether a consignment is being transported to a rural or urban destination.

Another option that may achieve similar outcomes is for the department to promote the option of importers, their suppliers or industry groups seeking to demonstrate measures that are equivalent in addressing biosecurity concerns as those stipulated by the department. Equivalent measures could encourage innovation in the pathway and reduce compliance costs along the pathway while meeting the ultimate objective of maintaining Australia's favourable biosecurity status. Such assurance measures would need to be backed by scientific evidence or demonstrated through equivalence of outcomes through more intensive monitoring at the border. Examples of measures could include using existing industry-based standards or certification schemes to meet some of the biosecurity controls sought by the department. Forms of equivalence, such as compliance agreements, are already available to importers, particularly through the department's Imported Food Program. However, greater promotion of these could lead to industry cost savings and boost industry understanding of Australia's biosecurity priorities.

Build awareness of the purpose of interventions and of system rules

To encourage a greater understanding by stakeholders of the range of interventions used, the department could provide additional information on:

- the biosecurity concerns which interventions are designed to address;
- the types of features assessors are investigating and have been trained to look for intervention processes; and
- the key interdependencies between rules which may affect the types of interventions to which consignments might be subject to meet biosecurity assurance requirements.

Promote investigation of equivalent measures

To encourage industry-based innovation approaches to biosecurity and to reduce compliance costs, the department could promote import-supply chain stakeholders proposing equivalent measures to assist in addressing biosecurity concerns.

6. Testing and Implementing Incentive-based Intervention Protocols

CEBRA Project 1304C laid the groundwork for the Department of Agriculture and Water Resources to develop a greater understanding of how biosecurity intervention protocols could be modified to improve compliance on plant-product pathways. The main goal was to better understand the theoretical issues around protocol design using the incentive structures inherent in regulatory interventions to encourage mitigation activity through the import-supply chain.

The next stages of the process involve testing how well such protocols might work, both in controlled environments (CEBRA Project 1404C) and in the field (CEBRA Project 1608C). Such activities seek to determine the protocol changes that are most effective in maintaining Australia's biosecurity status while reducing the costs of regulation. This chapter considers the objectives of testing protocol changes, the steps involved in proceeding to a field trial and determining how the success of the field trial can be evaluated. It closes by noting some important decisions the department will need to make around field trial operations.

6.1 Objectives from rolling out incentive-based intervention protocols

The principal aims for the department in trialling protocol changes are around identifying approaches that:

- further reduce the approach rate of consignments containing biosecurity risk material;
- encourage importers and/or their suppliers to modify their behaviour in ways that support preserving Australia's favourable biosecurity status;
- reduce the regulatory burden for system stakeholders who demonstrate a compliance record consistent with good biosecurity practices; and
- assist departmental resources to be reallocated from lower-risk pathways to allow the department to focus on pathways where the consequences of incursions are greater.

6.2 Experimental testing

Economics experiments provide a controlled, and somewhat "safe", environment which can be used to examine the effects of particular incentive and information structures on behaviour. While economic theory and intuition provide predictions about how importers are expected to react under different protocols, economic experiments can be constructed as a test-bed to measure the effects of different *experimental treatments* on the behaviour of participants. Importantly, experiments can examine how incentive and information structures may interact to change decision-making of experimental subjects.

Experiments are normally run in computer laboratories, seating up to 20 participants at a time and lasting up to half a day. Experiments are typically run across multiple sessions to assess the influence of different experimental treatments. In most cases, the participants are university students who are provided with monetary rewards that are designed to mimic the incentives of import-supply chain participants. Those who perform better in the experiments would therefore receive greater financial reward.

Treatments could involve different inspection rules, levels of information about inspection rules, cost structures, supply-chain structures and/or access to different technologies. Participants could represent importers needing to decide what types of technologies to use to reduce biosecurity concerns and any effort to put into cleaning consignments. It may also be of interest to examine how robust importers' decision-making is to having access to different types of information and potentially different market structures.

Economic experiments are typically analysed using statistical methods that enable direct evidence of the effects of different treatments to be compared, holding other factors fixed. These insights around protocol effectiveness, and how they concord with theoretical predictions, can provide evidence to support the department's decision-making around the types of protocols that may be worthwhile to trial in the field.

6.3 Field trial candidate pathways and suggested protocol changes

6.3.1 From the laboratory to the field

To achieve relatively "clean" measures of the treatment effects, the experimental environment abstracts from considerations that may be of practical importance. This includes features of the import-supply chain, such as the nature of established relationships between import-supply chain participants, the degree of importer influence over biosecurity concerns, awareness of biosecurity issues and uncertainty of outcomes. These other influences on behaviour not accounted for in the experimental context could result in different protocol changes having behavioural outcomes in the field from what was realised in an experimental setting.

In a practical sense, it is also difficult to develop interventions that perfectly suit a given plant-product pathway. This reflects the considerable differences between pathway participants and that the department does not have all the information required to determine how individual participants would behave in response to potential interventions.

Field trials of this type may also present risks to the department, since the behaviours fostered through the new protocols could undermine the Australian Government's biosecurity objective. Strategies to mitigate this type of action include careful design of the protocols to be tested experimentally, rigorous analysis of the experimental results, consultation with candidate pathway stakeholders as well as selecting pathways for the field-trial phase that possess control mechanisms or other features likely to limit downside risk to field-trial outcomes.

6.3.2 Recommended field trial pathways

The choice of which pathways are most suited to a field trial depends on multiple considerations that present significant trade-offs for the department. Pathways with higher approach rates for biosecurity risk material or those with greater variation in approach rates between importers, suppliers and/or countries of origin could enable the department to better measure import-supply chain participant responses to changing biosecurity intervention practices. However, this must be weighed against the potential consequences of biosecurity risk material entering Australia and resulting in pests, diseases or microorganisms becoming established. The potential for

the trialled protocols to raise the likelihood of biosecurity risk material entering the country must also be considered. This reflects:

- the practical difficulties in calibrating intervention protocols precisely, given the uncertainty around key cost parameters for importers;
- results from Rossiter and Hester (2016) that suggest CSP family rules can induce importers to raise the approach rate for biosecurity risk material in the "monitoring" phase of these algorithms; and
- reducing intervention at the border without increasing pre-border intervention or improving the effectiveness of border inspection activities when completed will unambiguously raise the likelihood of biosecurity risk material leaking into the Australian environment.

In needing to balance these trade-offs, the project team understood the department's desire to demonstrate these protocols successfully on lower-risk pathways first. Once these types of frameworks were embedded within the department, the more ambitious goal of rolling this out on pathways with higher approach rates and/or higher anticipated costs of leakage could then proceed. This resulted in pathways with relatively low approach rates for biosecurity risk material under the current 100 per cent inspection scheme considered more appropriate candidates, while acknowledging the impact this preference would have on the ability to measure behavioural responses to protocol changes.

Based on the considerations above and supported by the analysis on individual pathways, the project team recommends pursuing changes to biosecurity interventions on subsets of the *peat* and *vegetable seeds for sowing* pathways in the field trial phase of the project (CEBRA Project 1608C). Both of these pathways have one or more desirable qualities for field testing, including:

- willingness by industry in engaging with the department, as demonstrated through the stakeholder interview process;
- established industry self-regulatory or quality-assurance schemes that can provide assurance around biosecurity outcomes;
- evidence of importers and suppliers valuing their reputation of bringing plant-based products into Australia that are free from biosecurity risk material;
- evidence of consistent communication between import-supply chain participants around the biosecurity status of products; and
- technological and other system processes that can reduce the likelihood of biosecurity risk material entering Australia.

In addition to these characteristics, successfully implementing compliance-based protocols requires the pathway to be defined clearly around common types of biosecurity risk. For example, it would not be optimal to apply the same protocol to all vegetable seeds for sowing, because certain types of seeds potentially carry different diseases that have different consequences for industries and the environment. It would be more sensible to define separate pathways for different types of seeds. The definition should also be constructed to avoid the potential for inadvertent misclassification of products, with follow-up commodity profile questions used where appropriate. This scope of the definition needs to be understood by all parts of the import-supply chain as well as the department to ensure appropriate application for field trial protocols.

6.3.3 Potential protocol changes – Peat

Peat is the dead material that accumulates in the lower levels of a peat bog at a depth of at least two metres. The countries which produce this product tend to be from cooler climates and include Europe (both continental and the British Isles), Canada and New Zealand. It is one of the three major product types defined using the tariff code 2703 *Peat (including peat litter), whether or not agglomerated* from the HS tariff nomenclature.

The peat pathway is suitable for trialling compliance-based inspection protocols because:

- there are a sufficient number of consignments on the pathway, and inspection failures, that may allow for an informed assessment of whether outcomes have changed in a pilot period;
- there is a reasonable degree of variation in pathway failure rates between importers, suppliers and countries of origin;
- the pathway includes a mix of supply-chain structures;
- several alternative suppliers and/or countries of origin appear to be available to firms which are not vertically integrated;
- storage and transportation costs associated with inspections appear to represent a sizeable share of the cost of consignments for at least some importers;
- the direct and indirect costs of rectifying consignments found with biosecurity risk material are high relative to the product's value;
- there are established commercial incentives, such as having access to markets and insurance, from suppliers gaining accreditation through the RHP scheme (for which biosecurity risk mitigation is one component) for their products;
- several suppliers have production processes where biosecurity risk mitigation features are embedded into their systems and are difficult to circumvent; and
- several importers and suppliers seem to place a high weight on their reputation for product quality, including it being free from biosecurity risk material, which provides a strong incentive to comply with biosecurity requirements.

Potential changes to inspection protocols are listed in Table 2 and are

i. a change to pathway definition by either changing the tariff codes for peat, sphagnum moss and coir, defining a separate peat protocol according to country of origin, or adding commodity profile questions to the required documentation;
ii. implementing a continuous sampling plan algorithm by importer, supplier, or importer-supplier pairing;
iii. offering a 'menu of contracts' where importers choose an inspection regime from a limited number of options; and
iv. changing the cost structure of importers by modifying their delay costs or the direct costs they face from inspection.

These options are designed to be applied in combination, with the 'menu of contracts' option drawing upon the other types of changes recommended in Table 2.

Table 2. Potential changes to protocols for peat

Treatment	Changes to protocol	Implementation notes	What would we learn	Impact and measurement
Change pathway definition (3 options)	1: Define separate biosecurity pathways for *peat*, *sphagnum moss* and *coir peat* through different tariff codes. While separate Import Permits exist for these commodities, they currently appear under the same tariff code.	1: These two pathways have distinct risk profiles. A formal import risk assessment would be required for the current peat pathway. Implementation time is likely to be 12 months.	1 and 2: Better distinctions based on administrative data for both pathways, to identify failure rates and the factors attributable to quarantine failures.	1, 2 and 3: Changed resource requirements for each pathway.
	2: Reduce inspection on imports from particular, low-risk countries. For example, condition a peat protocol if the country of origin has a temperate climate (e.g. Europe, Canada, New Zealand). Tropical countries (e.g. India, Sri Lanka) would be put on a "separate" identifier to which the protocol would not apply.	2: Administratively easier but some coir peat is sourced in tropical countries and processed in temperate countries. Differentiating by country of origin will not be able to separate peat and sphagnum moss products. There are also transhipping issues that could affect country of origin designation.	1, 2 and 3: Accurate information on biosecurity risk material detected in quarantine failures (and other consignments identified as incidents) and thus resource requirements for inspection on each pathway.	1, 2 and 3: Calculating cost savings to importers using AIMS data is difficult due to recording issues. Getting this information from importers directly through interview may be more reliable. (NB: This applies to all suggestions, as current AIMS IT architecture may inhibit good data on time and cost savings.)
	3: Commodity profile questions could be added as part of the documentation requirements to see if a consignment consisted entirely of peat.	3: This is likely to require broker and importer education. Consignments that were a mix of coir, sphagnum moss and peat would not be eligible for the pathway. Commodity profile questions do not currently interact well with the CSP-3 algorithm in the current IT system.		
CSP-3 and/or CSP-1 (3 options)	1: Recognise the importance of suppliers in biosecurity status of peat by including importer-supplier pairing in CSP-3 algorithm.	1: AIMS is currently unable to profile on more than one dimension. Implementation may require IT systems to be modernised to allow this, meaning this is something that could not be done quickly. 1, 2 and 3: Peat is not yet on CSP-3. DA has experience with how to change a protocol, but implementation of CSP-3 has not necessarily provided the incentive structures intended. 1, 2 and 3: Actual roll-out on CSP-3 needs to reflect the intention of the algorithm.	1, 2 and 3: The CSP-3 approach already has an incentive framework embodied in the rules. By designing the incentives within CSP-3, using economic principles and observing behaviour change, we would learn about the advantages of a more systematic approach to designing the rules of a risk-based approach to biosecurity systems. Fine-tuning the rules of a risk-based approach could yield large benefits if the incentives	1,2, and 3: Potential impact - Laboratory experiments would provide estimates of the potential improvements that can be gained from improved incentives structures within CSP-3. Experiments could also indicate what impact disclosure of information (e.g. monitoring fraction) has on importer behaviour. 1,2 and 3: Actual impact - A field pilot would test whether these potential gains (observed in the laboratory) are translated

	2: Implement CSP-3 by supplier 3: Implement CSP-3 by importer	2: Similar to IFIS approach and presents a clearer link with biosecurity risks inherent in the product. The incidence of "rewards" on importers may mean incentives offered are not as powerful when CSP-3 done on the supplier dimension alone. 3: Existing option for other pathways on CSP-3. Likely to be most easily implemented.	induce behaviour change prior to shipping. NB: CSP-type algorithms affecting the frequency of inspection result in both direct financial savings and reduced delay costs for affected importers.	to the real world given the added complexity of commercial operations. 1, 2 and 3: Calculating cost savings to importers using AIMS data is difficult due to recording issues. Getting this information from importers directly through interview may be more reliable.
Menu of regulatory contracts	Offer importers a menu of penalties and frequencies of inspection that are designed to be incentive compatible. i.e. each importer/broker chooses the setting that reflects their private information whilst maintaining the biosecurity objectives of the Department. The following three menu items are suggested: 1: ("Good importer") Implement CSP-1 algorithm, which has higher penalties for non-compliance than CSP-3. Use relatively high clearance number (e.g. 10), but low monitoring fraction (e.g. 0.2) as reward for demonstrated compliance. 2: ("Good importer who wants to reveal information about high biosecurity compliance") Implement CSP-1 as above, but offer additional inducement to importers of access to a priority booking queue for physical inspections. Access would be based on them documenting RHP certification for shipments (and traceability back to extraction source) as increased assurance around biosecurity practices. Eligibility for the priority queue would only be available through	This approach is used extensively in the insurance sector. It has potentially significant advantages to low-risk importers (and their suppliers), allowing them to choose the inspection regime that matches their (perceived) risk status. The regulatory task is not significantly greater with a menu of contracts – the main issue is with IT systems being able to record the regime which an importer has chosen. This may be difficult with the current system. Designing the menu of inspection protocols and associated incentives is the complex aspect of this approach. Initially, it would be advisable that there be only two or three options which importers could choose from. Protocols would also need to be developed as to when/how often importers could switch between regimes. Department would need to be comfortable about the extra assurance RHP certification offers as an indicator of peat's biosecurity "quality". Could be added concern for the Department if this were to be applied for consignments going to rural destinations. This might need to result in some modification to protocols to consider whether this protocol should just apply in the case of consignments eligible for (non-rural) tailgate inspections.	Private information will be revealed regarding: • the importer's beliefs about their own biosecurity status. It may be close to their actual biosecurity status in the case of vertically integrated firms, or where there is extensive contact between the importer and supplier based on their private information about the source and production practices of the firm; • the underlying biosecurity risks of these countries and regions; and • the scope for firms to minimise biosecurity risks. By encouraging importers/suppliers to reveal additional information about their "good" biosecurity status (e.g. through independent certification), it enables the Department to use other available information about biosecurity risks in a more strategic way to focus its effort on consignments with inherently higher risk.	Potential impact - Laboratory experiments would provide estimates of the potential improvements that can be gained from a menu of contracts approach. Actual impact - A field pilot would test whether these potential gains (observed in the laboratory) are translated to the real world given the added complexity of commercial operations. AIMS and Incident databases could be used to observe the level of switching between suppliers by importers. Interviews with importers should reveal the new mitigation technologies implemented.

	providing additional certification information. 3: ("Moderately compliant importer") Implement CSP-3 algorithm with moderate clearance number (e.g. 6) but high monitoring fraction (e.g. 0.5). Inherent penalty for failure is lower, but cost gains are also expected to be lower.			
Relative costs (3 options)	Change the cost structure faced by importers for inspection, to encourage/discourage preferred/not preferred behaviours. 1: Direct costs: Change the biosecurity charges faced by importers (e.g. inspection costs/time unit, document check) that are controlled by the Department.	1: Opportunities may arise to address costs to importers from the assurance process through fee reviews. The ability to change cost structures is constrained by the Commonwealth Government's Cost Recovery Guidelines, while the ability to impose direct financial penalties for non-compliance is restricted by Australia's international trade obligations. Future fee reviews could assess whether all current charge structures related to inspection accurately reflect the costs incurred. Any current cross-subsidies in the system could be affecting the incentives facing importers.	1: Information about industry cost structures could be revealed if the changes to fees and charges are material.	1, 2 and 3: Discussions with importers may be required to reveal the impact, particularly if there are additional mitigation steps undertaken by suppliers to limit exposure to more costly intervention at the border. 1: Stakeholder discussions indicate that direct biosecurity-related costs for some firms are small. If this is the case for most importers, fee changes on their own may not induce significant behaviour change.
	2: Delay costs: Use potential to reduce in time spent waiting for and/or undergoing inspection to encourage preferred behaviours by importers. This could be achieved through a priority queuing system.	2: Introducing a priority queuing system for booking inspections would likely require IT changes to integrate systems AIMS importer/supplier profiles with the booking system.	2: From stakeholder interviews, costs related to delays in inspection process seem to be important for importers. Information about impact of delay costs may be gleaned through willingness to improve compliance with biosecurity requirements.	2 and 3: The AIMS database may provide some (independent) evidence of the impact through reduction in throughput times. Augmenting this with information on storage costs from importers and/or ports would enable regulatory burden reduction savings to be estimated. Attributing causation to this aspect alone may be difficult, though with careful design of menu options (as above) this could be achieved.
	3: Change intensity of inspections (e.g. those with a good history of inspection and going to a rural destination may instead just undergo tailgate inspection for one container rather than all), which could contribute to reduced direct and delay costs.	3: Consignments destined for rural areas inherently pose a greater biosecurity risk. Option 3 may exceed the risk tolerance for the Department, making changes to inspection intensity on this pathway more difficult. Also see comments around excluding consignments that would require rural tailgate inspections from the menu of contracts above.	3: Could result in reduced time-based inspection costs for compliant importers, so might reveal similar information to changing direct costs for importers who tend to bring in multiple containers in one consignment. Has the added bonus of potentially reducing delay and transport costs for importers.	3: As per comments related to direct costs, fee changes themselves may not induce significant behaviour change. Could estimate any time-based savings through AIMS and stakeholder consultation.

Of the protocols listed in Table 2, the project team recommends that a menu of regulatory contracts be offered to importers on this pathway. The table suggests three menu items be available to importers,[42] these are to:

1 apply CSP-1, which has higher penalties for non-compliance compared to CSP-3, but with the rule parameters chosen such that those who demonstrate good compliance over a relatively large number of consignments are inspected at a low rate;
2 apply CSP-1 as above, but with a further inducement to reveal information on biosecurity practices, traceability and assurance programmes. The inducement could be in the form of a priority queuing system for physical inspections; and
3 apply CSP-3 with a moderate clearance number and higher monitoring fraction (e.g. 0.5). While the inherent penalty for failure is lower, cost gains are also expected to be lower.

Offering a menu of contracts to importers of peat would require a way to differentiate it from coir peat on the pathway. Rather than changing the tariff code, which is a difficult and time-consuming process, it may be possible to profile particular importers that have lower pathway failure rates as a proxy measure. Department of Agriculture and Water Resources colleagues are considering the feasibility of this approach for the field trial.[43]

6.3.4 Potential protocol changes – vegetable seeds for sowing (a subset)

The vegetable seeds pathway has been defined using the HS tariff nomenclature, 1209.91 *Seeds, fruits and spores of a kind used for sowing: Vegetable seeds*. This tariff code encompasses a variety of vegetable seeds, including onion, cucumber, capsicum and tomato, but excludes seeds of forage plants, such as alfalfa and grass seeds.

The vegetable seeds pathway appears suitable for trialling compliance-based inspection protocols because:

- there are a sufficient number of consignments on the pathway, and inspection failures, that may allow for an informed assessment of whether outcomes have changed in a pilot period;
- there is significant variation in pathway failure rates between importers, suppliers and countries of origin;
- the pathway has a mix of supply-chain structures;
- several alternative suppliers and/or countries of origin appear to be available to firms which are not vertically integrated;
- testing protocols to verify consignments are free from particular diseases are costly for importers,[44] especially where the tests involve destroying high-value seed;

[42] Based on administrative records under a mandatory inspection system, it seems the range in pathway failure rates for the larger importers on the peat pathway as defined in this project is large enough for menu options to be configured that could distinguish between importers' different abilities to mitigate biosecurity risk material being present in consignments.

[43] Care would need to be taken in calibrating menu options in this situation so that importers would not all select the same option (e.g. the one with the lowest level of intervention).

[44] Importers currently have discretion as to where these tests are carried out, but not the nature of the tests. Viroid and liberi bacter tests are able to be completed once the seed arrives in Australia, or they can be completed overseas at selected seed-testing laboratories accredited by the International Seed Testing Association (ISTA) which are recognised by the Department of Agriculture and Water Resources.

- delays caused by inspection, verification or treatment activities can be costly, particularly if the consignment's product is seasonal and misses the window at the start of a growing season;
- for most seeds, suppliers appear to have production processes where biosecurity risk mitigation features are embedded into their systems and are difficult to circumvent; and
- several importers and suppliers seem to place a high value on their reputation for product quality, including it being free from biosecurity risk material, which provides a strong incentive to comply with biosecurity requirements.

Potential changes to inspection protocols are listed in Table 3 and are:

i. a change to pathway definition by either changing the tariff codes for particular vegetable seeds, or adding commodity profile questions to the required documentation;
ii. implementing the CSP-3 algorithm by importer, supplier, or importer-supplier pairing;
iii. offering a 'menu of contracts' where importers choose an inspection regime from several options; and
iv. changing the cost structure of importers by modifying their delay costs or the direct costs they face from inspection.

Of the protocols listed in Table 3, the project team recommends that a menu of regulatory contracts be offered to importers on this pathway, with a change to pathway definition to allow application of the new protocols to only a particular subset of vegetable seeds. The table suggests three potential menu items be available to importers,[45] these are to:

1. apply CSP-1 with priority queuing, giving a strong incentive to importers to achieve monitoring status. This would be of particular interest to "good" importers where timeliness is critical for their operations;
2. apply CSP-1 as above, but with less restrictive testing requirements based on equivalent processes. Changes in testing requirements would only be available to importers who can demonstrate good traceability of production through the chain, a good compliance history and external assurance processes around alternative testing arrangements; and
3. apply CSP-3 with a high monitoring fraction (e.g. 0.5) and without access to priority queuing.

[45] For the pathway as a whole, the range of pathway failure rates for the larger importers under the mandatory inspection system appears to be large enough for menu options to be configured that distinguish between importers' different abilities to mitigate biosecurity risk material being present in consignments.

Table 3. Potential changes to protocols for vegetable seeds for sowing

Treatment	Changes to protocol	Implementation notes	What would we learn	Impact and measurement
Change pathway definition (2 options)	1: Define separate biosecurity pathways according to tariff code. May wish to implement with option 2 to ensure quarantine lines that come in with this tariff designation are appropriately classified.	1: The main issue is how do change tariff codes sensibly and cleanly to include and exclude particular types/families of seed. Implementation will be difficult; time is likely to be 12 months.	1 and 2: Better distinctions based on administrative data for both pathways, to identify failure rates and the factors attributable to quarantine failures.	1 and 2: Changed resource requirements for each pathway.
	2: Add multiple commodity profile questions as part of the documentation requirements to ascertain whether line item contained 'seeds of concern'; e.g. daucus carota (liberibacter), seeds subject to viroid testing (Solanaceae family), seeds as potential carriers of cucumber mosaic virus (cucurbits). May need to consider "inclusive" wording of questions (i.e. answering "yes" pulls into the pathway).	2: This is likely to require broker and importer education. Would need to be clear in documentation about species level information. CP questions may involve an 'unsure' option, in which case they would be treated as a 'yes' response. Commodity profile questions do not currently interact well with the CSP-3 algorithm in the current IT system.	1 and 2: Could use this as a first step to ascertain biosecurity risk material detected in quarantine failures (and other consignments identified as incidents) and their frequency across different seed types, including 'seeds of concern'. Could therefore inform resource requirements for inspection on different seed types.	1 and 2: Calculating cost savings to importers using AIMS data is difficult due to recording issues. Getting this information from importers directly through interview may be more reliable. (NB: This applies to all suggestions, as current AIMS IT architecture may inhibit good data on time and cost savings.)
CSP-3 and/or CSP-1 (3 options)	Implement some kind of adaptive sampling. 1: Recognise the importance of suppliers (and all locations involved in the production process) in the biosecurity status of vegetable seed products by including importer-supplier pairing in algorithm.	1: AIMS is currently unable to profile on more than one dimension. Implementation may require IT systems to be modernised to allow this, meaning this is something that could not be done quickly. 1, 2 and 3: Actual roll-out on CSP-3 needs to reflect the intention of the algorithm.	1, 2 and 3: The CSP-3 approach already has an incentive framework embodied in the rules. By designing the incentives within CSP-3, using economic principles and observing behaviour change, we would learn about the advantages of a more systematic approach to designing the rules of a risk-based approach to biosecurity systems. Fine-tuning the rules of a risk-based approach could yield large benefits if the incentives induce behaviour and/or process change in an importer's supply arrangements or seed production and control methods.	1, 2 and 3: Potential impact - Laboratory experiments would provide estimates of the potential improvements that can be gained from improved incentives structures within CSP-3. Experiments could also indicate what impact disclosure of information (e.g. monitoring fraction) has on importer behaviour. 1, 2 and 3: Actual impact - A field pilot would test whether these potential gains (observed in the laboratory) are translated to the real world given the added complexity of commercial operations.
	2: Implement algorithm based on supplier history alone.	2: Similar to IFIS approach and presents a clearer link with biosecurity risks inherent in the product. The incidence of "rewards" on importers may mean incentives offered are not as powerful when CSP-3 done on the supplier dimension alone.	NB: CSP-type algorithms affecting the frequency of inspection result in both direct financial savings and reduced delay costs for affected importers.	1, 2 and 3: Calculating cost savings to importers using AIMS data is difficult due to recording issues. Getting this information from importers directly through interview may be more reliable

	3: Implement algorithm based on importer history alone.	3: Existing option for other pathways on CSP-3. Likely to be most easily implemented.		
Menu of regulatory contracts	Offer importers a menu of inspection options that are designed to be incentive compatible, i.e. each importer/broker chooses the setting that reflects their private information whilst maintaining the biosecurity objectives of the Department. The following three menu items are suggested: 1: ("Good importer where timeliness is critical for operations") Implement CSP-1 with priority queuing (this gives a strong incentive to importers to achieve monitoring status). Would be based on past history (preferably importer and supplier pairing). Might want to specify rules under which importers could lose priority queuing. Could be restricted to while they are in monitoring mode, or related to a broader measure of recent inspection history. Adding/removing from priority queue for inspections would in effect change the implicit penalty for importers who are worried about time delays. 2: ("Good importers who demonstrate reliable supply-chain practices") CSP-1 (as above) plus less restrictive testing requirements based on equivalent processes. Changes in testing requirements would only be available to importers who can demonstrate good traceability of production through the chain, a good compliance history and external assurance processes around alternative testing arrangements. 3: ("Moderately compliant importer") Implement CSP-3 algorithm with a high monitoring	1, 2 and 3: This approach is used extensively in the insurance sector. It has potentially significant advantages to low-risk importers (and their suppliers), allowing them to choose the inspection regime that matches their (perceived) risk status. The regulatory task is not significantly greater with a menu of contracts – the main issue is with IT systems being able to record the regime which an importer has chosen. This may be difficult with the current system. Designing the menu of inspection protocols and associated incentives is the complex aspect of this approach. Initially, it would be advisable that there be only two or three options which importers could choose from. Protocols would also need to be developed as to when/how often importers could switch between regimes. 2: Scientific input would be required to advise as to whether alternative offshore testing protocols (e.g. mother stock testing) or country-based accreditation systems are equivalent to Australia's biosecurity requirements. The alternative options available may themselves form part of a "menu" of equivalent processes which importers could opt into. Importer choices would depend on the relative costs of attaining compliance.	Private information will be revealed regarding: • the importer's beliefs about their own biosecurity status. It may be close to their actual biosecurity status in the case of vertically integrated firms, or where there is extensive contact between the importer and supplier based on their private information about the source and production practices of the firm; • the underlying biosecurity risks of these countries and regions; and • the scope for firms to minimise biosecurity risks.	Potential impact - Laboratory experiments would provide estimates of the potential improvements that can be gained from a menu of contracts approach. Actual impact - A field pilot would test whether these potential gains (observed in the laboratory) are translated to the real world given the added complexity of commercial operations. AIMS and Incident databases could be used to observe the level of switching between suppliers by importers. Interviews with importers should reveal the new mitigation technologies implemented.

	fraction (e.g. 0.5). Would not have access to the priority queue.			
Relative costs (3 options)	Change the cost structure faced by importers for inspection, to encourage/discourage preferred/not preferred behaviours. 1: Direct costs: Change the biosecurity charges faced by importers (e.g. inspection costs/time unit, document check) that are controlled by the Department.	1. Opportunities may arise to address costs to importers from the assurance process through fee reviews. The ability to change cost structures is constrained by the Commonwealth Government's Cost Recovery Guidelines, while the ability to impose direct financial penalties for non-compliance is restricted by Australia's international trade obligations. Future fee reviews could assess whether all current charge structures related to inspection accurately reflect the costs incurred. Any current cross-subsidies in the system could be affecting the incentives facing importers.	1: Information about industry cost structures could be revealed if the changes to fees and charges are material.	1, 2 and 3: Discussions with importers may be required to reveal the impact, particularly if there are additional mitigation steps undertaken by suppliers to limit exposure to more costly intervention at the border. 1: Stakeholder discussions indicate that direct biosecurity-related costs (other than testing) are relatively small. If this is the case for most importers, fee changes on their own may not induce significant behaviour change.
	2: Delay costs: Use potential to reduce in time spent waiting for and/or undergoing inspection to encourage preferred behaviours by importers. This could be achieved through a priority queuing system.	2: Introducing a priority queueing system for booking inspections would likely require IT changes to integrate systems AIMS importer/supplier profiles with the booking system. This could take some time to implement.	2: From stakeholder interviews, costs related to delays in inspection process seem to be important for importers, particularly given the time-critical nature of imports around the start of growing seasons. Information about impact of delay costs may be gleaned through willingness to improve compliance with biosecurity requirements.	2 and 3: The AIMS database may provide some (independent) evidence of the impact through reduction in throughput times. Augmenting this with information on storage costs from importers and/or ports would enable regulatory burden reduction savings to be estimated. Attributing causation to this aspect alone may be difficult, though with careful design of menu options (as above) this could be achieved.
	3: Offer less costly methods to importers/suppliers of assuring biosecurity status of seeds subject to testing (e.g. those with a good history of inspection and other information about production processes or country-level accreditation that provide assurance around managing biosecurity risks). Could contribute to reduced direct and delay costs.	3: Alternative testing regimes to those currently prescribed by the Department of Agriculture and Water Resources may entail less confidence/greater risk in the possibility of plant pathogens being present. Standards in the country of production and their mechanisms for ensuring compliance (e.g. mother stock testing) with biosecurity protocols may offer equivalent procedures. Could be done in conjunction with inspection history as a way of demonstrating equivalent procedures to meet biosecurity requirements. Scientific input would be required for this to be a viable option.	3: Could result in reduced testing costs overall as well as lower costs related to waiting for onshore test results at the border. Could reveal ways in which importers, suppliers and countries could provide alternative forms of assurance.	3: As testing can be particularly costly for some seed types, the "reward" offered through more flexible (and less costly) alternative testing arrangements for those who demonstrate good biosecurity compliance could improve seed production process. This could offer regulatory and administrative burden savings which could be measured by AIMS and the Department's internal cost structures.

The particular group of seed importers to which the change of protocols would be applied is still under discussion.[46] Once a decision is made, a change in pathway definition will be required. As was the case with peat, changing the tariff code is a difficult and time-consuming process, so an additional method for differentiating particular vegetable seeds will need to be used.

6.3.5 Implementation considerations

A menu of contracts and change to pathway definition has been suggested as the protocol change on both pathways. Three options for the menu of contracts were suggested and these will need fine-tuning to make sure they are implementable in the current operating environment.

For the 'menu of contracts' approach to be most valuable, importers need to have some choice over the inspection regime under which their consignments will be inspected. This means allowing importers at least two options, so that the department has the opportunity to discover some of their private information. The set of menu options available to a particular importer could be restricted *a priori* by the department, based on past compliance, pathway biosecurity risks (including leakage), or evidence around biosecurity mitigation mechanisms embedded in production and/or transportation systems.

All proposed menu options should be constructed taking into account the objectives of the department and the factors which influence departmental preferences on the pathway, including the relative costs of performing inspections and consequences of biosecurity risk material leakage. As a result, the characteristics in terms of approach rates for what constitutes a "good" importer eligible for the protocol with the least intervention may differ considerably between pathways.

Furthermore, the menu options also need to consider what an importer's best response would be to the rules under different assumptions about importers characteristics, such as the costs incurred in the inspection process, treatment costs and the value placed by an importer and/or supplier about its reputation. Simulation exercises drawing upon theoretical models would be particularly useful for assessing these issues, with experiments in the laboratory setting verifying these types of behaviour under a more restricted set of assumptions.

In designing the menu options, the department may also want to think about conditions under which importers may be offered a more favourable regulatory contract or be forced onto a less favourable intervention path. The former situation would represent an importer demonstrating improved compliance with Australian biosecurity requirements, while the latter could reflect increasing non-compliance where an importer frequently brings in consignments containing biosecurity risk

[46] One option under active consideration would be to trial these new protocols for vegetable seeds classed as "permitted seeds", which allow specific seeds to be imported without an Import Permit. The list of permitted seeds is defined on the department's website (http://www.agriculture.gov.au/biosecurity/legislation/new-biosecurity-legislation/bio-legislation/permitted-seeds) and this list is referenced in section 23(9) and (10), and section 30(1) of the *Biosecurity (Prohibited and Conditionally Non-prohibited Goods) Determination 2016*. Seeds currently on this list include: cauliflower, broccoli, Brussels sprout, cabbage (species *Brassica oleracea)*; turnip (species *Brassica rapa*); beetroot and chard (species *Beta vulgaris*); garlic (species *Allium sativum*); leek (species *Allium ampeloprasum*); onion (species *Allium cepa*); chives (species *Allium schoenoprasum*); and yams (genus *Dioscorea*).

material. Such considerations will be important once these types of arrangements are well-established in the department, as they can serve as yet another vehicle for encouraging compliant behaviour. Given the field-trial phase of the follow-up project (CEBRA Project 1608C) is expected to be of a relatively short duration, this potential to allow "switching" of regulatory options may be less critical. This type of penalty structure would add further levels of complexity in designing the menu of regulatory options, and as such, it is recommended that this framework could be explored at a later stage.

Determining the exact menus to offer will be an iterative process. Historical data analysis and simulation exercises can provide an indication as to what may be appropriate choices of rule parameters. However, care must also be taken to ensure that the parameter choices across the menu options encourage importers to truthfully reveal the private information about the (perceived) level of biosecurity risk in their consignments. This means designing menu options so that it is in the best interests of "good" importers to choose a menu option that offers a lower level of intervention, while importers with less ability to control biosecurity risks in their consignments are better off choosing menu options with greater levels of intervention. Further theoretical work may be required to ensure this incentive-compatibility property holds when designing the various options made available to importers. The types of menu options can also be tested in the laboratory setting as part of the refinement process.

Some protocol changes that offer sharper incentive structures, such as offering priority queuing to reduce delay costs or using adaptive sampling algorithms on more than one dimension (e.g. importer-supplier), may not be feasible without changes to departmental technology and business systems. In particular, the department's current information and data management systems represent significant constraints on the types of interventions that are possible in a field pilot and the ability to monitor progress. If system upgrades are not possible before the pilot phase commences, some of the types of menu options proposed here would need to be reconsidered. In turn, removing menu options that would provide greater incentives for improvements in biosecurity compliance may result in more modest behaviour changes by importers and suppliers during the pilot period.

Other implementation issues the department would need to consider include:

- the appetite for rules-based determinations versus allowing officers discretion in making judgements about the application of protocols;
- how it will cope with issues of precedence in rule application;[47]
- privacy and commercial considerations surrounding information that may be revealed by importers;
- how information and communications technology would evolve as compliance-based systems are implemented;
- the legal and ethical dimensions of 'discrimination' between importers on the basis of dimensions such as source country, accreditation procedures, source supplier, and information provision. This may be particularly relevant to the notion of priority queuing; and

[47] This may arise when an importer has different rulings applied for imports of the same product. This may undermine effectiveness of the inspection system by changing an importer's expectations of how future imports will be considered.

- whether incentives to report information could result in 'cheating' and what options may exist to impose penalties to discourage this situation.

6.3.6 Challenges and decisions for field trial application

A key challenge for the field trial will be to understand behaviour change of import-supply chain participants and subsequently measure the impact of the changed protocols. This requires identifying the counterfactual – what would happen if existing protocols were maintained – and comparing this to the changed behaviour. Typically this would require the selection of a 'control' group for field trial. In the current context there are commercial and ethical difficulties in setting up a control group if the rules are applied to some on the pathway and not others.

The length of field trial is also an important consideration. The trial should proceed sufficiently long so that import-supply chain participants can fully "feel" and respond to incentives that are contained in the new protocols. There may be interim responses recorded during the pilot phase, though more fulsome technology/process changes may take longer to be observed.

Responses of import-supply chain participants to the new protocols will likely be enhanced if they are more informed about how changes may affect them. In the current context this would mean allowing them to be familiar with the parameters of CSP rules used. Indeed, clarity and openness of the rules contained in the new protocols, and consistency of their applications will be crucial for participants to respond fully to incentive structures. In addition, import-supply chain participants must trust incentive structures available – behaviour change may involve up-front costs, which may be 'stranded' by protocol changes, and which may make stakeholders unwilling to respond to future protocol changes to incentivise "good" behaviour.

6.4 Measuring impact of the trialled protocols

The main aim of the changed protocol is a reduction in biosecurity risk material coming in to Australia. The only way of accurately measuring whether this happens would be via a leakage survey (checking everything that came through whether it had been inspected or not), but this is an expensive process and is not planned as part of this project. Furthermore, introducing a leakage survey would undermine attempts to change relative cost structures for compliant importers in the trial by raising their delay costs. Observations on changed behaviour will be undertaken in the laboratory (in CEBRA Project 1404C) and the field (in Project 1608C).

Where laboratory techniques are used, all relevant data is recorded throughout the repeated experimental sessions. The laboratory has the advantage that the experimenter knows what should have occurred (if all efficient transactions occurred) and what actually happened as a result of the autonomous actions of the players. Where field-based experiments are used, it will be difficult to measure the impact in terms of changes in biosecurity risk relevant to the selected pathways as the lag times may be long and the outcomes are difficult to track. The next best approach is to observe what is referred to as the "footsteps of beneficial change". This means looking for and systematically observing changes in behaviour that imply that the biosecurity system is moving to a better outcome. In some situations, the "footsteps of beneficial change" could be observed from laboratory sessions in CEBRA Project 1404C.

The types of footsteps we would look for in the field trial are likely to include:

- changes to shipment size and frequency (if an importer knows clearance is faster/cheaper/easier). This may be evident from departmental databases but will need to be confirmed by stakeholder interviews. This could represent either a positive or negative development, particularly if importers try to "game" the system with the timing of imports;
- a switching of suppliers if the importer expects the current supplier is responsible for frequent failed inspections, and the importer know of others who are 'cleaner'. Switching of suppliers will not be available for vertically integrated importers. Changing suppliers may also be difficult for those importers who have longstanding commercial relationships, due to the costs associated with switching suppliers. Critically, this is something that may take time, even for importers without long-term commercial relationships. Evidence of switching behaviour should be evident from departmental databases and may also be obtained from stakeholder interviews;
- a switching of source countries, as above;
- the number of physical inspections avoided through the trial phase, both in absolute terms and relative to the theoretical "best case" of a fully compliant importer;
- changes to biosecurity risk mitigation procedures in the exporting country and in the transportation process. This might only be evident from interviewing importers and suppliers; and
- evidence that certain types of importers no longer import and other types import more, although this behaviour may not be solely attributable to biosecurity rule changes.

All of the above behaviour changes would depend on the particular circumstances of importers and suppliers. Given the differences in capability, technology and costs for different importers and their suppliers, it would be expected that different types of importers would respond differently to the protocols changes introduced.

Changes in the costs faced by both the Department of Agriculture and Water Resources and importers should be considered when calculating cost-savings from the new protocols. Cost-savings to Department of Agriculture and Water Resources should be calculable from their AIMS and Incident databases. Departmental cost-savings would be in the form of avoided inspections and reductions in total time spent on inspections.

It will be difficult, however, to estimate the full cost savings to importers from the new protocols. We could ask the importers to describe the changes they made as a result of the new protocols and to provide estimates of cost and/or time savings, at least as a result of lower monitoring and enforcement costs. A comparison would then be made against the status quo. These estimates, however, will not take into account any broader market-wide adjustments that might have occurred as a result of the protocols or other events.

7. Conclusions

This report documents CEBRA Project 1304C, *Incentives for Importer Choices*, which considers how the department can use pre-border and border interventions in an efficient way to balance competing government objectives associated with Australia's biosecurity system. The analysis draws on insights from microeconomic theory, including the theory of incentives and information economics, to consider how import-supply chain participants can be encouraged to act in a manner consistent with the Australian Government's biosecurity objective.

The main findings relating to potential changes to biosecurity interventions are summarised below, including the recommended incentive-based inspection protocol that should be applied across two selected plant-product pathways.

7.1 Key findings

7.1.1 Industry cost structures, technology and protocol effectiveness

Industry cost structures play an important role in the potential success of compliance-based inspection protocols. Pathways where the costs of biosecurity interventions represent a larger share of total costs are more likely to be influenced by rewards from complying with the Australian Government's biosecurity objectives.

The ability for compliance-based intervention protocols to change behaviour revolves around encouraging the uptake of technology-based changes in the production, processing and transportation of plant-based products that reduce the likelihood of biosecurity risk material being present in consignments. Production, processing and transportation changes are likely to be most successful if they are "embedded" in the import-supply chain, becoming a "fixed" part of the importing process which is difficult for participants to avoid once systems are implemented.

For vertically integrated import-supply chain structures, technology-based changes represent the main way in which behaviour can change in response to incentives in biosecurity inspection protocols. In situations where importers have greater freedom to choose their suppliers, supplier switching also becomes an option. However, discussions with importers suggest that supplier relationships are often built up over very long horizons, so switching suppliers can be very costly. As such, changes in importers' supply arrangements may take longer to occur, if at all, which can be encouraged through a consistent regulatory regime over a relatively long time horizon.

7.1.2 Role of process assurance and equivalence in biosecurity

As part of moving towards incentive regulation in biosecurity, one of the opportunities could be to shift the focus of interventions away from prescribing treatment requirements on consignments towards an approach based more on outcomes. For example, process audits relating to production, processing and transportation of plant-based products may be an alternative means of assuring biosecurity standards at the border. This is consistent with encouraging systems-based approaches to reducing the likelihood of biosecurity risks throughout the import-supply chain. Pre-border audits could be combined with increased inspection intensity at the border during a trial phase to demonstrate the efficacy of alternative treatment options and their equivalence to existing standards.

The notion of equivalence in biosecurity standards could also be explored more fully. In cases where industry-based standards already exist, industry bodies or individual businesses in the import-supply chain could be encouraged to submit these to the department for consideration of equivalence. While this approach happens already on some pathways through compliance agreements, broadening the scope of how import-supply chain participants can demonstrate they meet Australia's biosecurity requirements could reduce overall system costs.

7.1.3 Improving the relative rewards for compliant parties

From stakeholder discussions, importers understood both direct costs of inspections and indirect costs accrued through the time taken to clear the inspection process. This implies that both of these channels could be used to differentiate between import-supply chain participants that are highly compliant and those that repeatedly demonstrate non-compliance with Australia's biosecurity requirements.

For many pathways, the impact of delay costs seems to be more of a concern to importers than the direct costs associated with inspections. In the case where biosecurity interventions are applied at the border, a priority queuing system based on compliance history could reduce delay costs for importers with a strong record of meeting Australia's biosecurity requirements. Such a scheme could also be based on an importer's overall compliance across the range of pathways they import, which could foster greater conduct across multiple pathways. This type of queuing system may be useful for different forms of interventions under the direct control of the department, such as document assurance and physical inspections. Such a system would likely require significant upgrades to departmental information systems, but could be funded through changes in fee structures that reward compliance.

7.1.4 Departmental communication and providing information to boost compliance

Stakeholder consultations highlighted that a significant proportion of importers wanted to understand in more detail about why they failed inspection. This largely stemmed from them wanting to be seen as "clean" importers by their customers. Providing this information encourages the implementation of processes to reduce the likelihood of future contamination from similar biosecurity risk material. Options for improving feedback to importers include allowing follow-up information requests or a greater ability to pass inspection samples on to third parties for further investigation.

Another way to encourage importers to improve compliance could be through providing information on their recent history of biosecurity compliance relative to the most compliant importers on the pathway. A dashboard system could be used to demonstrate the relative performance of the importer and their suppliers relative to others on the pathway. It could also illustrate a number of metrics around costs avoided or reductions in processing times that may encourage greater effort by importers to improve biosecurity compliance.

The confidence stakeholders have in the biosecurity system could be improved through greater communication of performance benchmarks that the department seeks to meet in delivering its services. This information could also be displayed on dashboards to stakeholders, as could actual information on performance, including for the importer's own consignments.

7.1.5 Field trial recommendations

Field pilots; guided by economic theory, data analysis and interviews of system participants; have been identified as an important methodology to test and refine changes to system incentive structures, rules and processes. The project team has identified two product pathways as candidates for field pilots: the *peat* pathway and a subset of the *vegetable seeds for sowing* pathway.

These pathways have several desirable qualities from a response measurement, risk management or influence potential perspective, including:

- relatively low approach rates for biosecurity risk material under the current 100 per cent inspection scheme;
- willingness by industry in engaging with the department, as demonstrated through the stakeholder interview process;
- established industry self-regulatory or quality-assurance schemes that can provide assurance around biosecurity outcomes;
- evidence of importers and suppliers valuing their reputation of bringing plant-based products into Australia that are free from biosecurity risk material;
- evidence of consistent communication between import-supply chain participants around the biosecurity status of products; and
- the existence of technological and other system processes that can reduce the likelihood of biosecurity risk material entering Australia.

For both pathways it is recommended that a 'menu of regulatory contracts', with refined pathway definitions, be applied. Under this protocol, each importer chooses the inspection regime that reflects their private information whilst maintaining the biosecurity objectives of the Department. This approach is used extensively in the insurance sector. It offers potentially significant advantages to importers (and their suppliers) using systems that ensure a high degree of compliance with Australia's biosecurity requirements, allowing them to choose the inspection regime that matches their (perceived) risk status.

Designing the menu of inspection protocols and associated incentives is the complex aspect of this approach. Initially, it would be advisable that there be only two or three options which importers could choose from. Three menu items have been recommended for the menu of contracts on each pathway and these involve:

- applying adaptive algorithms (i.e. CSP-1 and CSP-3) for inspections (changing frequency);
- using other information on biosecurity risk (encouraging information revelation on external accreditation/endorsement of processes); and
- priority queuing (reducing delay costs).

The exact configuration of the menu of contracts will depend on practical considerations, given that existing departmental systems may present significant barriers to using some of the options in the short term.

Well-designed pilots for these treatments on each pathway are recommended for the next phases of the project:

1. testing and refining proposed inspection protocols using simulated scenarios in a computer-based experimental economics laboratory (CEBRA Project 1404C); followed by
2. running field pilots for two plant-product pathways (CEBRA Project 1608C).

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9. List of Figures

10. List of Tables

Appendix A: Template for Customs Broker Interviews

CEBRA Project 1304C: Incentives for Importer Choices Stakeholder Consultations Customs Broker Template

Pathway

- ○ Green coffee beans
- ○ Vegetable seeds
- ○ Peat
- ○ Cut flowers
- ○ Dried vegetables
- ○ Plant-based stockfeed

Interview identifier

Interview method

- ○ Face-to-face
- ○ Telephone

Interviewed by

- ☐ Susie Hester
- ☐ Anthony Rossiter

Date of interview

Introduction

Thank you for agreeing to be part of the research project "Incentives for Importer Choices" being undertaken by the Centre for Market Design and the Centre of Excellence for Biosecurity Risk Analysis, both based at The University of Melbourne.

As part of this discussion, we are particularly interested in:
* your organisation's interactions with other parts of the import-supply chain;
* the ways in which your organisation can directly or indirectly mitigate biosecurity risks associated with imported products; and
* the costs incurred by parties in the import-supply chain in meeting Australia's biosecurity requirements and current inspection processes.

Please note that you have agreed to participate in this study voluntarily and are under no obligation to provide the information we are seeking through this discussion. If you do not wish to answer a particular question or questions, please let us know.

We expect this discussion will take between 30 and 45 minutes, though it may take more or less time depending on the level of information you are able to provide.

Before we start, can you please confirm you are comfortable in us recording this interview digitally to ensure an accurate record of our conversation?

Could you please confirm that you have read and understood the Plain Language Statement we sent you?

Did you have any questions about this research project or the interview before we begin?

General information and broking industry structure

We would like to start by find out more about your importing business and the requirements your customers place on the goods you provide to them.

Q1a) How long have you been offering customs broking services in Australia?

Q1b) For which entry points in Australia does your firm provide broking services?

Q1c) In which other countries, if any, does your organisation have a presence?

Q1d) What other services, if any, does your business offer clients in addition to customs broking services for importers? *(e.g. freight forwarding and integrated logistics; broking for exporters)*

Q2a) What are the three products or product types that your business has been involved in bringing into Australia most frequently over the past year?

i) ii) iii)

Q2b) What are the top three countries of origin for imported products that your business has been involved with bringing into Australia over the past year?

i) ii) iii)

We would now like to ask you about the customs broking industry in Australia as a whole.

Q3a) How many other customs brokers service similar clients to you?

Q3b) Who tend to be your main competitors for business?

◯ Other third-party customs brokers ◯ Brokers employed directly by importers

Q3c) What information, if any, do you know about what your competitors are charging clients?

Interactions with importers

We would now like to focus on how you attract importer clients. For the next few questions, please focus on importers of *xxx* as one of the products we are using as a case study for this project.

Q4a) How do importers usually hear or find out about your business?

Q4b) Could you describe three main factors that encourage importers to contract with your business to provide broking services for *xxx*?

i)

ii)

iii)

Q4c) *(If not identified above)* How important do you think your experience with and knowledge of Australia's biosecurity inspection system affects a client's decision to use your services?

We would now like to focus on the arrangements you have with the importer of *xxx* for which you have provided broking services most frequently over the past year. For the rest of this discussion, we will refer to this as your *principal importer*.

Q5a) Could you explain what sort of agreements you have entered into with this importer? *(e.g. duration of engagement, number of shipments, performance requirements)*

Q5b) Under what circumstances can this importer client terminate your contract?

Q5c) Could you please describe how you tend to invoice your principal importer? *(e.g. how often are invoices raised, how charges are/are not itemised)*

We would now like to discuss how you set fees for the services you provider to importers. For these questions, we are interested in the full range of products for which you provide services to importers. We appreciate these questions are of a commercial nature and reiterate that all information obtained through these discussions will be treated in confidence.

Q6a) Could you please describe your organisation's general approach to setting the fees you charge importer clients? *(e.g. estimate the costs associated with servicing particular types of clients/products and then apply a profit margin to this estimate)*

Q6b) *(Tick if a yes to the option or, if none, type "none" in other considerations)*
Do the fees you charge vary by:

- ☐ product type?
- ☐ consignment size?
- ☐ frequency of service use by importers?
- ☐ other considerations? (list)

Q6c) Could you describe how these fees vary in some more detail?

We would now like to ask you about the sort of information you exchange with importers about their consignments.

Q7a) Could you describe what type of information you typically provide your principal importer of *xxx* about their consignments? *(e.g. inspection outcome, time of release, notification of consignment arrival at the border)* ***NB specifically ask about providing information about the quarantine inspection outcome if not volunteered***

Q7b) Thinking about all your importer clients, what are the three main factors that would determine the level of information you share with them? And how does this affect the information you give them?

i) *Factor influencing information sharing*	*Type of information given*
ii)	
iii)	

We would now like to ask you about some issues you may have faced in dealing with importer clients across all goods imported.

Q8a) In your experience, how knowledgeable are importers regarding the import and biosecurity conditions required for their products to enter Australia?

Q8b) What are the three main factors that you believe determine the level of importer awareness about biosecurity requirements and import conditions? *(Probe regarding type of product, size of business as potential sources)*

i)

ii)

iii)

Q8c) *(Tick if a yes to the option or, if none, type "none" in other considerations)*
In the past five years, have you:

- ☐ declined an approach from an importer because of their reputation in the industry?
- ☐ received what you thought could be false or misleading customs declaration or offshore certification?
- ☐ volunteered a consignment for quarantine inspection where the goods listed on the customs documentation would not normally require an inspection?
- ☐ none of the above/explanation

Q8d) For the most recent incident you identified above, could you please outline the circumstances of the situation, what you did and what the outcome was?

Interactions with transport operators and suppliers

For the next few questions, we would like to focus on the transport arrangements for importing *xxx* into Australia for your principal client.

Q9a) Who is typically responsible for making the transport arrangements?

- ○ *My organisation (customs broker) - GO TO Q9c)*
- ○ *Importer*
- ○ *Supplier*
- ○ *Other arrangement*

Q9b) Can you influence the transportation in any way (e.g. what other products are in the sea container with the *xxx*)?

- ○ Yes — *GO TO Q9c)*
- ○ No — *GO TO Q10a)*

Q9c) Could you describe how you, as a customs broker, are able to make (or influence) the transportation of *xxx* to Australia?

For the next few questions, we would like to focus on your interactions with suppliers of your clients' products.

Q10a) In the past five years, have you had any contact with suppliers contracted by the importers of *xxx* for which you have provided broking services?

- ○ Yes — *GO TO Q10b)*
- ○ No — *GO TO Q11a)*

Q10b) For the most recent instance where you had contact with a supplier of *xxx*, could you please describe the circumstances under which you interacted and the outcome of the interaction?

Experience with biosecurity inspections

We would now like to ask you some questions about the time it takes for consignments of *xxx* to clear customs and quarantine once they are available to be processed.

First we would like to know about the time taken by consignments that pass through customs and quarantine without issue -- that is "clean" consignments.

Q11a) Over the past year, what was the longest time taken for a "clean" consignment of *xxx* to clear customs and quarantine checks?

Q11b) What was the quickest time you can recall?

Q11c) What was the typical time taken for a "clean" consignment of *xxx* to clear these checks?

We would now like to ask you some questions about the time it takes for consignments of *xxx* that fail a *quarantine* inspection.

Q12a) Over the past year, what was the longest time taken for a consignment of *xxx* that required testing, treatment or another form of rectification to clear quarantine?

Q12b) What was the quickest time you can recall?

Q12c) What was the typical time taken for a consignment of *xxx* that needed testing, treatment or rectification to clear quarantine?

We would now like you to reflect on your recent experience with customs checks and quarantine inspections when providing services to importers bringing *xxx* into Australia.

Q13a) In the past year, have you experienced delays in clearing customs and/or quarantine for the shipments of *xxx* you provide broking services for?

- ○ Yes — *GO TO Q13b)*
- ○ No — *GO TO Q14a)*

Q13b) Over the past year, how many times have your shipments of *xxx* been delayed?

Q13c) And about how many shipments of *xxx* in total have you received over the past year?

Q13d) In the most recent instance when you experienced delays, what was the cause of these delays?
(e.g. were they from clearing customs or quarantine, something wrong with the paperwork)

Q13e) Did you incur additional costs, in terms of time or money, from the most recent delay?

- ◯ Yes — *GO TO Q13f)*
- ◯ No — *GO TO Q13h)*

Q13f) Could you please describe what these additional costs were?

Q13g) Were you able to pass on these costs to your importer client?

- ◯ No
- ◯ Yes, all costs
- ◯ Yes, but only some costs (% of total/types)

Q13h) How did this most recent delay affect your business operations, if at all?

Q13i) Was there anything else you wanted to say about your recent experience with clearing goods through Australia's customs and quarantine inspections?

We would now like to seek your views on why you think shipments of *xxx* might fail a quarantine inspection.

Q14a) In your experience, what do you think are the three main reasons or factors contributing to why your consignments of *xxx* might fail inspection?

i)

ii)

iii)

Q14b) *(Tick if answers "yes", or, if none of these, write "none" in the other factors)*
Based on your experience over the past five years, does the incidence of failure of *xxx* depend on the:

- ☐ supplier?
- ☐ importer?
- ☐ country of origin?
- ☐ mode of transport?
- ☐ transport or warehousing company?
- ☐ other factors? (list)

Q14c) Could you briefly explain why you believe that?

Q15a) Speaking more generally about the range of products you help clear, are some products more problematic than others when it comes to certification?

- ○ Yes — *GO TO Q15b)*
- ○ No — *GO TO Q16a)*

Q15b) In your experience, what are the three most problematic plant-based products for certification?

i) ii) iii)

Perceptions of Australia's biosecurity system

We would now like to finish the conversation with some questions about your perceptions of Australia's biosecurity system and how it affects (or could affect) your business.

Q16a) How important is it for your organisation to know about changes to quarantine inspection protocols?

Q16b) How you you, or do you, find out about this type of information?

Q16c) Are you aware of any recent changes to inspection protocols or procedures by Biosecurity Australia?

- ○ Yes — *GO TO Q16d)*
- ○ No — *GO TO Q17a)*

Q16d) Can you describe what you understand to the be the recent changes to inspection procedures or protocols?

Q16e) What feedback, including complaints, have you offered to other organisations or the Australian Government about Australia's biosecurity system?

As mentioned in the Plain Language Statement we sent you, this research project is investigating how to design inspection protocols to reduce the costs associated with Australia's biosecurity system while not raising the likelihood of biosecurity hazards entering Australia. One feature of this system could be that importers with a history of good compliance would be rewarded with a lower frequency of inspection.

Q17a) Are you aware of any products that currently have compliance-based inspection regimes applied to them? If so, what are they?

- ○ No
- ○ Yes (list them)

Q17b) How do you think an inspection system like this would affect your business?

Q17c) Do you think such an inspection system would mean you would consider changing your customs broking operations?

- ○ Yes — *GO TO Q17d)*
- ○ No — *END INTERVIEW*

Q17d) What changes do you think you might make to your business?

That concludes the formal part of our discussion. Did you have any further questions or comments about Australia's quarantine inspection system or our project in general?

Thank you again for assisting us with our research project.

Will be in touch within the next two weeks with a written summary of the key information you have provided in this conversation. Please feel free to request that we change or update this information at that time if you notice any information in the summary is incorrect.

If you have any questions about this research, please feel free to contact the interviewers or the Principal Research, Professor Peter Bardsley. All our contact details are in the Plain Language Statement we sent you.

Appendix B: Template for Importer Interviews

CEBRA Project 1304C: Incentives for Importer Choices Stakeholder Consultations Importer Template

Pathway

- ○ Green coffee beans
- ○ Vegetable seeds
- ○ Peat
- ○ Cut flowers
- ○ Dried vegetables
- ○ Plant-based stockfeed

Interview identifier

Interview method

- ○ Face-to-face
- ○ Telephone

Interviewed by

- ☐ Susie Hester
- ☐ Anthony Rossiter

Date of interview

Introduction

Thank you for agreeing to be part of the research project "Incentives for Importer Choices" being undertaken by the Centre for Market Design and the Centre of Excellence for Biosecurity Risk Analysis, both based at The University of Melbourne.

As part of this discussion, we are particularly interested in:
* your organisation's interactions with other parts of the import-supply chain;
* the ways in which your organisation can directly or indirectly mitigate biosecurity risks associated with imported products; and
* the costs incurred by your organisation in meeting Australia's biosecurity requirements and current inspection processes.

Please note that you have agreed to participate in this study voluntarily and are under no obligation to provide the information we are seeking through this discussion. If you do not wish to answer a particular question or questions, please let us know.

We expect this discussion will take between 30 and 45 minutes, though may take more or less time depending on the level of information you are able to provide.

Before we start, can you please confirm you are comfortable in us recording this interview digitally to ensure an accurate record of our conversation?

Could you please confirm that you have read and understood the Plain Language Statement we sent you?

Did you have any questions about this research project or the interview before we begin?

General information and customer influence

We would like to start by find out more about your importing business and the requirements your customers place on the goods you provide to them.

Q1. How long have you been importing goods into Australia?

Q2. What are the three products or product types that your business has brought into Australia most frequently over the past year?

i) ii) iii)

Q3a) For the three main products you import, what standards do your customers require for these products?
(NB: Repeat products/product types to ensure accurate recording.)

Q3b) Do your customers appear to care about whether biosecurity hazards are present in the products you import?

- ○ Yes
- ○ No

Q3c) If so, how important do you think it is to them?

Interactions with customs brokers

We would now like to discuss the arrangements your business makes for progressing your consignments through customs and quarantine checks. For these questions, we would like you to consider the range of products you import into Australia.

Q4a) Do you use in-house customs brokers, external customs brokers or a combination of both for clearing your goods through customs and quarantine?

- ◯ Only in-house — *GO TO Q5*
- ◯ Only external — *GO TO Q6a)*
- ◯ In-house and external — *GO TO Q4b)*

Q4b) Does your use of in-house or external customs brokers differ between which product you import?

- ◯ Yes
- ◯ No

Q4c) If so, how does it differ by product or country of origin?

Q5. Could you describe the three main reasons why you choose to employ and in-house broker to clear some (or all) of the goods you import?

i)

ii)

iii)

*If answer to Q4a) was "*only in-house"*, go to Q11a) (*Interactions with suppliers, *page 7).*

We would now like to ask you about how your business chooses and engages customs brokers to act on your behalf.

Q6a) Could you describe the three main factors you take into account in choosing which broker/s to use?

i)

ii)

iii)

Q6b) *(If not identified above)* How important is a customs broker's reputation in your decision to use them?

Q6c) What are the three most important aspects of reputation to you?

i)

ii)

iii)

Q7. Under what terms and conditions do you usually engage an external customs broker?
(e.g. duration of engagement, number of shipments)

Q8a) Over the past five years, have you changed or stopped using an external customs broker?

- ◯ Yes *GO TO Q8b)*
- ◯ No *GO TO Q9a)*

Q8b) For the most recent time you changed brokers, could you explain why you did this?

Q8c) What costs, if any, were involved when you changed brokers?

The next few questions relate to the information a customs broker provides to you about your consignments clearing quarantine.

Q9a) How often does a broker tell you whether a consignment has passed or failed a quarantine inspection?

- ◯ Always
- ◯ Most of the time
- ◯ Sometimes
- ◯ Infrequently
- ◯ Not at all

Q9b) How often does a broker tell you if a product has been delayed in quarantine for testing or treatment?

- ◯ Always
- ◯ Most of the time
- ◯ Sometimes
- ◯ Infrequently
- ◯ Not at all

Q9c) Is there any other information a broker would normally tell you about a consignment clearing quarantine?

Q9d) Did you have any other comments about the information a broker provides you about your consignments clearing quarantine?

The next few questions relate to how customs brokers charge you for the services they provide.

Q10a) How often do customs brokers usually invoice you?
(e.g. for each consignment individually or grouped, or by date)

Q10b) What information is contained in the invoices you receive from the main brokers you use?
(e.g. are invoices itemised, listing charges involved in clearing customs and quarantine)

Q10c) Did you have any other comments about how customs broker invoice you?

Interactions with suppliers

We would now like to discuss the relationship you have with your suppliers. For these questions, please focus on your suppliers of *xxx* as one of the products we are using as a case study.

Q11a) How many suppliers do you believe are available for this product?

Q11b) Over the past year, how many different suppliers have you used?

Q11c) Why did your business choose to use that many suppliers?

Q12a) What are the three most important factors for you when choosing a supplier?

i)

ii)

iii)

Q12b) *(If not identified above)* How important is a supplier's reputation in your decision to use them?

Q12c) What are the three most important aspects of reputation to you?

i)

ii)

iii)

We would now like to focus on the arrangements you have with the supplier of *xxx* you have used most frequently over the past year. We will refer to this organisation as your *principal supplier*.

Q13a) What level and frequency of contact do you have with your principal supplier?

Q13b) What role does your supplier play in the supply chain? For instance, is your principal supplier:

- ○ a direct producer of the goods you import?
- ○ an intermediary that aggregates products from various producers?
- ○ don't know.
- ○ something else?

Q13c) Does your principal supplier have direct control over the supply chain for the products they supply to you?

○ Yes ○ No ○ Don't know

Q13d) What information, if any, do you report back to your principal supplier on the outcomes of quarantine inspections?

Q14a) What type of contractual arrangements do you have with your principal supplier?
(e.g. length of contract, number of shipments involved or amount of product supplied)

Q14b) Under what circumstances can you terminate that supply contract?

Q14c) What information, if any, have you given your principal supplier about Australia's quarantine inspection requirements?

Q14d) If a shipment fails a quarantine inspection, who bears the costs of this according to the contract?

- ○ My organisation (importer)
- ○ The supplier
- ○ Other arrangement

The next few questions focus on steps taken by you or your suppliers to reduce the risk of biosecurity hazards in the products you import. For these questions, please think about all the suppliers you frequently use for *xxx*.

Q15a) In the past five years, have any suppliers of *xxx* told you about the processes or procedures they use to reduce the risk of biosecurity hazards being in the products you import?

- ○ Yes — *GO TO Q15b)*
- ○ No — *GO TO Q15c)*

Q15b) Could you please describe three of the processes or procedures your suppliers have told you about?

i)

ii)

iii)

Q15c) Has your organisation ever taken steps to reduce quarantine risks (e.g. contamination) in products you obtain from suppliers?

- ○ Yes — *GO TO Q15d)*
- ○ No — *GO TO Q16a) (next page)*

Q15d) Could you please describe three of the processes or procedures you have implemented in the past five years that you think have been most effective in reducing biosecurity risks in *xxx*?

i)

ii)

iii)

Transport arrangements for consignments

We would now like to discuss the transport arrangements associated with bringing *xxx* into Australia.

Q16a) How are your consignments of *xxx* usually transported to Australia?

- ○ Air
- ○ Sea
- ○ Other arrangement [ ]

Q16b) Who is typically responsible for arranging the transport arrangements?

- ○ My organisation (importer)
- ○ Customs broker
- ○ Supplier
- ○ Other arrangement [ ]

If answer above is not "my organisation", *ask the next two questions.*

Q16c) Do you have any influence regarding how your goods are brought to Australia?

- ○ Yes — *GO TO Q16d)*
- ○ No — *GO TO Q16e)*

Q16d) Could you please describe how you influence your goods' transportation?
(e.g. what other products are in the same sea container as yours)

[ ]

Q16e) In the past five years, has the mode of transport used for *xxx* resulted in problems on entry to Australia?

- ○ Yes — *GO TO Q16f)*
- ○ No — *GO TO Q17a)*

Q16f) Could you briefly describe the types of problems that have resulted from this mode of transport in the past five years?

[ ]

We would now like to ask you some questions about the time it takes for your *xxx* consignments to come from the country of origin to the Australian border.

Q17a) Over the past year, what was the longest time taken for a consignment of *xxx* to come from its country of origin and arrive in Australia?

Q17b) What was the quickest time you can recall?

Q17c) What was the typical time taken for a consignment of *xxx* to be shipped to Australia?

Experience with biosecurity inspections

We would now like to ask you some questions about the time it takes for your *xxx* consignments to clear customs and quarantine checks in Australia.

Q18a) Over the past year, what was the longest time taken for a consignment of *xxx* to clear customs and quarantine checks?

Q18b) What was the quickest time you can recall?

Q18c) What was the typical time taken for a consignment of *xxx* to clear border inspections?

We would now like you to reflect on your recent experience with customs checks and quarantine inspections when importing *xxx* into Australia.

Q19a) In the past year, have you experienced delays in clearing customs and/or quarantine for your shipments of *xxx*?

- ○ Yes — *GO TO Q19b)*
- ○ No — *GO TO Q20a)*

Q19b) Over the past year, how many times have your shipments of *xxx* been delayed?

Q19c) And about how many shipments of *xxx* in total have you received over the past year?

Q19d) In the most recent instance when you experienced delays, what was the cause of these delays?
(e.g. were they from clearing customs or quarantine, something wrong with the paperwork)

Q19e) Did you incur additional costs, in terms of time or money, from the most recent delay?

- ○ Yes — *GO TO Q19f)*
- ○ No — *GO TO Q19g)*

Q19f) Could you please describe what these additional costs were?

Q19g) Was there anything else you wanted to say about your recent experience with importing goods into Australia?

We would now like to seek your views on why you think your shipments of *xxx* might fail a quarantine inspection.

Q20a) In your experience, what do you think are the three main reasons or factors contributing to why your consignments of *xxx* might fail inspection?

i)

ii)

iii)

Q20b) Do you believe the incidence of failure depends on the supplier and/or the country of origin of the product?

- ○ Supplier
- ○ Country of origin
- ○ Both
- ○ Neither

Q20c) Could you briefly explain why you believe that?

*If the pathway is not "*green coffee beans*", go to Q22a).*

Q21a) Before today, were you aware that the quarantine clearance methods for green coffee beans changed in mid-2013?

- ○ Yes
- ○ No

GO TO Q21b)
Explain the changes, then GO TO Q22a)

Q21b) Can you briefly describe what you understand to be the changes introduced by the Australian Government?

Q21c) What has been the impact of the change to inspection procedures on your business?
(e.g. transport/logistics arrangements, compliance cost changes, change in behaviour?)

Compliance costs for the importer

We would now like to discuss the types of costs associated with your organisation complying with Australia's current quarantine inspection arrangements.

Q22a) Could you please describe the types of costs you face in complying with quarantine inspections in Australia?
(e.g. inspection fees, storage/delay costs)

Q22b) If you are able to, could you please estimate the rates for these costs for a typical consignment of *xxx* that passes the initial quarantine check?
(e.g. for storage costs, $ per container per day)

Q22c) What additional costs do you face if a consignment fails a quarantine inspection?
(e.g. for storage costs, $ per container per day)

Q22d) About what share of your total costs of bringing *xxx* into Australia do quarantine-related costs represent?

Perceptions of Australia's biosecurity system

We would now like to finish the conversation with some questions about your perceptions of Australia's biosecurity system and how it affects (or could affect) your business.

Q23a) How important is it for your organisation to know about changes to quarantine inspection protocols?

Q23b) How you you, or do you, find out about this type of information?

Q23c) What feedback, including complaints, have you offered to other organisations or the Australian Government about Australia's biosecurity system?

Q23d) What impact, if any, would the entry of a new pest or disease to Australia have on your business?

As mentioned in the Plain Language Statement we sent you, this research project is investigating how to design inspection protocols to reduce the costs associated with Australia's biosecurity system while not raising the likelihood of biosecurity hazards entering Australia. One feature of this system could be that importers with a history of good compliance would be rewarded with a lower frequency of inspection.

Q24a) How do you think an inspection system like this affect your business?

Q24b) Do you think such an inspection system would mean you would consider changing your import operations?

- ○ Yes — *GO TO Q24c)*
- ○ No — *END INTERVIEW*

Q24c) What changes do you think you might make to your business?

That concludes the formal part of our discussion. Did you have any further questions or comments about Australia's quarantine inspection system or our project in general?

Thank you again for assisting us with our research project.

Will be in touch within the next two weeks with a written summary of the key information you have provided in this conversation. Please feel free to request that we change or update this information at that time if you notice any information in the summary is incorrect.

If you have any questions about this research, please feel free to contact the interviewers or the Principal Research, Professor Peter Bardsley. All our contact details are in the Plain Language Statement we sent you.

Appendix C: Economic Theory for Biosecurity Intervention Design

The biosecurity inspection problem lends itself to analysis using concepts drawn from microeconomic theory and behavioural economics. The purpose of this Appendix is to draw attention to the relevant ideas in economics that can be applied to designing biosecurity interventions in a non-technical manner. The references discussed herein should be consulted for more detail on specific theoretical developments.

C.1. Game-theoretic treatment of biosecurity inspections

C.1.1. Players, actions and equilibrium solution concepts

The biosecurity inspection setting lends itself to analysis using *game theory*.[48] Game theory provides a way to study strategic behaviour between two or more agents (*players*). These agents have more than one *action* or *strategy* from which they can choose, with their choices affecting the returns (*payoffs*) of at least one other agent in the interaction. Solving the game involves using optimisation techniques to solve for an agent's *best response* to others' anticipated behaviour, where the solution/s for these interconnected optimisation problems of the game (*equilibria*) can be used to predict how the agents will behave in the strategic interaction. The form of equilibrium concept (*refinement*) suitable for a particular setting will depend on its characteristics, such as what each player knows in the game and the extent of uncertainty around actions and payoffs.

In a simplified, stylised representation of the biosecurity inspection process, the regulator and importer can be considered players in the game.[49] The biosecurity regulator can be considered the *leader* in the game, since it is able to choose its actions, such as how frequently to inspect the importer, and convey these to the importer in advance of the importer making any decisions. The importer then responds to the actions by:

- selecting how much effort to put into reducing the likelihood of biosecurity risk material entering the country, if importing operations are vertically integrated; or
- choosing which third-party supplier will provide them with the goods, based on the costs of those goods and the likelihood of them failing inspection.

Since the biosecurity regulator makes the first choice, it can take into account the importer's (expected) response when choosing its own actions.

The type of strategic interaction outlined above is known as an *inspection game* and its properties have been explored in several applications in the economics literature; for instance, see Avenhaus et al. (2002) and the references therein. Furthermore, the appropriate equilibrium concept for this type of problem is the *subgame-perfect Nash equilibrium*, which takes the sequencing of decision-making into account and assumes

[48] For a more extensive discussion of concepts from non-cooperative game theory and their application in economics, see Fudenberg and Tirole (1991) for an extensive theoretical treatment, or Gibbons (1992) for a more applied focus.

[49] It would be possible to extend the representation to include the overseas suppliers as another level in the hierarchy, though doing so appears to complicate the analysis without aiding explanation of the importer's actions to inspection rules set by the regulator.

the importer and regulator perfectly know their own and each other's payoffs.[50] This framework assumes the importer is profit-maximising, rational and self-interested[51] and the regulator is benevolent in seeking to minimise the social costs of the regulatory intervention and potential damages from pest and disease incursions.[52]

In practice, biosecurity inspection interactions occur repeatedly over time between an importer and the biosecurity regulator. The result is a *dynamic game,*[53] where both the importer and regulator make choices over time. Rossiter and Hester (2016) considers the interaction between a biosecurity regulator and a vertically integrated importer over time where the biosecurity regulator commits to using a rule from the CSP family of algorithms. In this setting, the regulator selects the type of rule[54] (CSP-1, CSP-2 or CSP-3) and the rule parameters (such as the clearance number and monitoring fraction) upfront, taking into account the expected (strategic) response of the importer. The importer chooses a level of fixed technology to apply across all consignments imported and then a level of effort which can be varied for each consignment imported.

The assumption of regulator commitment and the nature of incentive structures inherent in adaptive compliance-based inspection rules, such as those in the CSP family, can help constrain the types of equilibrium strategies used by the importer to a smaller set. Rossiter and Hester (2016) restrict the search for equilibrium strategies so that variable effort levels only differ between the regimes of the CSP algorithm of interest.

C.1.2. Accounting for risk preferences in player decision-making

In this setting, both the importer and regulator face uncertainty in the decision-making problem. This arises because it is not known whether a particular consignment contains biosecurity risk material[55] and may also reflect imperfect decision-making by the regulator in the biosecurity inspection process.

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50 Rossiter and Hester (2016) establish the biosecurity inspection game in this way and provide a generic solution for the subgame-perfect Nash equilibrium when the importing activities occur once.

51 The self-interest perspective of the importer can extend to ignoring any social costs that could arise from them introducing biosecurity risk material into the local environment.

52 As noted in Chapter 3.1, this could be extended to consider the reduction in consumer surplus stemming from reduced access or higher prices paid for internationally traded goods resulting from the pass-through of inspection costs to Australian consumers and businesses.

53 The use of dynamic, or repeated, games to analyse regulatory compliance issues has been well-established in the economic theory literature; see, for instance, Greenberg (1984) and Franckx (2001).

54 In a general regulatory setting, it may be desirable to base the incentive scheme facing import-supply chain participants on their entire compliance history, rather than focusing on atypical incidents. The advantage of the CSP family of rules is that they are Markovian in structure; that is, these rules can be expressed in terms of a Markov chain, which then allows a very simple one-period memory structure. The potential advantages of rules with more complex information structures would need to be weighed against the potential difficulties in communicating these rules to biosecurity system stakeholders and in the department being able to implement these rules in practice.

55 Rossiter and Hester (2016) assume that the probability of contamination is known, given the choices of the importer, but the outcome as to whether a consignment contains biosecurity risk material is assumed to be drawn from independent Bernoulli distributions.

Both the importer and regulator face *lotteries* over a finite set of outcomes. Assuming the decision-making environment is perfect,[56] the potential outcomes from the importer's perspective are that the consignment is:

- not inspected;
- inspected and found not to contain biosecurity risk material; and
- inspected and found to contain biosecurity risk material.

Under a perfect inspection environment, the regulator's choices are such that the consignment is:

- inspected and, if required, treated to rectify it for any biosecurity risk material;
- not inspected but does not pose a threat to the biosecurity objective (in that it is free of biosecurity risk material); and
- not inspected and contains biosecurity risk material that threatens the regulator's objective.

Each of these types of outcomes for the importer and regulator involve different payoffs for each party. In linking the probabilities of the different outcomes and each player's preferences over those outcomes, the objective functions of both players are represented by a *von Neumann-Morgenstern utility function*.[57] As part of solving for the game's equilibrium, this means assuming both players are *expected utility maximisers*.[58]

An important consideration in constructing the objective functions is determining each player's utility function over the outcomes of the lottery. This involves the possibility of dealing with the *risk preferences* of each player. Rossiter and Hester (2016) assume both the importer and regulator are risk neutral. Such an assumption simplifies the mathematical representation of the problem, since the objective function becomes a weighted average of the payoffs for each outcome in the lottery, with the weights given by the probability of each outcome occurring.

However, there are good reasons to think the importer, the regulator or both players could be *risk averse*. Under risk aversion, the importer or regulator would prefer to receive the expected value of the lottery than face the risk inherent from the lottery itself. Having players in the game being risk averse could lead to substantially different behaviour than if both the importer and regulator are risk neutral. For the vertically integrated importer, it could imply that they are more conservative in their choices of technology and effort so as to reduce the likelihood of biosecurity risk material being present in their consignments. A risk-averse regulator would prefer to inspect consignments more frequently than a risk-neutral regulator, such as through choosing CSP rules with a higher clearance number and/or monitoring fraction.

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[56] See Section 3 of Rossiter and Hester (2016) for a discussion of the implications of imperfect decision-making in the inspection process for the outcome of the strategic interaction.

[57] Expected utility theory and the existence of von Neumann-Morgenstern utility functions arise from a set of axioms that govern preferences over lotteries (Hashimzade et al., 2012, 946). Violations of these axioms of choice under uncertainty form the basis of a considerable part of behavioural economics, which is discussed in more detail later in the Appendix.

[58] A more formal discussion of decision-making under uncertainty, including the foundation axioms, and risk aversion can be found in standard microeconomic theory textbooks; for example, see Chapter 2.4 of Jehle and Reny (2001).

C.2. The role of information in biosecurity regulation

C.2.1. Information asymmetries in biosecurity inspections

An added complication in the biosecurity setting is that participants in the import-supply chain have an information advantage over the regulator. There are two main types of information asymmetries that arise in regulation. The first, known as *adverse selection*, comes from importers (and their suppliers) knowing more about their costs of mitigation, the processes they can adopt to influence the likelihood of biosecurity risk material appearing in consignments and the likely effectiveness of these options than the regulator.

The second type of information advantage stems from the regulator being unable to directly observe all the actions taken by agents in the import-supply chain to reduce the likelihood of biosecurity risk material entering the country. Such a problem is referred to as *moral hazard*. In the Australian biosecurity context, the Department of Agriculture and Water Resources (the department) can only observe what could be seen as a "signal" of the effort applied to reduce biosecurity risk material being present in consignments, since inspections yield a binary pass/fail outcome. However, importers and their agents in the supply chain who apply greater biosecurity abatement effort should have a lower probability of failing inspection.

A desirable characteristic of an inspection regime would be to encourage importers to reveal some of this private information to the regulator. In the biosecurity context, this could include information about the mitigation processes that can be independently verified. If importers or their suppliers can gain an advantage from voluntarily revealing this information to the department, such as by allowing the importer to be subject to different inspection rules that may be more advantageous to them, the incentives for firms to disclose activities that reduce the likelihood of biosecurity risk material entering the country can be improved.

More formally, the two information problems in regulation described above can be tackled using the tools of *contract theory*, and more specifically the class of economic models known as *principal-agent models*.[59] This type of framework extends beyond relationships that are contractual from a legal perspective, such as that between an employer and employee, and can accommodate any type of relationship, particularly where the information issues highlighted above arise. Regulation is a prominent example where this framework has been applied, particularly in relation to natural monopolies, such as utilities (e.g. Baron and Myerson, 1982; Berg, 1998; Blackmon, 1994; Laffont and Tirole, 1993). For the biosecurity inspection setting, the principal of the arrangement is the regulator and the agent is the importer as the regulated entity.

The *incentive regulation* approach outlined in Chapter 3.2.3 is underpinned by principles of contract theory and the economics of information. Incentive regulation acknowledges the information advantage of regulated entities and uses the regulated entity's information superiority and profit-maximising motives to encourage

[59] An extensive treatment of these types of models as applied to economic problems can be found in Bolton and Dewatripont (2005) and Laffont and Martimort (2002). In the regulatory compliance literature, principal-agent frameworks have been used to frame issues around tax compliance and optimal auditing (e.g. Reinganum and Wilde, 1985; Ravikumar and Zhang, 2012) and the use of incentive contracts in environmental regulation (e.g. Goldsmith and Basak, 2001).

particular behavioural responses (Vogelsang, 2002). The reward structure under incentive regulation is based on outcomes and, as for risk-based regulation, some discretion is offered to regulated entities in how they meet the stated regulatory objective.

In biosecurity inspections, the department implicitly offers an arrangement (or *incentive contract*) to an importer by specifying particular rules governing the inspection process.[60] In developing an optimal (or nearly optimal) arrangement for regulation to deal with the trade-offs inherent in the regulator's own objectives, it is desirable for the inspection regime to be able to distinguish between regulated entities with different abilities (or costs) to mitigate biosecurity risk. For example, one supplier may already use a production process for quality control purposes that significantly reduces contamination risk, whereas another may still be using more primitive technologies, because of their geography, production cost structure or lack of access to a skilled workforce. The ability to distinguish based on an importer's (or supplier's) "type" would provide an incentive to those who can implement mitigation strategies to reduce biosecurity risks at low cost to take up those technology options.

C.2.2. Menus of regulatory contracts

Chapter 3.4 noted that there are likely to be a range of import-supply chain participants with different characteristics on any given pathway. Because some of this information is private in nature, and not readily discoverable by the regulator, it is not clear what type of arrangement the regulator should offer a particular importer without knowing all the relevant information about them.

Under certain technical conditions,[61] contract theory offers a way to overcome these information asymmetries by offering the importer a *menu of regulatory contracts*, with the options comprising the menu constructed by drawing upon the *revelation principle*. The intuition behind the revelation principle is that only one regulatory contract needs to be considered for each "type" of importer, but that it is optimal (i.e. in the importer's best interests) for the importer to choose only the regulatory contract that has been designed for her type. This optimal selection by the importer ensures each contract is *incentive compatible*.[62] Based on the choices made by the importer, the regulator is able to elicit information about that importer's characteristics, under the assumption that the importer has chosen the regulatory scheme that is "optimal" for them.

In practice, there are likely to be a potentially infinite number (or continuum) of types of import-supply chain firms and, at best, the regulator may have some knowledge of the distribution of characteristics over the relevant population of firms. Furthermore, being able to implement regulatory menus requires offering importers only a

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60 Given inspections tend to be repeated interaction, the issue of how early performance should affect the terms of subsequent incentive contracts arises. For a discussion of the implications for optimal incentive contract design, see, for example, Lewis and Sappington (1997).

61 For example, see Laffont and Martimort (2002).

62 The regulator also needs to consider that the importer may only import particular products if they expect to make a profit from such activities. From a contract theory perspective, this forms the importer's *participation*, or *individual rationality*, constraint. In practice, the regulator's policy settings may mean engaging in the importing process is not profitable for some types of firms. In this case, their participation constraint is violated, which results in the regulator's choices *implicitly* changing the characteristics of importing firms for particular products.

relatively small number of menu options so that the system can be manageable.[63] This truncation of the problem means the regulator cannot perfectly design a regulatory contract to suit each type of importer and extract all the potential *information rents* from importers. Instead, for some types of importers, there will be some level of inducement remaining in the menu options as part of encouraging firms to reveal their private information.

In constructing the simplified menu options for import-supply chain participants, the biosecurity regulator will need to take into account the incentive compatibility and individual rationality[64] requirements of all types of importers. Because of the dependence of results across different types of importers, the menu options for rewards and punishments offered by the regulator are not a group of independent alternatives. Specifically, the terms of one option in the menu will influence the terms of other options that the importer would willingly accept (Sappington, 1994, 261).

In the biosecurity context, care needs to be taken to provide sufficient rewards for importers to take up measures that will strengthen compliant behaviour, while providing relatively limited rewards for those firms who choose production approaches associated with a greater likelihood of non-compliance. The general principles provided by Sappington (1994, 261) are informative for this type of regulatory setting. In particular, higher rewards should be coupled with more stringent requirements or eligibility criteria on import-supply chain participants.

C.3. Designing robust regulatory regimes

C.3.1. Incentive regulation as a mechanism design problem

As outlined in Chapter 3.2.3, the regulator seeks to design an incentive scheme within the regulatory framework which allows the regulated entity's objective, which is often taken as maximising profits, to be aligned, or at least better aligned, with the regulator's objective. This becomes a problem of *mechanism design*[65] to choose the appropriate suite of regulatory interventions that would be best from a societal perspective.

Mechanism design rests on the principles of *normative* economic analysis, dealing with what should happen in economic interactions and how economic systems should be designed. As noted in Mookherjee (2008), the "mechanism" which defines the rules of the interaction between agents encompasses many aspects such as:

- who makes the key decisions in the interaction;
- who communicates with whom and in what fashion; and

63 As noted in Chapter 3.4.4, the potential limited ability to commit to specific protocols may restricts the range of feasible incentive programs that can be offered by regulator (Sappington, 1994). In practice, such constraints also must be recognised by the regulator when menus of regulatory contracts are being formulated.

64 If the regulator were *deliberately* trying to encourage certain types of import-supply chain participants from engaging in importing activities, then the regulator might seek to violate the individual rationality constraint for those types of importers. However, there may be practical or legal limits, such as through the SPS Agreement, on a biosecurity regulator's ability to implement this type of strategy.

65 See Baliga and Sjöström (2008) for a discussion of recent developments in the theory of mechanism design.

- how resources (or financial returns) are allocated based on choices made by all agents.

In the biosecurity context, the regulator controls the choice of mechanism and can ideally construct a regulatory system which is optimal in the sense of *societal welfare*, or some other *normative criterion*. Such a *social welfare function* would take into account the trade-off between the cost to society of intervening in the importing process and the potential harms that leakage of biosecurity risk material could cause to the environment and the domestic economy.

Mookherjee (2008, 239) explains that mechanism design problems are usually formulated to embed some degree of uncertainty around the preferences and technologies of individual agents (e.g. importers) in the strategic interaction. Furthermore, it is typically assumed that information concerning these preferences and technologies is dispersed throughout the population. The normative criterion of the biosecurity regulator, in this context, would incorporate sensitivity to this uncertainty and require allocations of risk and financial returns based on the mechanism to respond suitably to changing preferences and technology.

Some of the "tight" theoretical results around designing optimal mechanisms in contexts such as regulation rely in part on particular properties of preferences and allocations (Mookherjee, 2008, 255). This reliance on and sensitivity to properties that the mechanism designer and individual agents may not know precisely has been identified as a significant shortcoming of many mechanisms developed in the economic theory literature.[66] More recent contributions to the literature (e.g. Bergemann and Morris, 2012) have focused on designing mechanisms that are more robust by relaxing some of the strong informational assumptions, such as the preferences and beliefs[67] of economic agents, and consider weaker *equilibrium* solution concepts. In this sense, there may be a desire for simpler and potentially sub-optimal mechanisms that, for instance, take into account factors which the regulator may not know with much certainty and are sufficiently robust to apply across a wide range of scenarios.

C.3.2. Applying the economic design methodology in regulation

In practice, the theoretical structures described thus far in this Appendix are useful for gaining insights and developing intuitive explanations into how institutional structures operate and the optimality of alternative candidate mechanisms. However, the design of institutions for real-world applications requires consideration of detail, including all the features of economic interactions, rather than just the principal features. The desire for analytically tractable solutions for intuitive purposes requires simplifications of the real-world environment. In doing so, there is the risk that

66 For example, see the foreword by Eric Maskin to the volume by Bergemann and Morris (2012).

67 A frequently used assumption in the literature is that economic agents hold prior beliefs about the distributions of particular quantities (random variables) of interest which they then update according to Bayes' rule of conditional probability. Such an approach gives rise to the *Bayesian mechanism design* approach; see Hartline (2012) for an extensive discussion of this literature. Bayesian updating has been applied in the biosecurity literature in other contexts, such as learning for adaptive management of invasive species (Springborn, 2014). Such an approach also fits naturally with importers learning about the biosecurity compliance of suppliers in the case where the importer and supplier are not integrated as part of the one firm.

ignoring certain small features present in interactions could result in an entirely different set of institutions being more suited to addressing the problem of interest.

Roth (2002) notes that such complexities in real-world applications require using more engineering-style approaches, which combine theory with computer-based simulation modelling[68] and experimentation to develop robust and implementable institutional structures. Experimentation in a laboratory environment followed by small-scale field trials are envisaged as part of follow-up projects. Computational modelling also forms an important part of pre-testing before the laboratory experiments and field trials. Such testing allows the department to be better informed about the likely effectiveness of different incentive schemes, be more aware of potential risks and develop an understanding about the robustness of particular protocols.

C.4. Building in behaviour-based devices into biosecurity intervention design

C.4.1. Incorporating behavioural economics into "standard" theoretical frameworks

The research methodologies considered in this report to date have been underpinned by what have been referred to as "standard" economic assumptions associated with the neoclassical approach to economics. Implicitly, these frameworks assume economic agents are fully optimising, self-interested, rational and have access to all relevant information to make decisions. However, Bhargava and Loewenstein (2015) notes that this assumes away many potentially problematic behaviours associated with human limitations and their consequences in real-world decision environments.

The field of *behavioural economics* seeks to strip away some of these strong assumptions to explain how people actually behave when making economic decisions. It draws together knowledge from other social sciences, particularly psychology, in constructing and testing[69] theories of human behaviour, including aspects such as the impact of various cognitive biases on decision-making by economic agents. There has been widespread interest in considering how insights from behavioural economics can be used to improve the operation of government policies.[70] Furthermore, Shogren (2012) highlights that augmenting policies designed using the economics of information and incentives with insights from behavioural economics may offer ways to address policy objectives such as environmental protection at a lower cost to government and society.

As part of scoping options for improving the design of biosecurity interventions, the project team sought to draw upon insights from theoretical behavioural economics

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68 In this vein, Rossiter and Hester (2016) use simulation modelling to investigate the application of CSP rules to importer interactions where analytical solutions are not readily available.

69 Behavioural economics readily lend themselves to testing in experimental economics laboratories. The experimental economics literature is particularly relevant for the design of laboratory experiments in CEBRA Project 1404C.

70 For example, Alm et al. (2012) and Hashimzade et al. (2012) discuss the application of behavioural economics to tax compliance and tax evasion. Knetsch (2011) and Lunn (2014) discuss the use of behavioural economics in regulation, while Shafir's (2013) edited volume features a wide variety of public policy applications, albeit more from the perspective of applied behavioural science.

and considered how these may be used to augment frameworks developed using "standard" economic assumptions. This is in keeping with the pragmatic approach to applying behavioural economics to public policy espoused by Raj Chetty (Chetty, 2015). Incorporating behavioural economics in this manner can:

- offer new policy tools to influence behaviours and expand the set of outcomes achievable through policy mechanisms;
- yield better predictions about the effects of existing policies; and
- generate new welfare implications for policy analysis based on distinguishing agents' experienced utility (reflecting their actual well-being) and their decision utility (the objective function they maximised when making choices) (Chetty, 2015, 1-2).

This strategy has resulted in framing and analysing biosecurity intervention design problems using standard (neoclassical) assumptions, as done in this report and Rossiter and Hester (2016), to understand the incentive properties of different mechanisms. Subsequent experimental testing will then be used to investigate whether devices drawing on behavioural economics can aid the operation of these designed protocols.

Given this sequencing of work, the final sections of this Appendix briefly outlines some of the behavioural economics explanations that could assist in the implementation and operation of designed biosecurity interventions.

C.4.2. Deviations from the expected utility theory paradigm

A significant portion of behavioural economics research has sought to explain deviations from the predictions of expected utility theory as demonstrated through repeated observation. Two observed traits of human behaviour of particular interest when crafting regulation are:

- *loss aversion*, where economic agents respond to losses (relative to a reference point) differently from corresponding gains. Since changes in the reference point can mean gains can be re-expressed losses and vice versa, it can give rise to preference reversals, violating the transitivity axiom underpinning expected utility theory; and
- *ambiguity aversion*, where agents prefer to bet on events where they know the relevant probability distribution precisely than those where the distribution is uncertain (i.e. "ambiguous" events), even if the bet on ambiguous events may deliver the agent a larger "expected" payoff (Hashimzade et al., 2012, 958). This, in turn, violates the notion of agents being subjective expected utility maximisers.[71]

In the biosecurity inspection context, loss aversion may arise if an importer behaves more conservatively in their attitudes to compliance when alerted to the consequences of losses associated with failing inspection than an equivalent representation of gains associated with being compliant. Under the expected utility framework, these scenarios are symmetric and should not result in different behaviours. However, if biosecurity system stakeholders react differently between these two representations,

[71] See Ghirardato and Marinacci (2002) for an axiomatic treatment of subjective expected utility theory.

this gives rise to the regulator being able to *frame* a situation[72] by altering the description of the status quo.[73] This would allow the biosecurity regulator to exploit stakeholders' *reference-dependent* utilities and sunk costs in decision-making.

The potential for behaviours associated with ambiguity aversion[74] already exist in the current implementation of the Compliance-Based Inspection Scheme (CBIS). Until June 2016, the department provided only vague information on the parameters used in the inspection rules in terms of ranges. For instance, the monitoring fraction in the CSP-3 algorithm is specified as a range between 10 and 50 per cent, dependent on the commodity. Such instructions could result in a range of different importer reactions, such as:

- effectively ignoring the incentive scheme offered, in part reflecting *cognitive inertia*, by preferring to stick with their supply-chain strategies as if they were subject to a mandatory inspection regime;[75] or
- dealing with the ambiguity by focusing on the least favourable incentive scheme for them (i.e. the monitoring fraction of 50 per cent) and basing their behaviour on that assumption.[76]

In some cases, the responses to ambiguity could result in importers and others in the import-supply chain behaving in ways that reduce the likelihood of biosecurity risk material being contained in consignments. However, it is not clear *a priori* what effect this will have on importer decision-making in the context of these highly complex rules. Such considerations warrant assessing the effect of providing different levels of information about inspection rules experimentally as part of a follow-up project.

C.4.3. Decision-making tendencies and sources of cognitive bias

Understanding the cognitive processes people go through in making decisions in economic environments is critical for identifying potential influences for implementing government policies, programs and regulations. Many formal economic

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72 The concept of framing also has wider application to how regulation is applied and developed. For example, Nash (2006) demonstrates that the way in which regulatory instruments and schemes are described can have a wider influence on their perception by stakeholders, including members of the community, which in turn influences regulators' attitudes towards different ways of regulating activities. See Feldman and Perez (2012) for an experimental investigation of framing effects in regulation.

73 For more examples of framing and its psychological foundations, see Kahneman and Tversky (1984). *Prospect theory* (Kahneman and Tversky, 1979) or the more theoretically consistent *cumulative prospect theory* (Tversky and Kahneman, 1992) are able to encompass loss aversion and the related concept of diminishing sensitivity, where agents are more sensitive to a given difference on a dimension when the reference point is closer than when it is further away (Kahneman and Tversky, 1991, 1049). Koszegi and Rabin (2006) go further to develop a model for reference-dependent preferences with loss aversion.

74 For a more formal treatment of ambiguity aversion, see Einhorn and Hogarth (1986) or Camerer and Weber (1992).

75 Such an outcome could also arise as the result of *status quo bias* (Samuleson and Zeckhauser, 1988), where importers have a general preference to retain their current supplier arrangements compared with alternative options.

76 Importers could also anchor their beliefs about the actual monitoring fraction used by the department based on the most favourable rate to them (i.e. 10 per cent) or they could make some other guess, such as the midpoint of the interval, on the "true" rate applied by the department. Fundamentally, importers' beliefs about the true rule parameters are likely to have a material effect on their behaviour under this type of inspection protocol.

models of behaviour assume economic agents make decisions in a controlled, rule-based, systematic and analytical manner (Antonides, 2008, 228).

In practice, economic agents are limited by:

- the information available to them on which they can base their decisions;
- their own cognitive limits related to the ability to process the available information and deal with the complexity, or tractability, of the decision-problem; and
- the time constraints they face in making a decision.[77]

This means many situations involve agents making decisions based on intuition and governed by simplifying *heuristics* – that is, mental shortcuts that involve simplified versions of the approximate problem or rule. Under this type of decision-making process, importers could choose to stick with their existing arrangements, rather than using information available to them about different suppliers' biosecurity compliance to inform how they choose their suppliers. Furthermore, for a complex inspection protocol, importers may instead approximate use a simplified version of the rule to inform their decisions around supplier choices.

These influences on stakeholder decision-making provide two important policy implications for the biosecurity regulator. First is the opportunity to reduce the cognitive load on importers in making their supplier decisions by providing consolidated feedback on their biosecurity inspection performance. The regulator has the opportunity to *frame* this feedback, using simple measures of performance that are easily understood by the importer, in a way that can encourage the importer to make decisions in line with the regulatory objective. For example, providing easily digestible (graphical) comparisons of inspection failure rates over time could help importers identify suppliers with higher rates of non-compliance. Importers could then use this information to provide feedback to suppliers around why consignments are failing inspection, thereby improving compliance within their existing supply chain, or choose to switch to suppliers with lower failure rates.[78]

In addition, consideration needs to be given to ensuring inspection protocols, and their inherent incentive structures, are sufficiently well-understood by stakeholders. This could mean using different ways to explain the protocol – such as in words and diagrams – and assessing whether more complex incentive structures deliver better regulatory outcomes. In the biosecurity inspection context, the CSP-1 rule has a relatively easy incentive structure across two modes of inspection frequency that can be easily explained to stakeholders. In contrast, the additional modes in the CSP-3 algorithm provide added complexity that may result in stakeholders using simplified (or truncated) approximations of the rule on which to base their decisions. Whether

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77 Such constraints on decision-making are referred to in the economics literature as the theory of *bounded rationality*; see Simon (1955) for the classic reference in this literature. Gigerenzer and Goldstein (1996) provide an application of bounded rationality and *satisficing* behaviour based on heuristics.

78 Providing targeted feedback on biosecurity inspection performance may also guard against other cognitive biases dominating decision-making. For example, regulatory stakeholders may tend to focus more on positive or negative experiences, rather than an "average" experience, when considering a series of inspection events. More recent events may also be more prominent in their memory, which may mean stakeholders make decisions according to a reference frame that is not representative of the overall experience. Such cognitive biases have been documented in the *peak-end rule* (Kahneman, 1994) approach to temporal integration of decision-making.

this changes the way importers respond to the rules in terms of their actions is something that can be examined experimentally.

C.4.4. Social or other-regarding influences on importer decisions around biosecurity compliance

Many models of inspections treat compliance decisions as choices made by individual agents based on the relative penalties and rewards they face for different actions. However, there may be many other motivations for particular behaviours that have a social dimension or are influenced by how society views compliance. Attitudes to regulatory compliance may also depend on notions of "fairness" and "justice" related to the design of protocols and the administration of the biosecurity inspection system.[79]

One mechanism that can reinforce compliant behaviour is via *social norms*[80] – the customary rules that coordinate interactions with others that remain in force through mutually conforming behaviour (Young, 2008).[81] In the biosecurity context, a societal expectation of compliance with biosecurity requirements at the border could be sustained by the threat of social disapproval or punishment for violating these expectations. On the other hand, if social attitudes to non-compliance are weak, then import-supply chain actions around compliance are likely to be driven much more by "purely economic factors" that are private in nature.

Social punishment mechanisms operating as "psychological" taxes, in the form of shame,[82] social disapprobation or a loss of commercial reputation (Tan and Low, 2011, 36), can mean actions consistent with regulatory compliance are in importer's self-interest. Furthermore, Tan and Low (2011) argue government actions that act to change social norms, such as encouraging a culture of biosecurity compliance, may provide longer-lasting societal benefits than only shifting private incentives for compliance.

Since social norms are a key determinant of reputational benefits and costs of particular actions (Sunstein, 1996, 916), understanding the extent to which societal conventions influence choices around compliance decisions is critical to determining which types of regulatory approaches are most appropriate (Kirchler et al., 2008, 211). These considerations, among others, underscore the need for regulators to move away from one-size-fits-all policy mechanisms. Instead, "differentiated policy

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79 The literature on tax compliance considers these types of influences on behaviour extensively; see, for example, Alm et al. (2012) and Braithwaite and Wenzel (2008).

80 Individual norms, around moral reasoning and personal values, also influence attitudes to compliance (Kirchler et al., 2008, 218). These are more difficult for regulators to influence, though internalising social norms of proper conduct (Young, 2008) provides an avenue through which individual behaviours can be influenced by regulatory conduct.

81 Social norms are also closely related to the notion of reciprocity, in which agents are more cooperative (brutal) in response to friendly (hostile) actions than would be predicted by models of self-interest. When regulatory contracts are *incomplete*, in that they cannot be made contingent on all verifiable measures informative of the agent's effort (Fehr and Gächter, 2000, 176), reciprocity can substantially contribute to the enforcement of incomplete contracts.

82 Perceptions of shame for non-compliance could be reinforced through institutional arrangements that publicly announce those who have not complied with requirements; see, for example, the monthly Failing Food Reports (http://www.agriculture.gov.au/import/goods/food/inspection-compliance/failing-food-reports) issued under the Department of Agriculture and Water Resources' Imported Food Inspection Scheme.

structures that respond to the heterogeneous psychological and situational factors that characterise actual regulatory environments" (Feldman and Perez, 2012, 407) are likely to be more appropriate to achieve better outcomes for society.

Perceptions of fairness and justice among those subject to biosecurity regulations can also affect compliance. In systems seen as "fair", research in the tax compliance literature (for example, see Alm et al., 2012; Kirchler et al., 2008) suggests that trust builds among those subject to the requirements and, consequently, compliance rises in a voluntary manner. Kirchler et al. (2008) describes three notions of fairness that have emerged in the social psychology literature, namely:

- *distributive justice*, which relates to the desire for individuals or groups to be "treated relative to their merits, efforts and needs" (Kirchler et al., 2008, 218). In practice, this means ensuring the regulator deals with stakeholders in similar circumstances in similar ways from the perspective of regulatory interventions and outcomes;
- *procedural justice*, where the procedures used by the regulator are perceived to be "transparent, impartial, respectful and inclusive of others' concerns" (Braithwaite and Wenzel, 2008, 322) and that regulated entities have a voice in policy-making; and
- *retributive justice*, which relates to how regulatory interventions are perceived by stakeholders and the form and severity of penalties imposed for non-compliance.

In the context of biosecurity inspections, stakeholder interviews conducted as part of this project emphasised the importance regulated entities place on consistent treatment by department officers. Some of the recommendations in Chapter 5 suggest ways in which distributive and procedural justice in the biosecurity system can be strengthened. The menu of regulatory contracts approach advocated in this report also provides an avenue to strengthen regulated entities' participation in the policy process, since they are able to choose the regulatory scheme they follow from a list devised by the regulator, thereby improving procedural justice. This is reinforced by the experimental economics literature, which suggests that allowing choice of institutional arrangements has a positive influence on cooperation and compliance in these types of decision environments; see, for example, Sutter et al., (2010).

The ability to impose direct penalties for non-compliance is limited by international agreements to which Australia is a signatory. However, where "benefits" available through continuous sampling plan protocols or priority queueing are able to be withdrawn from non-compliant regulated entities, the extent of these implicit penalties may need to be moderated by the potential deleterious effects on "voluntary" compliance.