Ministry for Primary Industries
Manatū Ahu Matua

How valuable is that plant species? Application of a method for enumerating the contribution of selected plant species to New Zealand's GDP

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MPI Summary

BACKGROUND

This report was produced for MPI by the New Zealand Institute of Economic Research (NZIER).
MPI recognised there were gaps in knowledge about the economic value of some plant species that are important to New Zealand. The report will be used to better support the biosecurity system by addressing those gaps.
The report provides contextual information useful to the governance of the biosecurity system, and services pest risk assessments when potential economic consequences of plant pests and diseases need to be estimated.

SCOPE

The report has calculated the approximate economic values of 65 plant species in New Zealand, based on market activity in the 2012 financial year. The approximations do not include non-market values such as ecosystem services.

VALUATION METHODOLOGY

The valuation method used in the report is a new approach, and a first step towards developing a consistent approach to valuing individual plant species in economic terms. The measure of value is 'contribution to GDP', meaning the entire value chain of a plant is considered rather than just the value of export or domestic sales.

This approach enables species that contribute their value through dependent livestock industries to be valued alongside the plant species that have traditionally been easier to estimate a value for, e.g. horticultural and forestry species.

The valuations are based on official statistics (supplied by Statistics New Zealand) supplemented by interviews with industry participants, past industry performance data, journal articles, consultants' reports, informed observers and NZIER knowledge of relevant plants and economic analysis.

Note: The valuations are approximations. This means that it is the order of magnitude of the plant values that is relevant, rather than the exact number calculated.

The approximate values are based on 2012 data. This means that where there has been strong industry growth or decline, these newer changes need to be taken into account in application of the knowledge in the report.

APPLICATION OF THE REPORT

The report should be used when:

- approximation is appropriate (i.e. when orders of magnitude are sufficient)
- other information sources are scarce – the most useful plant valuations will be of the species for which economic value information has previously been scarce or incomplete
- needing to augment other sources of data – for plants where other sources of economic data are available and updated regularly, this report might supplement but not replace those sources
- a wider context about plant values is needed.

NZIER
NEW ZEALAND INSTITUTE OF ECONOMIC RESEARCH

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NZIER report to the Ministry for Primary Industries

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About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice to clients in the public and private sectors, throughout New Zealand and Australia, and further afield.

NZIER is also known for its long-established Quarterly Survey of Business Opinion and Quarterly Predictions.

Our aim is to be the premier centre of applied economic research in New Zealand. We pride ourselves on our reputation for independence and delivering quality analysis in the right form, and at the right time, for our clients. We ensure quality through teamwork on individual projects, critical review at internal seminars, and by peer review at various stages through a project by a senior staff member otherwise not involved in the project.

Each year NZIER devotes resources to undertake and make freely available economic research and thinking aimed at promoting a better understanding of New Zealand's important economic challenges.

NZIER was established in 1958.

Authorship

This paper was prepared at NZIER by Chris Nixon.

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Key points

The aim: to assess the economic value of selected plant species

This report is focused on supporting the biosecurity system by estimating economic values attributable to 65 plant species in New Zealand, in the 2012 production year. To value the specified plant species, we used as our yardstick the contribution to Gross Domestic Product (GDP), or the sum of all income for each species.

Our valuations are based on official statistics supplemented by interviews with industry participants, past industry performance data, journal articles, consultants' reports, informed observers and our knowledge of relevant plants and economic analysis.

Better information leads to informed decision making in biosecurity

The report addresses a gap in the Ministry's knowledge about the economic value of some of the species studied. It does so by setting out an overview of the indicative value (in 2012) of 65 economically valuable plant species. We also illustrate the potential impact of those plants on dependent industries (e.g. livestock industries).

Having an overview of indicative values is beneficial to the biosecurity system because it provides:

- a quick understanding of the potential economic consequences of plant pests and diseases on plants species, particularly for plant species that we have not had values for previously
- contextual information useful to the governance of the biosecurity system.

This information will enable better informed decision making across the biosecurity risk management system.

From output (value of production) to income (contribution to GDP)

We have used contribution to GDP – the income derived from each plant species – to compare the value to New Zealand of products of plant species consumed in both New Zealand and overseas. In economics, GDP is also known as 'value added': it includes wages, salaries, and profit (before tax) plus depreciation and any indirect taxes net of subsidies.

Our methodology uses the national accounting framework to estimate contribution to GDP. This is done by estimating output and then attributing income (contribution to GDP) at each stage of the value chain (see Table below for an overview of our approach) to derive values for each species.

This is different from other ways of estimating plant value which rely on valuing sales, particularly export sales. The flaw of methods that rely on export sales is that they do not capture the value from domestic consumption of the products. The main reason for choosing this GDP method is so we can value plant species produced for both the export and domestic markets on a comparable basis e.g. many arable crops (wheat, barley, maize etc.) are not major exports but have significant domestic value, and so using a valuation approach that takes account only of export sales would not enable that significant value to be estimated.

In preparing this report we have:

- compiled annual figures for Gross Output value and the contribution to GDP derived from particular species, using estimates from the 2012 production year
- assembled data on all identified species, identified gaps in available information and attempted to fill them by contacting those knowledgeable in the industries or from available statistics.

Framework for identifying contribution to GDP with examples

2012 year

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
The Gross Output value is calculated at each stage of the value chain e.g. nursery, farmgate, processing, domestic, and export	Impact on other industries e.g. the impact of ryegrass on livestock production is a substantial 75%	Share of Gross Output value[1] equals Gross Output value minus Intermediate Consumption.[2] We have estimates of the share of Gross Output value from the Input-Output tables	Gross Output value multiplied by impact (%) multiplied by the share of GDP equals the contribution to GDP at each stage of the value chain
Example one: apples: nursery stage			
Nursery ($7.8 million)	100% (100% impact on the apple industry since nurseries supply the apple industry)	GDP share equals 0.37	$7.8m x 100% x 0.37 = $3.0 million (rounded)
Example two: brassicas for fodder at the farmgate stage for dependent industries			
Dairy farmgate ($10,828 million)	1% (estimated impact on dairy according to DairyNZ estimate)	GDP share at farmgate for livestock is 0.49	$10,828 x 1% x 0.49 = $58.1 million
Notes (1) The share of Gross Output value that contributes to GDP (also known as value added in economics) includes wages, salaries, and profit plus depreciation and any indirect taxes net of subsidies. The residual by definition is Intermediate Consumption i.e. (Gross Output value (column I) minus Impact on GDP (column IV)). Profit includes return on capital and land ownership, and managerial expertise (e.g. profit-shares or bonuses). (2) Intermediate consumption includes the goods and services used in making a product or service. Accounting, marketing and sales activity, transport, storage, maintenance and R&D are inputs and part of intermediate consumption. Note that we do not have a direct estimate of Intermediate Consumption. We do have an estimate of contribution to the economy for each species.			

Source: NZIER

Challenges

There were a number of challenges in putting this data together. Avoiding double counting is a major issue. A bakery may earn $100,000 by selling bread but needs to pay suppliers $50,000 for intermediate inputs (flour, butter, eggs, electricity etc.). The income (or GDP contribution to the economy) added by the baker is therefore $50,000. If we didn't take away the intermediate inputs, we would simply double count actual output at every stage in the supply chain. But the national accounting framework is designed to eliminate that.

To partly avoid double counting we have modified estimates in some areas. In particular, we have used a "Processing and Wholesaling" margin (rather than Gross Output) for the stages between primary production and sales into final demand (both

domestic and export).[1] We still believe there may be some double counting at the domestic and export sales part of the value chain, however the resources that it would take to estimate the double counting are significant[2] relative to the resources available for this project.

The way we have set up the analysis reflects what we see in the market. Apart from the processing and wholesaling part of the value chain more profit is made the closer you are to the consumer. However, a grower dominated single marketing entity (Zespri) has been set up to counteract this in kiwifruit markets. Therefore, the individual marketing chain estimates that are observed in standard accounting do not reflect the contribution to GDP at each stage of the marketing chain. Although the overall GDP contribution estimate for kiwifruit still represents a good proxy, to better approximate kiwifruit contribution at each stage would require a more in-depth study of this industry than is possible in this study of values across a wide range of species.

The valuations show that although the end point is the same, i.e. a measure of contribution to GDP, the means of getting there can be quite different and specific to a particular species. For instance:

- some of the bigger industries have good data supported by Statistics New Zealand's export data and industry surveys (approximately 11% of plant species examined)
- many of the crops and some crop-dependent industries are produced for the domestic market where we have only industry data or industry approximations (approximately 55% of plant species examined)
- other industries fall well below the radar of statistical collection. We have obtained estimates from industry participants where possible and made assumptions where necessary (approximately 34% of plant species examined).

Consequently, there are gaps in the evaluation for the 2012 year (the base year used). In some cases, information has not been forthcoming because of confidentiality issues or lack of data.

For plant varieties with smaller Gross Output values, e.g. chillies or celery, the lack of data may not be a material issue for national assessment. But for those with more substantial economic activity further discussion with industry may be useful in improving the information on which the valuations are based.

This report proceeds by outlining some factors in choice of valuation method, findings of the literature review, refinements in the methodology, and current information gathered about plant species, with estimated values.

[1] Gross Output at the Processing stage minus Gross Output at the farm/orchard gate equals the Processing and Wholesaling margin.

[2] At least 10 to 15 times the resources used in this project.

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1. Introduction

The purpose of this report is to provide an overview of the indicative value of the identified economically valuable plant species and show the potential impact of those plants on dependent industries (e.g. livestock industries). In doing so, the report fills a gap in the Ministry for Primary Industry's (MPI's) knowledge on the economic value of selected plant species.

The economic values calculated in this report are 'contributions to GDP' (income from each plant species).[3] There are broadly two intended uses of the plant valuations:

- **pest management assessments** that enable decision making across the biosecurity system. Specifically, the approximate estimates of species value are key data needed when potential economic consequences of plant pest and disease incursions are estimated. Therefore, the valuations can inform:
  - pest risk assessments done to underpin phytosanitary measures on importation pathways
  - rapid risk assessments done to underpin the initial stages of incursion responses
  - pest risk assessments that underpin MPI's Emerging Risks System
  - pest risk assessments that underpin MPI's organism ranking system (a system that compares the relative risks of a number of pests)
- provide **contextual information** useful to the governance of the biosecurity system.

We have drawn on domestic studies in peer-reviewed journals, case studies, information from growers and industry specialists, publications such as Fresh Facts, past assessments, and other sources.

There remain a number of important uncertainties on valuations particularly on domestic activity since these valuations are based on industry perceptions. And while in many cases we have taken information from one source, the lack of depth[4] of the analysis reflects the initial scoping nature of the assessment i.e. many of the Gross Output values for plant varieties grown for domestic consumption are not recorded in official statistics.

Estimating the contribution to GDP has also been a challenge, particularly around avoiding double counting. To partly avoid double counting we have used a "Processing and Wholesaling" margin for the stages between primary production and sales into final demand (both domestic and export). We still believe there may be some double counting at the domestic and export sales part of the value chain, however the resources that it would take to estimate the double counting are significant relative to the resources available for this project.

[3] That is total Gross Output (price multiplied by quantity) less Intermediate Consumption (the dollar value of converting crops into a sellable product at each stage of the production process) equals the contribution of that crop to the economy at each stage of the value chain.

[4] Estimates are typically taken from publications such as Fresh Facts. While this is a useful starting point, it is difficult to verify production data. Also the processing and wholesaling data is difficult to come by. This is because processing is highly competitive with thin margins. Even if one source does "reveal" cost information the ability to verify this information is almost nil.

Whilst this study had capacity to include only a limited number of plant species, the intention is that our methodology can be applied to other plants in the future.

1.1. Study requirements

The methodology must be able to be used across a range of New Zealand's economically important plants (65 plant species). MPI requires a list of plant species and their value to the New Zealand economy.

MPI has specified the following work streams:

1. to develop and validate an economic methodology that will enable calculation of the economic contribution to New Zealand of individual plant species. This includes:
   - reviewing existing methodologies
   - documenting the current state of information on the economic value of plant species in New Zealand
   - an explanation of the methodology for peer review and subsequent users
   - documentation of the process used to validate the method on plant species
   - a description of the value chains of the plant species
   - documentation of the economic value for these species.
2. calculate the value of 65 selected plant species covering:
   - their contribution to GDP
   - details of the limitations that apply to each species' calculations.

The output is required to provide MPI with information that can be used to prioritise, assess and manage the risks to the primary sector.

1.2. Scope and definitions of terms used

Two issues are out of scope:

- assessments of the economic impact of pests on specific plant species
- non-market activity (such as the value of national parks) and existence value or option value.

The scope of work includes:

- the value of vascular plants for commercial production activities in New Zealand. The criteria used to choose plant species were:
  - the range of species examined may include exotic or native[5]
  - the range of species examined were thought to be currently generating the most commercial value to New Zealand, but also cover at least one

[5] Manuka was a potential candidate to include in the study because it is used to produce manuka honey. However, it was excluded from this study because of the difficulties at the current time in defining what constitutes manuka honey.

example of all end product categories derived from plant species: food, fodder/forage, fibre, fuel, pharmaceuticals.

- setting out a plant's contribution to GDP. This equals Gross Output value minus Intermediate Consumption at 2012 market value. Currently, the scope could include inferred values e.g. where there is an economic rent attributable to a plant species which is not currently explicitly traded or Gross Output values not fully covered by the market price[6]
- the value chains that are referred to potentially include all routes to New Zealand's final demand markets, both domestic and export, including:
  - primary producer to final consumer (e.g. seed and orchard/vineyard/farmgate)
  - primary producer to tertiary market intermediary (wholesaler, distributor) to final consumers
  - primary producer, secondary intermediary (processor, cannery, jam manufacturer etc.) and wholesaling to final consumers
  - primary producer to primary intermediary (e.g. fodder to livestock producers) to dependent products (such as livestock) and wholesaling to final consumers
  - multiple intermediary combinations of the above.

[6] For the processing and wholesaling part of the value chain we have used a Processing and Wholesaling margin to avoid double counting: Gross output at the Processing and Wholesaling stage minus Gross Output at the Orchard gate.

2. Approaches to valuation

The purpose of this section is to introduce the reader to the approach taken by NZIER to valuing plant species. We explain:

- what is meant by value and its application to the biosecurity system
- the types of valuation that could potentially be undertaken
- the New Zealand and international literature that potentially could inform the study
- the methodology used
- the application of the methodology.

2.1. Why estimate economic value of plant species?

Plants are inputs into primary production activities and clearly have economic value in the market prices of seeds and plant products produced in New Zealand. But their value to New Zealand extends beyond that private commercial value, as they support production of other industries which use them as inputs.

In approaching the valuation of individual plant species to assist MPI in evaluating and prioritising risks to primary sectors, we assume a primary purpose in valuing plants is for directing and improving investment in biosecurity. The 2012 Sapere report on the PSA-V incursion suggested that MPI looks at the relative costs/benefits of reprioritising its resources towards managing the risks for economically significant industries (Moore and Loan 2012). Currently, plant-pest risk assessments used by MPI focus on bio-physical considerations, with largely qualitative consideration of potential economic consequences. There is a risk that biosecurity effort may be directed at risks of low consequence, while more significant economic activity is relatively under protected.

This project is a **first step** towards developing a consistent approach to valuing individual plant species in economic terms (it is not a risk assessment of individual plant species). This focus needs to be emphasised since the aim is to:

- identify what's at stake for the economy if a particular species comes under threat from a biosecurity incursion
- identify the dependency of economic activity on particular plant species, where the species or particular links in their supply chains are under threat
- weight the options for prioritising areas of activity on biosecurity measures.

This initial step can supplement the current plant-pest risk assessment process. An economic valuation would go beyond the identification of potential impacts to quantifying the scale of their effects and placing monetary value on them, to better identify the value at risk and the level of response that is likely to be worthwhile.

Should a threat materialise further investigation can be done to firm up the estimates.

2.2. Factors which guide the choice of valuation method

Valuation is the process of assigning a weighting to objects for the purpose of comparing the relative worth of one thing with another. The value of plants used in productive activity will be a measure of the benefits obtained from that plant and all products and services derived from it.

Value is the topic of hundreds of books and scholarly articles but for this report, we are focusing on preference related concepts of value: ultimately, it is the public's willingness to pay for something that creates demand and confers value. When goods are traded in markets, demand generates price signals and incentives for supplying that demand. A key economic characteristic is that the expression of value results from supply and demand that are expressed by actions (not words) and are constrained by real-world scarcity.[7]

2.3. Valuation – some basic considerations

2.3.1. Value depends on what people are prepared to pay

The choice of valuation method varies with the purpose for which it is needed. It also depends on a) the perspective taken – private or societal value; and b) the timeframe for consideration – immediate or long term.

The commercial value of plant-based products depends on people's willingness to pay for those products in domestic and export markets. The sales value less the cost of all inputs used in producing the sales leaves a residual economic surplus, which provides a return on those who committed their resources to producing sales. In a private setting, that surplus is the company's profit that goes to covering the costs of capital, tax and providing dividends to shareholders. Employees may also share in the surplus, to the extent that it enables the company to pay more to secure the particular skills needed to produce the surplus.

Any residual surplus after all other inputs have covered their cost (including allowance for risks) is often treated as an 'economic rent' attributed to unpriced inputs, such as land, water or management skills. Given adequate data to understand how economic rent varies with changing mixes of unpriced inputs, statistical methods can determine an attribution of rent, or 'shadow price' for each of these inputs. However, such calculations are case specific, vary with local factors, and are problematic in determining values of plants nationwide. A simpler, higher level approach is more suited to prioritising and assessing biosecurity risks across the country.

Productive plant species are commercial goods with seeds supplied to growers at a market price. But as in any goods market, for some purchasers the market price is less than their willingness to pay for a product, providing them with an economic surplus for commercial plants over and above the observed market price. The value of plant species to New Zealand is therefore not confined to the market values of plant

[7] See Brown TC (1984) "The Concept of Value in Resource Allocation", Land Economics 60(3) 231-246.

products, but market values provide a relatively well-documented source on which to base a valuation.

2.3.2. Any valuation must consider the broader social context

In a private setting, the economic value of an asset is driven by the discounted stream of net benefits it delivers over its lifetime, i.e. a net present value of benefits less costs incurred. In such a private setting or for small public projects it is appropriate to examine value through an investment appraisal framework, identifying the stream of revenues obtained against the opportunity cost of resources used in obtaining them.

A similar approach can be applied to public assets, with the scope of costs and benefits broadened to include effects that fall anywhere across the affected community. In a public setting, this gives rise to cost benefit analysis. Some in the community will gain, some will lose, but it is the net effect that counts in determining whether the activity is worthwhile. Such analysis accepts as worthwhile any project that yields gains that are greater than losses across the community.[8]

But for large societal issues that have widespread implications across the inter-linked sectors of the economy, 'investment appraisal' is not enough to show the full consequences across the economy. Such large issues have flow on effects that spread across the economy beyond the directly affected activities, the scale of which can be assessed through a national accounting framework that reflects inter-industry flows.

2.3.3. A valuation must consider the contexts in which it is being used

Security, whether against biological incursions or other threats, entails components both before and after incursion:

- **before an incursion**, security is about anticipating threats, of which there are many but with little knowledge about the probability of each one's occurrence and impact. Before an incursion, security entails deploying resources widely, with a capability for detection and rapid response to threats as and when they materialise. In that context, an approximated valuation is usually sufficient
- **after an incursion**, security is more about the response when it is relatively easier to assess significance and devise appropriate response measures against a known pest or disease. Although many incursions can be managed using an approximated valuation, often times a more precise and detailed valuation is needed in the after incursion context, especially for high impact pests.

There is no hard and fast rule that stipulates the preferred approach – the point is that context must be considered. So what are the factors that inform contextual judgements?

[8] The theory behind this is so-called Pareto efficiency, an allocation of resources at which it is impossible to reallocate without leaving someone worse off. This is a stringent criterion to meet in practice, so recourse is made to the Kaldor-Hicks principle that total gains exceeding total losses is sufficient to determine net benefit: the gainers' gains would be big enough to compensate the losers and leave no-one worse off, but no compensation is paid.

- where the incursion has occurred – it may not be in New Zealand, however if the outbreak is important officials might think it prudent to have an in-depth valuation done just in case. In other cases, it may not be necessary
- the size of the incursion – an in-depth after incursion study of a pest/weed may/may not be necessary because its impact is small/large
- other contextual considerations may dominate - social, environmental and cultural reasons dictate the type of valuation required.

Both 'before incursion' and 'after incursion' valuations have their place in the biosecurity system. In general, a 'before incursion' valuation, characterised by approximated values, is about enabling risk assessments that give a breadth of coverage of a multitude of potential threats by having approximate data on species value. An 'after incursion' valuation, characterised by the need for more accurate values, can enable an in-depth understanding and assessment of specific threats and how they can be ameliorated.

As resources for risk assessment are limited it is not practical to analyse all potential threats in depth. MPI can use a 'before incursion' valuation for pest risk assessment in many parts of the biosecurity system e.g. for decision making in the pre-border space when determining what phytosanitary measures are needed on imported plant products, such as fruit, vegetables, seeds and nursery stock. Furthermore, 'before incursion' valuations are useful for providing valuable contextual information which can inform a range of governance decisions relating to the biosecurity system.

From the foregoing, we assume the valuation of species for current purposes should be:

- based on a societal rather than a private perspective, i.e. consider the effects on New Zealand Inc
- capable of reflecting the differences in potential loss of livelihood caused by potential threats to different plant species
- capable of reflecting external effects and flow-on impacts from the species and activities most directly under threat
- useful primarily in contexts for which approximated values are appropriate. This includes contexts before an incursion. However, it can be also useful in some contexts after an incursion e.g. early in a response.

2.4. Review of current valuations of species

2.4.1. New Zealand literature

We have not discovered any comprehensive economic valuations of individual plant species in New Zealand. Discussion on the importance of particular plant-derived industries focuses on partial measures like export values or domestic Gross Output revenues from the principal value chains for the particular product (like wine from grapes). Sometimes this extends to a contribution of a particular plant category to Gross Domestic Product, but existing published statistics are not set up to make this readily attributable to individual species (BERL 2011 and 2012).

In a previous report to MAF entitled *Forest and Forest Land Valuation: How to Value Forests and Forest Land to Include Carbon Costs and Benefits,* Meade et al (2008)

examine a range of valuation approaches, in particular comparable sales analysis, discounted cash-flow (DCF) analysis and real options analysis, a variant of DCF that enables selection of options and their timing within an overall project appraisal to optimise overall return. Their preferred method is what they call Boot-Strapping Real Options Analysis, which involves repeated trial and error in testing results of different options and is critically dependent on the definition of options for land use. This approach is more appropriate to valuation of particular parcels of land than to valuing forestry at large or their constituent species – it is an after incursion approach to valuation after alternative options have been identified, rather than a valuation suited to a before incursion assessment against threats, the identity and scale of which are not known.

A search and review of previous studies of biosecurity threats has uncovered none that identify a before incursion valuation to assist with prioritisation. A number of ad hoc studies have been undertaken when a biosecurity threat materialises i.e. all after incursion approaches. These all take a similar format and identify the potential damages caused by the threat by valuing the change in outputs from the industries using the plants at risk (or in some cases damage to capital assets). Some consider other impact costs external to the productive system as well (e.g. health and medication costs for pests such as the white tailed tussock moth, which as well as damaging trees was also thought to provide an irritant to those with respiratory conditions).

These studies all consider pest impact as a change in the outputs from a counter-factual without the pest, so they focus on the marginal output changes. The total output value without the pest is considered as the counter-factual, but it is not commonly presented in the report. Moreover, there may be minor changes in the way different analysts calculate these output effects, raising the prospect of inconsistencies between these studies. Individual biosecurity impact studies do not provide a coherent lead on the valuation of particular plant species.

Two general reports have attempted to identify the aggregate cost of pests and weeds to New Zealand, which have drawn on and incorporated estimates of individual pests of plant species. One was the estimate by Bertram (1999), the other a later study by Nimmo-Bell (2009) for Biosecurity New Zealand.[9] These reports have similar characteristics to the individual biosecurity impact studies. They estimate the cost of established pests on New Zealand's productive systems, and also the cost of defensive measures to prevent new pests from becoming established, but they do not explicitly estimate the value by plant species.

2.4.2. International literature

The international literature search for the value of plant species revealed many more studies on the non-market value of species for biodiversity conservation or pharmaceutical uses than there are for general estimates of value of productive species. A notable exception to this is forestry, where the long time-frames and use of wild resources internationally has led to a tradition of valuing standing trees in terms of future revenue flows net of costs. The "stumpage value" of a standing tree consists of an assessment of the value of all products derived from it, less the costs of realising that value. It is an economic surplus attributable to the tree after all other factor inputs

[9] Nimmo Bell (2009) "Economic cost of pests to New Zealand"; MAF Biosecurity New Zealand Technical Paper No 2009/31.

have recovered their costs. Primarily used by private companies to assess the value they can bid up to in making offers to suppliers, stumpage understates the value to the nation as it excludes any economic surplus earned by the various production agents, and it excludes any indirect flow on effects to other sectors. It is a value from the perspective of the forest owner, not the wider economy and dependent industries.

The OECD recognises the use of net present value of future income streams as a method for valuing standing timber. That approach has the potential advantage in accounting for future costs like replanting to provide a value in perpetuity, and it could also in principle incorporate other external effects, such as the value of standing timber for recreation purposes or its contribution to ecosystem services such as regulating water run-off. Net present value however depends on a number of assumptions about future outcomes. Real options modelling attempts to explicitly model choices over timing of undertaking irreversible actions (like felling a tree) but it is challenging to implement and also dependent on strong assumptions.

Plant species can be viewed as a basic input to agricultural production systems, and one indication of value at a farm level would be a general form of production function relating crop yield to the characteristics of species or variants:

$$Q = f(Y, PS, e).$$

Where Q is tonnes of output per hectare, Y is a vector of inputs such as labour hours, fertiliser and pesticides, PS is a particular species and e represents stochastic factors such as rainfall and temperature. The value as an input approach has also been adapted to sector wide estimates of value, and has recently been applied to valuing water[10] and also to bee populations in response to concerns about threats to bees such as varroa mite and colony collapse syndrome, which has raised the necessity of establishing what economic value is dependent on the input (Winfrey et al 2011). These studies postulate that the social value derived from the input is a function of the profit of producers in the areas affected by input loss, the profit of producers in other parts of the market, and the value to consumers – consumer surplus from changes in market availability.

2.5. Methodology for estimating plant values

Our method is based on the assumption that species valuation is required to provide an improved source of economic data that MPI can access when developing strategies to manage the biosecurity system, and can use to prioritise targeting of resources across the system. It proposes a quick and readily updateable means of establishing the relative value derived from different species. These values can be used as inputs into a range of analyses, but a specific use identified when developing the proposal was as a data input into pest risk assessments, which include a qualitative estimate of potential economic consequences of the pest being assessed.

The System of National Accounts (SNA) provides a consistent framework for looking at each industry's production. The basic components are:

[10] For example, see the Deloitte/Access Economics 2013 paper on *Economic Value of Groundwater in Australia* http://www2.deloitte.com/au/en/pages/economics/articles/economic-value-groundwater-australia.html

- Gross Output Value less Intermediate Consumption equals Value Added (GDP)[11]
- GDP equals Fixed Capital Consumption (depreciation) plus Net Indirect Taxes plus Employee Compensation plus Operating Surplus.

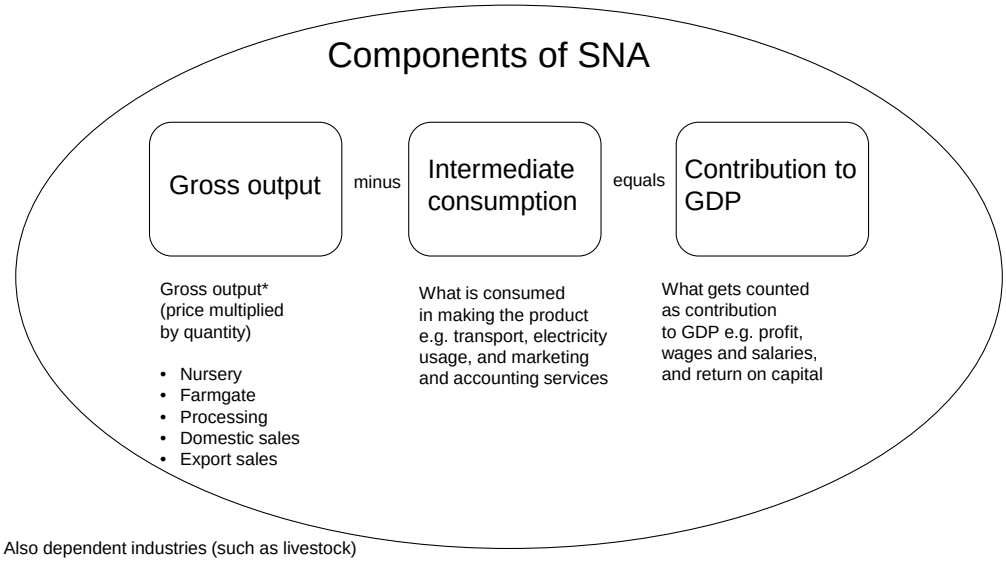
Operating surplus is a residual in the SNA calculation, and it approximates a return to ownership and is close to the private concept of profit. But, as a surplus, it will also implicitly include returns to all factors of production over and above the price paid for them. Thus an input, like water, that is not explicitly priced contributes to the value of Gross Output Value and Value Added, but the economic value it generates is absorbed within Operating Surplus. Similarly, a new seed strain which is sold at a standard price on the market but which proves exceptionally productive in certain management conditions generates an economic value in excess of its market price which, unless explicitly recognised, will accrue as Operating Surplus and return to owners.

2.5.1. Using contribution to GDP to value plant species

There are a number of approaches to working out the contribution of each plant species to GDP. For data reasons we have taken the production approach i.e. building up estimates of Gross Output value and then approximating contribution to the economy taking into account the impact of the plant species on the industry in question and estimating the share of GDP.

The formula is Gross Output value minus Intermediate Consumption equals Contribution to the Economy per species (see Figure 1).

Figure 1 The contribution of plants to Gross Domestic Product



* Also dependent industries (such as livestock)

Source: NZIER

[11] For the processing and wholesaling sector we have used a Processing and Wholesaling margin to be explicit about what we are valuing. Although, technically it could also be called a Gross Output value.

Figure 1 also provides a description of Gross Output value, Intermediate Consumption and Contribution to the Economy. Specifically:

- Gross Output value at each stage of the value chain estimates the value of production at stage of value chain (price(s) multiplied by volume). Specifically, at the:
  - seed/nursery stage of the value chain. Estimates of seeds, root stock, trees and other plant material sold to orchardists/farmers
  - farm/orchard or vineyard gate stage of the value chain. Estimates the value of what farmers and growers sell to all other parts of the value chain (prices multiplied by quantity)
  - processing and wholesaling stage of the value chain. To partly avoid double counting we have used a Processing and Wholesale margin. The margin estimates the value of product sold to domestic and export stages of the value chain less the cost of all raw materials including all purchases from the orchard gate. Processing and wholesaling activities can include handling, grading, packing, freight, labelling, bottling, storing including cool storing, juicing, wholesaling, and any other transformation processes – such as for wheat used in bread making
  - domestic stage of the value chain. Estimates value of product sold by retailers to consumers. This ranges from orchard gate sales to supermarkets and sales by food service outlets
  - export stage of the value chain. Estimates export revenue generated from product sold to wholesalers, consumers and other buyers in other jurisdictions.
- Intermediate Consumption measures what is consumed in the making of any particular product
- Contribution to GDP comprises profits, salaries, wages and capital replacement.

We also multiply the impact of dependent industries by using estimates supplied by various industries where applicable. For example, Table 2, example 2, illustrates that fodder for brassicas provides 1% of the dairy industry energy in-take. The dependent industry – in this case dairy at the farmgate stage of the value chain – contributes $58.1 million to fodder brassicas at the farmgate stage of the value chain.

For most cases we do not have direct estimates of Intermediate Consumption, therefore the simple calculation outlined in Figure 1 cannot be used for all plant valuations.[12]

However, we can calculate the contribution to GDP by using the Input-Output tables compiled by Statistics New Zealand (and using data from the System of National Accounts). From the Input-Output tables we can derive estimates of what each plant species contributes to GDP at each stage of the value chain.

Specifically, the Input-Output tables enables calculation of the **share** of Gross Output that contributes to GDP at each stage of the value chain. By multiplying Gross Output values at each stage of the value chain by Statistics New Zealand estimates of the **share** of Gross Output value that contributes to the economy we can obtain the GDP impact

[12] Intermediate Consumption estimates are available for broad sector areas from Statistics New Zealand. Where possible we have used official statistics.

of that species on the economy. The residual from this calculation by definition is Intermediate Consumption (i.e. GDP Impact minus Gross Output value equals Intermediate Consumption).

To illustrate the approach, Table 1 below provides a simplified and stylised depiction of the process we have undertaken and how the data from the Input-Output tables and System of National Accounts has been used in the valuations.

Table 1 Framework for identifying contribution to GDP

2012 year

Gross Output value (price multiplied by quantity at each stage of the value chain) Column I	Impact of plant species on industry (or at stage in the value chain) Column II	Share of Gross Output (attributable to stage in the value chain) that contributes to GDP Column III	Impact of the plant species on GDP Column IV
Gross Output value calculated at each stage of the value chain e.g. nursery, farmgate, processing and wholesaling (margin), domestic, and export	Impact on other industries e.g. the I mpact of ryegrass on livestock production is a substantial 75%	Share of Gross Output value equals Gross Output minus intermediate consumption. We have estimates of the share of Gross Output value to the economy from the Input-Output tables	Gross Output value multiplied by impact (%) multiplied by the share of GDP equals the contribution to GDP at each stage of the value chain

Source: NZIER

From Table 1 it is possible to identify:

- **Value of production supported by plant species**: this estimates the value of Gross Output (Column I) dependent directly or indirectly on particular plant species, highlighting linkages between co-dependent economic sectors and resulting in a Gross Output value which reflects the contributions of many other input factors apart from plant species e.g. the land required to grow the plant species, the labour inputs that organise production, and the capital required to plant, grow and harvest production
- **Contribution of particular plant species to aggregate economic indicators**, such as Economic Value Added, also referred to as Gross Domestic Product (GDP), and associated income and employment values. As GDP is Gross Output values less Intermediate Consumption (determined by Column III), it is a net figure that can be attributed back to the original individual plant inputs
- **Impact of dependent industries (Column II).** This is determined by industry analysis, expert opinion, and the literature.

These value estimates (particularly the contribution to economy) when viewed across all plant based production activities indicate the relative economic value of each plant species and production activity to the economy.

In each valuation of a plant species we have compiled Gross Output figures (estimates of price multiplied quantity) for each part of the value chain (Column I):

- the value that nurseries have in the development of each plant, including seeds that end up being used domestically and exported (and in the case of carrot seed exported and possibly re-imported)
- the production which is generated from the plants, either by the plants or through derived production (e.g. livestock)
- any intermediate production that occurs as plants or their derived products are processed
- final domestic and export market values.

To avoid double counting of plant species value we do not add the Gross Output values together since value from one stage of a value chain is partly created by the previous state of the value chain e.g. plants sold as seeds from the nursery stage of the value chain contribute to the Gross Output values of the orchard/vineyard/farm gate stage of the value chain.

Instead, at each stage of the value chain we subtract from Gross Output what has been consumed to create the impact of the plant species on GDP (as shown in Figure 1).[13] To work out what is consumed at each stage of the value chain we have used Statistics New Zealand's Input-Output tables (disaggregated data on gross and net outputs and the transactions between them) and their System of National Accounts estimates.

The impact of a plant species on each industry is set out in Column II. The impact is determined from advice by industry experts (e.g. DairyNZ) and the literature. The SNA accounts are typically structured around industries, such as Agriculture or Mining, Fishing and Forestry, so the value contribution of individual species needs to be attributed and stripped out of the industry totals. While there are comprehensive data on exports of particular plant products and some industries have published data on primary production (e.g. mining, fishing and forestry), there are not regularly published data on domestic outputs, inputs and components of value added, which need to be inferred for the industries and attributed to component species, on the basis of input shares or other indications of species' role in the production system.

Using national accounting figures provides annual figures which are subject to the vagaries of such influencing variables as climate, exchange rates and fluctuating commodity prices. Tracking annual figures over time enables some evening out of such fluctuations, and an annual figure can also be projected into the future, to consider potential impacts of incursions on successive years, or damage to capital stock (such as established plants) that will endure beyond a single year. However, species characteristics differ, so an annual production value at risk plus annualised value of long lived capital stock (if appropriate) may be the most useful for a comparison across species.

The valuation approach is an exercise in inferring value components from uneven statistics, and it involves investigating details in the Input-Output tables, their sources and supplementary studies of particular plant-production systems. The method was initially tested on 5 pilot species – rye-grass, carrots, kiwifruit, maize and maize silage, and *Pinus radiata* – and has been rolled out across another 60 species.

[13] We do not have an estimate of intermediate consumption at each stage of the value chain i.e. the items that are consumed in making the good or service (i.e. marketing, transport, storage etc.). What we do have is an estimate from the Input-Output tables of approximate share of output that each species contributes to GDP.

2.6. The rationale for using the contribution to GDP approach

In this section, we have reviewed approaches to valuation of natural resources that can be adapted to identify the value of plant species of importance to New Zealand's economy. The aim is to identify a method that can be applied or adapted to a wide variety of species with diverse statistical data to produce consistent estimates of the value at risk should biosecurity threats to particular species materialise.

There is no single valuation method that can be extracted from the literature and applied to this task. However, there are plentiful examples of after incursion valuations of specific pest damage in New Zealand but there is a gap in the valuation from a before incursion perspective that is required to cover a broad range of species facing non-specific threats. The international literature search has not uncovered a definitive method for valuing species, although there are various studies attributing value to some specific input for agricultural production. Some methods depend on detailed data and analytical processes that would be difficult to replicate across many species facing non-specified threats.

The literature review has confirmed that the approach outlined in our proposal is a practical way of proceeding. Statistics on even major species are rather limited to mainly export volumes and values and some information on areas planted and volumes harvested. However, our proposal is to use the system of national accounts to provide a framework in which to approach value, and Statistics New Zealand's Input-Output tables to derive ratios between key economic aggregates like output and value added, and key linkages between production, processing and distribution stages of the value chain, to construct a picture of the value chain attributable to individual plant species.

While some species (such as *Pinus radiata*) have substantial statistical documentation that can be linked to the national accounts, other species are much less conspicuous and are absorbed within a single horticultural grouping in the Input-Output tables. For these smaller species other information will need to be sourced to supplement the official statistics.

3. Users guide to plant species value

3.1. General approach

The general approach is based on Table 1 and is repeated in Table 2 with examples.

Marketing chain analysis is a useful tool for tracing through estimates of the value of specified plants (Gross Output, Column I set out in Table 2). It details the value of the transformation process as plant or derived plant products move through the marketing chain: from nurseries to final markets. At each stage, we can (if credible estimates are available) estimate the GDP share of output (Column IV in Table 2).

The general approach has been to use the marketing chain to identify value being generated from seeds/nurseries to final demand to quantify economically valuable

plants associated with land based industries. It also means we can contrast and compare the value across plants.

The examples given in Table 2 demonstrate the mechanics of the approach:

- example one sets out the impact of nursery Gross Output in the apple industry. Nursery Gross Output to growers have a 100% impact on the apple industry and a share of output of 0.37 (estimated from the Input-Output tables). Therefore, Gross Output value at the nursery stage translates into $3.0 million in contribution to GDP
- example two shows the impact of brassicas for fodder on the dairy industry. The impact (Column II) of brassicas for fodder (estimated at 1% on advice from DairyNZ) is multiplied by the dairy farmgate Gross Output value (Column I). To estimate contribution to GDP, Columns I and II are multiplied by share of output GDP (estimated from the Input-Output tables).

Table 2 Framework for identifying contribution to GDP with examples

2012 year

Gross Output value (price multiplied by quantity at each stage of the value chain) Column I	Impact of plant species at each stage in the value chain Column II	Share of output value (attributable to stage in the value chain) that contributes to GDP Column III	Impact of the plant species on GDP Column IV
Gross Output value calculated at each stage of the value chain e.g. nursery, farmgate, processing, domestic, and export	Impact on other industries e.g. the impact of ryegrass on livestock production is a substantial 75%	Share of Gross Output equals Gross Output minus Intermediate Consumption. We have estimates of the share of Gross Output to the economy from the Input-Output tables	Gross Output multiplied by impact (%) multiplied by the share of GDP equals the contribution to GDP at each stage of the value chain
Example one: apples: nursery stage			
Nursery ($7.8 million)	100% (100% impact on the apple industry since nurseries supply the apple industry)	GDP share equals 0.37	$7.8m x 100% x 0.37 = $3.0 million (rounded)
Example two: brassicas for fodder at the farmgate stage for dependent industries			
Dairy farmgate ($10,828.0 million)	1% (estimated impact on dairy is 1% according to DairyNZ estimate)	GDP share at farmgate for livestock is 0.49	$10,828 x 1% x 0.49 = $58.1 million

Source: NZIER

Table 3 below sets out the format of the final summary table that will be used for each plant species valued. It is divided into sections that calculate: a) direct impact and b) the impact on dependent industries. In most cases plants species only have a direct impact (e.g. they are sold domestically or exported to consumers). The calculation for dependent industries occurs when the plant is sold for use in another industry, e.g. barley and maize into the pig and poultry industries or ryegrass and clover used in livestock industries.

Table 3 Sample final summary table

2012 year

Gross Output value (price multiplied by quantity at each stage of the value chain) Column I	Impact of plant species at each stage in the value chain Column II	Share of output value (attributable to stage in the value chain) that contributes to GDP Column III	Impact of the plant species on GDP Column IV
Direct impact			
Nursery/seed Gross Output value	Typically, 100%	0.37 (e.g. horticulture see Table 4)	Multiply Column I, II, III
Farmgate Gross Output value	Typically, 100%	0.37 (horticulture see Table 4)	Multiply Column I, II, III
Processing and Wholesaling margin[1]	Typically, 100%	0.29 (horticulture see Table 4)	Multiply Column I, II, III
Domestic Gross Output value	Typically, 100%	0.18 (horticulture see Table 4)	Multiply Column I, II, III
Export Gross Output value	Typically, 100%	0.45 (horticulture see Table 4)	Multiply Column I, II, III
Subtotal (direct impact)			Sum Column IV (direct impact)
Dependent industries Gross Output (only applicable when one industry acts as supplier to another industry e.g. grasses, herbs, and other fodder supplied to dairy and other livestock)			
Farmgate	Ranges from under 1% to 75%	0.49 (sheep, beef etc. see Table 4)	Multiply Column I, II, III
Processing and Wholesaling margin	Ranges from under 1% to 75%	0.15 (sheep, beef etc. see Table 4)	Multiply Column I, II, III
Domestic	Ranges from under 1% to 75%	0.18 (sheep, beef etc. see Table 4)	Multiply Column I, II, III
Export	Ranges from under 1% to 75%	0.48 (sheep, beef etc. see Table 4)	Multiply Column I, II, III
Subtotal (dependent industries)			Sum Column IV (dependent industries)
Total			**Sum subtotals**
Note (1) The Processing and Wholesaling margin value reflects all processes that transform the product post-farmgate and sold to other stages in the value chain (i.e. domestic and export stages of the value chain) e.g. the transformation processes include packing, packaging, manufacturing (i.e. carrots being juiced) freight, wholesaling, and further processing (i.e. rye being used in breads). It does not include the raw material purchased i.e. represented by the Gross Output value from the farmgate stage of the value chain.			

Source: NZIER

3.2. GDP share of output

To avoid double counting we have used Statistics New Zealand's Input-Output tables to calculate the GDP share of output. The GDP share is then multiplied by the impact of the plant species on the industry (Column II, Table 1) and the Gross Output (Column I, Table 1) at each stage of the value chain.

The values provided by the method are estimates of value added associated with particular species, not economic rents. Value added includes returns to capital, labour and ownership (operating surplus). Economic rents to other factor inputs are subsumed within the operating surplus. Clearly value is created or added to a species by labour and capital inputs, but without detailed information on the assets and other inputs employed to determine an appropriate return to each factor, calculation of a residual rent attributable to a species will be problematic. However, identifying the scale and distribution of value added at potential risk is useful for prioritising precautionary and preventive measures.

Table 4 sets out the GDP share of output in percentages terms for each step in the marketing chain.

Table 4 Shares of total output

Percentage, estimated from the Input-Output tables

Industry	Shares of Total Output: from Input-Output table estimate			
	Seeds, nurseries, farmgate Value Added share of Total Output	Processing and wholesaling Value Added share of Total Output	Domestic to final demand share of Total Output	Export (final demand) share of Total Output
Horticulture	37%[2]	29%[2]	18%[1]	45%[2]
Sheep, beef, cattle and grain farming	49%[2]	15%[2]	18%[1]	48%[2]
Dairy farming	49%[2]	13%[2]	18%[1]	48%[2]
Poultry, deer and other livestock farming	25%[2]	15%[2]	12%[1]	20%[2]
Forestry and logging	35%[1]		16%[1]	22%[1]
Wood product manufacturing		28%[1]	3%[1]	32%[1]
Pulp and Paper		22%[1]	4%[1]	38%[1]

Note (1) Statistics New Zealand and NZIER estimates.
http://www.stats.govt.nz/~/media/Statistics/Browse%20for%20stats/NationalAccountsIndustryBenchmarks/HOTPYeMar13/naib-yeMar13-tables.xlsx

(2) These figures reflect "actuals" from Statistics New Zealand, System of National Accounts tables.

Source: Statistics New Zealand

3.3. The base year is 2012

The comparator year for this project is 2012. The decision to use 2012 is based on a trade-off between choosing a year that has some relevance to current production and finding enough information (prices and volumes) to reflect market chain values, particularly for domestic crops.

For some (mainly) export crops, such as apples and cherries, 2012 does not reflect the current state of the industry. However, for many horticultural and arable crops that are consumed domestically, finding data for 2012 is difficult e.g. the 2013/14 Lincoln Financial Budget Manual for some products only has price data for the 2005-2010 period.

3.4. Assumptions and uncertainties

Most of the export data was sourced through Statistics New Zealand, various industry publications and personal communications with industry sources (Situation and Outlook for Primary Industries (Ministry for Primary Industries, various years), Fresh Facts (Horticulture New Zealand and Plant and Food Research, various years), Beef + Lamb New Zealand publications (Farm Facts, various years and personal communication with Mr Rob Davison), Foundation for Arable Research (FAR) (personal communication with Mr Nick Pyke), DairyNZ (Mr Matt Newman) and individual reports e.g. such as Booker 2009).

The difficult part of the process is determining the share of domestic and intermediate consumption since these statistics are not collected. In the absence of this data we have used:

- the Input-Output tables to estimate share of GDP per stage of the value chain
- a mixture of industry experts and available literature to calculate activity at each stage of the value chain (i.e. nursery, farmgate, domestic, processing and wholesaling, export).

Specifically, the difficulty is locating written material, identifying the right people in the industry, and also finding ways of verifying the information. In some tightly held stages of the value chain such as maize and nearly all its proceeding industries we were not able to obtain independently verifiable information. Further processing costs have been estimated from industry sources. Mr Rob Davison from Beef + Lamb New Zealand and Mr John Seymour at Horticulture New Zealand have been particularly helpful.

Of specific interest are the assumptions made about domestic market operations. With the guidance of Horticulture New Zealand (John Seymour) we have applied the following rule of thumb where no other information was available:

- farmgate or (grower) Gross Output values are often 50% of retail value (including GST) for domestic and export Gross Output value (based on FOB value)
- processing and wholesaling margin values of plant products range from between 10% and 50% above farmgate gross output values. Where we have no information or information is limited, we have used an additional 15% above farmgate Gross Output values as a proxy for processing and wholesaling margin value. This is based on NZIER and industry views

- processing and wholesaling margin values of products in the dependent livestock industries are actuals provided by the industry (Rob Davison, Beef + Lamb New Zealand)
- mark-ups from processing and wholesaling to other final uses (domestic and export) are estimated at 28% for meat and 21% for plant based products (Retailers Association (2013).

In the course of the investigation we also noticed that nursery Gross Output values were approximately 1% of farmgate returns. This is not the same in every industry but it does give a reasonable approximation where there is limited or no information.

3.5. Guidance on use of the report in the biosecurity context

Below we have set out guidance on appropriate use of the report in a 'before incursion' situation in the biosecurity context.

3.5.1. Use when approximations are appropriate

The valuations are intended to provide indicative values of plant species in instances when an approximate assessment of potential economic consequences of a pest or disease is appropriate. It is the orders of magnitude of the values that are of particular interest, not the absolute valuation figure. Questions often asked by risk assessors are "is the species worth millions, tens of millions, or hundreds of millions?"; and "how does the value of species 'X' compare to species 'Y'?"

The valuations will be useful in the following examples of biosecurity decision making:

- when pest risk assessments are done to help with development of import health standards of seeds, nursery stock, fresh produce etc.
- when emerging risks are assessed
- when rapid risk assessments are done for incursion investigations
- when assessments are done to inform MPI's organism ranking system.

3.5.2. Use when other information sources are scarce

The most useful values are of the plant species for which other sources of economic data are scarce. For instance, this report provides a valuation for the first time of brassica species, for ryegrass and for olives, to name a few that can be compared. As the report fills a gap in existing knowledge for those species, it will improve risk assessments affecting those plants.

3.5.3. Use when valuations can augment other sources of economic data

In contrast, where there are alternative sources of economic data for some plants, particularly those that have big export industries e.g. kiwifruit, apples, grapes, avocado, the valuations in this report should only be used to augment that data, not replace it. Furthermore, appropriate use of the 2012 approximations in this report will

require special consideration for industries that have experienced high growth rates since 2012 e.g. apples, cherries, kiwifruit etc.

3.5.4. Use when a wider context about plant values is needed

Those that provide governance to the biosecurity system often need to see the issues in a wider context. Consequently, this report will be particularly useful as it provides information across species and sectors. For example:

- how does the order of magnitude compare to other species?
- what (if any) other sectors are reliant on the species?
- which segment of the value chain is generating the greatest proportion of GDP?

4. The project output

This report has estimated the economic values for the productive activity of 65 important plant species in New Zealand, using contribution to GDP as the primary measure.

4.1. Summary of the project valuations

The results of the valuations are presented in four tables, each differing only in the way the plant species are sorted and named.

Each of these tables should always be used in conjunction with the data notes in Table 5e, which gives users an overview of the source, quality and reliability of the data used in the calculations of each plant species.

The result tables are presented as follows:

- Table 5a: **Common names** - plant species are sorted alphabetically using common name of the plant
- Table 5b: **Scientific names** - plant species are sorted alphabetically using scientific name of the plant
- Table 5c: **Sector groupings** -plant species are grouped into sectors (Horticulture, Pastoral, Forestry and those that are used in multiple sectors), and sorted alphabetically by common name within each sector group
- Table 5d: **Rankings** - plant species are sorted by value, from highest to lowest
- Table 5e: Data notes on each species.

4.1.1. Detailed workings and results

Refer to Appendices A to D for detailed workings and results, including overview of the value chain for each species, and the calculations for each stage of the value chain.

Table 5a Value added calculations with selected plant species broken down by common names

Table 5a must be used in conjunction with Table 5e, 'Data notes on each species'. Direct and dependent industry GDP contribution at each stage of the value chain, dollars.

	Direct impact					Dependent industry impacts				Total Impacts
Selected species data broken down: Brassicas, Curcubita, Prunus, Ribes, and Rubus	**Seeds/nursary**	**Farmgate**	**Processing**	**Domestic**	**Exports**	**Farmgate**	**Processing**	**Domestic**	**Exports**	
Apples	2,886,000	84,344,841	72,115,488	29,219,760	173,520,000					362,086,089
Asparagus	334,110	2,826,294	332,280	2,160,000	1,440,000					7,092,684
Aubergines	imported	1,295,000	152,250	1,260,000						2,707,250
Avocados	482,850	13,653,000	3,585,141	4,138,200	29,115,000					50,974,191
Barley	606,779	90,970,513				113,886,279	15,107,551	50,694,528	62,694,403	333,960,053
Beans (broad)	20,498	204,980	80,330	199,440		58,447		17,100	65,015	645,809
Beans (green)	884,300	12,025,000	2,356,250	3,240,000	21,150,000					39,655,550
Beetroot	140,863	2,061,270	242,339	2,005,560	292,500					4,742,531
Blueberries	560,665	6,682,940	785,697	3,136,320	8,415,000					19,580,622
Brassicas & brassics for fodder	5,488,950	239,575,000	1,848,750	16,403,400	6,363,000	111,446,933	17,615,830	7,040,160	126,422,061	532,204,083
Brassicas: human consumption	*1,739,000*	*15,725,000*	*1,848,750*	*14,454,000*	*2,115,000*					*35,881,750*
Brasscias: Fodder	*3,749,950*	*223,850,000*		*1,949,400*	*4,248,000*	*111,446,933*	*17,615,830*	*7,040,160*	*126,422,061*	*496,322,333*
Browntop	381,100			54,000	792,000	14,714,326	2,274,557	1,323,720	16,647,075	36,186,779
Capsicums	imported	12,099,000	1,422,450	5,274,000	16,245,000					35,040,450
Carrots	6,586,000	14,800,000	3,480,000	5,400,000	17,190,000					47,456,000
Celery	imported	925,000	29,000	900,000						1,854,000
Chicory	3,330,000			3,240,000		16,497,171	2,613,343	905,904	18,729,605	45,316,023
Chillies	imported	185,000	36,250	180,000						401,250
Chrysanthemum	5,550	555,000	-	540,000	90,000					1,190,550
Citrus	52,817	10,563,336	4,139,686	9,343,800	3,015,000					27,114,638
Lemons	*11,803*	*2,360,681*	*925,132*	*1,440,000*	*1,125,000*					*5,862,617*
Oranges	*15,232*	*3,046,358*	*1,193,843*	*2,844,000*	*405,000*					*7,504,433*
Mandarin	*24,240*	*4,848,062*	*1,899,916*	*4,681,800*	*1,440,000*					*12,894,018*
Grapefruit	*244*	*48,840*	*19,140*	*54,000*	*13,500*					*135,724*
Tangelo	*619*	*123,728*	*48,488*	*144,000*	*18,000*					*334,835*
Limes	*678*	*135,667*	*53,167*	*180,000*	*13,500*					*383,012*
Clover (red & white)	4,227,250			1,566,000	6,367,500	988,708,060	156,800,580	54,025,920	1,122,528,043	2,334,223,352
Cocksfoot	347,800			59,400	697,500	5,885,731	909,823	529,488	6,658,830	15,088,572
Cucurbita species	222,000	17,075,500	2,007,525	4,914,000	29,285,100					53,504,125
Pumpkin	*222,000*	*2,294,000*	*269,700*	*2,232,000*	*35,100*					*5,052,800*
Squash	*imported*	*12,561,500*	*1,476,825*	*522,000*	*29,250,000*					*43,810,325*
Zucchini	*imported*	*2,220,000*	*261,000*	*2,160,000*						*4,641,000*
Cypress			11,800,000	1,900,000	5,300,000					19,000,000
Douglas fir			124,100,000	19,900,000	56,300,000					200,300,000
Eucalyptus			25,600,000	4,100,000	11,600,000					41,300,000
Feijoas	22,200	351,500	41,325	306,000	90,000					811,025
Garlic	13,135	1,313,500	154,425	1,170,000	270,000					2,921,060
Grapes	2,765,750	132,101,567	14,635,934	76,501,710	529,785,000					755,789,961
Hops	43,290	740,000	884,500	540,000	4,140,000					6,347,790
Kiwifruit	1,850,000	233,204,119	101,534,393	3,946,680	466,626,429					807,161,622
Kumara	244,200	3,330,000	681,500	5,040,000	2,277,450					11,573,150
Lettuce	imported	8,029,000	943,950	7,524,000	720,000					17,216,950
Lillies	74,000	6,549,000		2,160,000	10,530,000					19,313,000
Lucerne	407,000	4,409,167				17,151,773	2,613,343	1,097,424	19,457,769	45,136,476

Selected species data broken down: Brassicas, Curcubita, Prunus, Ribes, and Rubus	Direct impact					Dependent industry impacts				Total Impacts
	Seeds/nursary	Farmgate	Processing	Domestic	Exports	Farmgate	Processing	Domestic	Exports	
Maize - Corn	16,579,413	142,807,420	1,337,625	3,600,000	18,900,000	237,139,973	34,664,895	38,041,696	228,958,434	722,029,457
Nuts	37,000	2,670,882	314,009	1,320,696	3,195,000					7,537,587
Oats	290,080	11,254,660				14,483,385	2,050,463	4,474,526	16,334,339	48,887,454
Olives	11,100	518,000	60,900	414,000	225,000					1,229,000
Onions	965,700	22,570,000	2,972,500	5,400,000	27,990,000					59,898,200
Orchids	39,775	3,977,500		540,000	8,325,000					12,882,275
Parsnip	8,325	832,500	29,000	810,000						1,679,825
Passionfruit	11,100	297,679	34,997	234,000	139,083					716,859
Pears	153,920	2,563,160	2,690,030	4,056,121	2,485,957					11,949,188
Peas	8,876,629	27,782,856	3,271,621	13,351,968	37,575,000	9,078,413	1,377,374	960,876	9,403,811	111,678,548
Persimmons	297,854	2,874,900	337,995	720,000	3,195,000					7,425,749
Pinus Radiata			2,760,500,000	443,700,000	1,249,900,000					4,454,100,000
Potatoes	4,203,200	52,540,000	12,354,000	81,180,000	52,830,000					203,107,200
Prunus	259,000	16,286,066	1,914,713	6,858,000	14,358,670					39,676,450
Peaches	*37,000*	*1,815,289*	*213,419*	*1,332,000*	*193,389*					*3,591,097*
Nectarines	*37,000*	*2,341,634*	*275,300*	*1,818,000*						*4,471,934*
Apricots	*37,000*	*3,697,632*	*434,722*	*1,098,000*	*4,597,253*					*9,864,607*
Cherries	*111,000*	*6,646,306*	*781,390*	*1,260,000*	*9,478,028*					*18,276,724*
Plums	*37,000*	*1,785,206*	*209,882*	*1,350,000*	*90,000*					*3,472,088*
Radish	4,329,000	259,000	539,400	252,000	9,900,000					15,279,400
Ribes	37,000	4,172,120	490,506	673,560	8,470,800					13,843,986
Blackcurrant	*37,000*	*4,148,440*	*487,722*	*648,000*	*8,470,800*					*13,791,962*
Redcurrant		*18,500*	*2,175*	*18,000*						*38,675*
Gooseberry		*5,180*	*609*	*7,560*						*13,349*
Ribwort plantain	416,250	4,810,000		405,000		16,450,413	2,613,343	892,224	18,677,594	44,264,824
Roses	38,850	3,885,000		3,780,000						7,703,850
Rubus	18,500	1,979,500	232,725	1,476,000	1,125,000					4,831,725
Raspberry	*5,735*	*573,500*	*67,425*	*540,000*	*45,000*					*1,231,660*
Blackberry	*740*	*74,000*	*8,700*	*72,000*						*155,440*
Boysenberry	*12,025*	*1,332,000*	*156,600*	*864,000*	*1,080,000*					*3,444,625*
Rye	203,500	1,776,000				8,248,585	1,306,671	452,952	9,364,803	21,352,511
Ryegrass	15,632,500			6,170,400	22,599,000	6,179,425,375	980,003,622	337,662,000	7,015,800,267	14,557,293,164
Silverbeet	7,400	388,500	45,675	378,000						819,575
Sphagnum moss		1,040,625	122,344	202,500	2,025,000					3,390,469
Spinach		721,500	84,825	702,000						1,508,325
Strawberries	1,295,000	4,828,500	567,675	3,834,000	2,160,000					12,685,175
Tall fescue	373,700			7,200	891,000	5,885,731	909,823	529,488	6,658,830	15,255,772
Tamarillos	27,750	277,500	32,625	234,000	90,000					661,875
Tea	4,174	417,362	49,068	81,216	812,165					1,363,985
Timothy	7,400			7,200		2,204,510	454,911	2,579,040	3,303,409	8,556,471
Tomatoes		38,295,000	6,426,690	25,200,000	4,635,000					74,556,690
Tulips	22,755	2,275,500		540,000	4,185,000					7,023,255
Wheat	1,066,553	51,097,000				224,978,600	23,342,589	137,448,720	30,662,809	468,596,271

Source: NZIER

Table 5b Value added broken down by scientific name(s)

Table 5b must be used in conjunction with Table 5e, 'Data notes on each species'. Direct and dependent industry GDP contribution at each stage of the value chain, dollars.

Direct impact						Dependent industries				Total Impacts
Scientific names	Seeds/nursary	Farmgate	Processing	Domestic	Exports	Farmgate	Processing	Domestic	Exports	
Acca sellowiana (feijoas)	22,200	351,500	41,325	306,000	90,000					811,025
Actinidia spp. (8)	1,850,000	233,204,119	101,534,393	3,946,680	466,626,429					807,161,622
Agrostis capillaris (browntop)	381,100			54,000	792,000	14,714,326	2,274,557	1,323,720	16,647,075	36,186,779
Allium cepa (onions)	965,700	22,570,000	2,972,500	5,400,000	27,990,000					59,898,200
Allium sativum (garlic)	13,135	1,313,500	154,425	1,170,000	270,000					2,921,060
Apium graveolens var. dulce (celery)	imported	925,000	29,000	900,000						1,854,000
Asparagus officinalis (asparagus)	334,110	2,826,294	332,280	2,160,000	1,440,000					7,092,684
Avena sativa (oats)	290,080	11,254,660				14,483,385	2,050,463	4,474,526	16,334,339	48,887,454
Beta vulgaris (beetroot)	140,863	2,061,270	242,339	2,005,560	292,500					4,742,531
Beta vulgaris var. cicla (silverbeet)	7,400	388,500	45,675	378,000						819,575
Brassica spp. (2)	5,488,950	239,575,000	1,848,750	16,403,400	6,363,000	111,446,933	17,615,830	7,040,160	126,422,061	532,204,083
Camellia sinensis (tea)	4,174	417,362	49,068	81,216	812,165					1,363,985
Capsicum annuum (bell peppers/capsicums) (3)	imported	12,099,000	1,422,450	5,274,000	16,245,000					35,040,450
Capsicum spp. excluding *C.annuum* (chillies) (4)	imported	185,000	36,250	180,000						401,250
Chrysanthemum spp. (chrysanthemum)	5,550	555,000	-	540,000	90,000					1,190,550
Cichorium intybus (chicory)	3,330,000			3,240,000		16,497,171	2,613,343	905,904	18,729,605	45,316,023
Citrus spp. (5)	52,817	10,563,336	4,139,686	9,343,800	3,015,000					27,114,638
Cupressus macrocarpa (cypress)			11,800,000	1,900,000	5,300,000					19,000,000
Cucurbita spp. (6)	222,000	17,075,500	2,007,525	4,914,000	29,285,100					53,504,125
Dactylis glomerata (cocksfoot)	347,800			59,400	697,500	5,885,731	909,823	529,488	6,658,830	15,088,572
Daucus carota (carrots)	6,586,000	14,800,000	3,480,000	5,400,000	17,190,000					47,456,000
Diospyros kaki (persimmons)	297,854	2,874,900	337,995	720,000	3,195,000					7,425,749
Eucalyptus spp. (eucalyptus)(7)			25,600,000	4,100,000	11,600,000					41,300,000
Festuca arundinacea (tall fescue)	373,700			7,200	891,000	5,885,731	909,823	529,488	6,658,830	15,255,772
Fragaria x ananassa (strawberries)	1,295,000	4,828,500	567,675	3,834,000	2,160,000					12,685,175
Hordeum vulgare (barley)	606,779	90,970,513				113,886,279	15,107,551	50,694,528	62,694,403	333,960,053
Humulus lupulus (hops)	43,290	740,000	884,500	540,000	4,140,000					6,347,790
Ipomoea batatas (kumara)	244,200	3,330,000	681,500	5,040,000	2,277,450					11,573,150
Lactuca sativa (lettuce)	imported	8,029,000	943,950	7,524,000	720,000					17,216,950
Lilium spp. (lillies)	74,000	6,549,000		2,160,000	10,530,000					19,313,000
Lolium spp. (ryegrass)	15,632,500			6,170,400	22,599,000	6,179,425,375	980,003,622	337,662,000	7,015,800,267	14,557,293,164
Malus domestica (apples)	2,886,000	84,344,841	72,115,488	29,219,760	173,520,000					362,086,089
Medicago sativa (lucerne)	407,000	4,409,167				17,151,773	2,613,343	1,097,424	19,457,769	45,136,476
Nuts diverse species (9)	37,000	2,670,882	314,009	1,320,696	3,195,000					7,537,587
Olea europaea (olives)	11,100	518,000	60,900	414,000	225,000					1,229,000
Orchidaceae (orchids)	39,775	3,977,500		540,000	8,325,000					12,882,275
Passiflora edulis (passionfruit)	11,100	297,679	34,997	234,000	139,083					716,859
Pastinaca sativa (parsnip)	8,325	832,500	29,000	810,000						1,679,825
Persea americana (avocados)	482,850	13,653,000	3,585,141	4,138,200	29,115,000					50,974,191
Phaseolus vulgaris (green bean)	884,300	12,025,000	2,356,250	3,240,000	21,150,000					39,655,550
Phleum pratense (timothy)	7,400			7,200		2,204,510	454,911	2,579,040	3,303,409	8,556,471

Direct impact						Dependent industries				Total Impacts
Scientific names	Seeds/nursary	Farmgate	Processing	Domestic	Exports	Farmgate	Processing	Domestic	Exports	
Pinus radiata (pine)			2,760,500,000	443,700,000	1,249,900,000					4,454,100,000
Pisum sativum (peas)	8,876,629	27,782,856	3,271,621	13,351,968	37,575,000	9,078,413	1,377,374	960,876	9,403,811	111,678,548
Plantago lanceolata (ribwort plantain)	416,250	4,810,000		405,000		16,450,413	2,613,343	892,224	18,677,594	44,264,824
Prunus spp. (11)	259,000	16,286,066	1,914,713	6,858,000	14,358,670					39,676,450
Pseudotsuga menziesii (douglas fir)			124,100,000	19,900,000	56,300,000					200,300,000
Pyrus spp. (10)	153,920	2,563,160	2,690,030	4,056,121	2,485,957					11,949,188
Raphanus sativus (radish)	4,329,000	259,000	539,400	252,000	9,900,000					15,279,400
Ribes spp. (12)	37,000	4,172,120	490,506	673,560	8,470,800					13,843,986
Rosa spp. (roses)	38,850	3,885,000		3,780,000						7,703,850
Rubus spp. (13)	18,500	1,979,500	232,725	1,476,000	1,125,000					4,831,725
Secale cereale (rye)	203,500	1,776,000				8,248,585	1,306,671	452,952	9,364,803	21,352,511
Solanum betaceum (tamarillos)	27,750	277,500	32,625	234,000	90,000					661,875
Solanum lycopersicum (tomatoes)		38,295,000	6,426,690	25,200,000	4,635,000					74,556,690
Solanum melongena (aubergines)	imported	1,295,000	152,250	1,260,000	-					2,707,250
Solanum tuberosum (potatoes)	4,203,200	52,540,000	12,354,000	81,180,000	52,830,000					203,107,200
Sphagnum cristatum & C.subnitens (sphagnum moss)		1,040,625	122,344	202,500	2,025,000					3,390,469
Spinacia oleracea (spinach)		721,500	84,825	702,000	-					1,508,325
Trifolium spp. (red & white clover)(14)	4,227,250			1,566,000	6,367,500	988,708,060	156,800,580	54,025,920	1,122,528,043	2,334,223,352
Triticum spp. (wheat) (15)	1,066,553	51,097,000				224,978,600	23,342,589	137,448,720	30,662,809	468,596,271
Tulipa spp. (tulips)	22,755	2,275,500		540,000	4,185,000					7,023,255
Vaccinium spp. (1)	560,665	6,682,940	785,697	3,136,320	8,415,000					19,580,622
Vicia faba (broad bean)	20,498	204,980	80,330	199,440		58,447		17,100	65,015	645,809
Vitis spp. (grapes)	2,765,750	132,101,567	14,635,934	76,501,710	529,785,000					755,789,961
Zea mays (maize & corn)	16,579,413	142,807,420	1,337,625	3,600,000	18,900,000	237,139,973	34,664,895	38,041,696	228,958,434	722,029,457
Notes										
(1) *Vaccinium corymbosum, Vaccinium formosum* (*syn. V. australe*) (both Highbush varieties) and *Vaccinium virgatum* (*syn. V. ashei)* (rabbit eye variety).										
(2) Brassicas for human consumption = (*Brassica olearacea*) cauliflower, broccoli, cabbage.										
Brassicas for fodder = (*Brassica rapa*) oil seed rape, turnips; (*Brassica napus*) swede; (*Brassica olearacea*) kale.										
(3) *Capsicum annuum* (capsicums or red pepper, green pepper, coloured peppers)										
(4) *Capsicum frutescens, C. chinense, C. pubescens, C. baccatum*										
(5) Oranges, lemons, limes, tangelos, mandarins, and grapefruit.										
(6) *Curcrbita pepo* (zucchini; includes some pumpkins), *Curcurbita maxima* (buttercup squash), and *C. moschata* (butternut squash)										
(7) *Eucalyptus regnans, E.fastigata, E.nitens*										
(8) *Actinidia chinensis* (gold), *Actinidia deliciosa* (green), and *Actinidia arguta* (berry)										
(9) Chestnut (*Castanea* spp.; *Fagaceae* family), cashews (*Anacardium occidentale*; *Anacardiaceae* family);										
macadamias (*Macadamia* spp.; *Protaceae* family); walnuts (*Juglans* spp.; *Juglandaceae* family).										
(10) *Pyrus communis* varieties (pears) and *Pryrus pyrifolia* (nashi pear)										
(11) Peaches (*Prunus persica*) nectarines (*P. persica var. nucipersica*), apricots (*P.armeniaca*), cherries (*P.avium*)										
(12) Blackcurrent (*Ribes nigrum*), redcurrant (*R. rubrum*), gooseberry (*R. uva-crispa*)										
(13) Boysenberry, blackberry, raspberry.										
(14) Red clover (*Trifolium pratense*), white clover (*Trifolium repens*).										
(15) Including *Triticum aestivum* and *T. durum*										

Source: NZIER

Table 5c Species by common name and grouped into sectors

Table 5c must be used in conjunction with Table 5e, 'Data notes on each species'. Direct and dependent industry GDP contribution at each stage of the value chain, dollars.

	Direct impact					Dependent industry impacts				Total Impacts
	Seeds/nursary	**Farmgate**	**Processing**	**Domestic**	**Exports**	**Farmgate**	**Processing**	**Domestic**	**Exports**	
Horticultural sector										
Apples	2,886,000	84,344,841	72,115,488	29,219,760	173,520,000					362,086,089
Asparagus	334,110	2,826,294	332,280	2,160,000	1,440,000					7,092,684
Aubergines	imported	1,295,000	152,250	1,260,000						2,707,250
Avocados	482,850	13,653,000	3,585,141	4,138,200	29,115,000					50,974,191
Beans (green)	884,300	12,025,000	2,356,250	3,240,000	21,150,000					39,655,550
Beetroot	140,863	2,061,270	242,339	2,005,560	292,500					4,742,531
Berries	18,500	1,979,500	232,725	1,476,000	1,125,000					4,831,725
Raspberry	*5,735*	*573,500*	*67,425*	*540,000*	*45,000*					*1,231,660*
Blackberry	*740*	*74,000*	*8,700*	*72,000*						*155,440*
Boysenberry	*12,025*	*1,332,000*	*156,600*	*864,000*	*1,080,000*					*3,444,625*
Blueberries	560,665	6,682,940	785,697	3,136,320	8,415,000					19,580,622
Brassicas for human consumption	1,739,000	15,725,000	1,848,750	14,454,000	2,115,000					35,881,750
Capsicums	imported	12,099,000	1,422,450	5,274,000	16,245,000					35,040,450
Carrots	6,586,000	14,800,000	3,480,000	5,400,000	17,190,000					47,456,000
Celery	imported	925,000	29,000	900,000						1,854,000
Chillies	imported	185,000	36,250	180,000						401,250
Chrysanthemum	5,550	555,000		540,000	90,000					1,190,550
Citrus	52,817	10,563,336	4,139,686	9,343,800	3,015,000					27,114,638
Lemons	*11,803*	*2,360,681*	*925,132*	*1,440,000*	*1,125,000*					*5,862,617*
Oranges	*15,232*	*3,046,358*	*1,193,843*	*2,844,000*	*405,000*					*7,504,433*
Mandarin	*24,240*	*4,848,062*	*1,899,916*	*4,681,800*	*1,440,000*					*12,894,018*
Grapefruit	*244*	*48,840*	*19,140*	*54,000*	*13,500*					*135,724*
Tangelo	*619*	*123,728*	*48,488*	*144,000*	*18,000*					*334,835*
Limes	*678*	*135,667*	*53,167*	*180,000*	*13,500*					*383,012*
Corn	3,413	6,826,500	1,337,625	3,600,000	18,900,000					30,667,538
Currents and gooseberry	37,000	4,172,120	490,506	673,560	8,470,800					13,843,986
Blackcurrant	*37,000*	*4,148,440*	*487,722*	*648,000*	*8,470,800*					*13,791,962*
Redcurrant	-	*18,500*	*2,175*	*18,000*	-					*38,675*
Gooseberry	-	*5,180*	*609*	*7,560*	-					*13,349*
Feijoas	22,200	351,500	41,325	306,000	90,000					811,025
Garlic	13,135	1,313,500	154,425	1,170,000	270,000					2,921,060
Grapes	2,765,750	132,101,567	14,635,934	76,501,710	529,785,000					755,789,961
Hops	43,290	740,000	884,500	540,000	4,140,000					6,347,790
Kiwifruit	1,850,000	233,204,119	101,534,393	3,946,680	466,626,429					807,161,622
Kumara	244,200	3,330,000	681,500	5,040,000	2,277,450					11,573,150
Lettuce	imported	8,029,000	943,950	7,524,000	720,000					17,216,950
Lillies	74,000	6,549,000		2,160,000	10,530,000					19,313,000
Maize human consumption				10,000,000						10,000,000
Nuts	37,000	2,670,882	314,009	1,320,696	3,195,000					7,537,587
Olives	11,100	518,000	60,900	414,000	225,000					1,229,000

	Direct impact					Dependent industry impacts				Total Impacts
	Seeds/nursary	**Farmgate**	**Processing**	**Domestic**	**Exports**	**Farmgate**	**Processing**	**Domestic**	**Exports**	
Onions	965,700	22,570,000	2,972,500	5,400,000	27,990,000					59,898,200
Orchids	39,775	3,977,500		540,000	8,325,000					12,882,275
Parsnip	8,325	832,500	29,000	810,000						1,679,825
Passionfruit	11,100	297,679	34,997	234,000	139,083					716,859
Pears	153,920	2,563,160	2,690,030	4,056,121	2,485,957					11,949,188
Persimmons	297,854	2,874,900	337,995	720,000	3,195,000					7,425,749
Potatoes	4,203,200	52,540,000	12,354,000	81,180,000	52,830,000					203,107,200
Pumpkin, squash, zucchini	222,000	17,075,500	2,007,525	4,914,000	29,285,100					53,504,125
Pumpkin	222,000	2,294,000	269,700	2,232,000	35,100					5,052,800
Squash	imported	12,561,500	1,476,825	522,000	29,250,000					43,810,325
Zucchini	imported	2,220,000	261,000	2,160,000						4,641,000
Radish	4,329,000	259,000	539,400	252,000	9,900,000					15,279,400
Roses	38,850	3,885,000		3,780,000						7,703,850
Silverbeet	7,400	388,500	45,675	378,000						819,575
Spinach	-	721,500	84,825	702,000						1,508,325
Strawberries	1,295,000	4,828,500	567,675	3,834,000	2,160,000					12,685,175
Stonefruit	259,000	16,286,066	1,914,713	6,858,000	14,358,670					39,676,450
Peaches	*37,000*	*1,815,289*	*213,419*	*1,332,000*	*193,389*					*3,591,097*
Nectarines	*37,000*	*2,341,634*	*275,300*	*1,818,000*						*4,471,934*
Apricots	*37,000*	*3,697,632*	*434,722*	*1,098,000*	*4,597,253*					*9,864,607*
Cherries	*111,000*	*6,646,306*	*781,390*	*1,260,000*	*9,478,028*					*18,276,724*
Plums	*37,000*	*1,785,206*	*209,882*	*1,350,000*	*90,000*					*3,472,088*
Tamarillos	27,750	277,500	32,625	234,000	90,000					661,875
Tea	4,174	417,362	49,068	81,216	812,165					1,363,985
Tomatoes	-	38,295,000	6,426,690	25,200,000	4,635,000					74,556,690
Tulips	22,755	2,275,500	-	540,000	4,185,000					7,023,255
Sphagnum moss	-	1,040,625	122,344	202,500	2,025,000					3,390,469
Multiple sectors										
Beans (broad)	20,498	204,980	80,330	199,440	-	58,447		17,100	65,015	645,809
Brassicas for fodder	3,749,950	223,850,000		1,949,400	4,248,000	111,446,933	17,615,830	7,040,160	126,422,061	496,322,333
Maize silage	16,576,000	102,408,600				196,311,640	31,515,120	6,963,696	223,309,342	577,084,398
Maize grain		33,572,320				40,828,333	3,149,775	21,078,000	5,649,093	104,277,520
Peas	8,876,629	27,782,856	3,271,621	13,351,968	37,575,000	9,078,413	1,377,374	960,876	9,403,811	111,678,548
Pastoral Sector										
Browntop	381,100			54,000	792,000	14,714,326	2,274,557	1,323,720	16,647,075	36,186,779
Clover (red & white)	4,227,250			1,566,000	6,367,500	988,708,060	156,800,580	54,025,920	1,122,528,043	2,334,223,352
Cocksfoot	347,800			59,400	697,500	5,885,731	909,823	529,488	6,658,830	15,088,572
Chicory	3,330,000			3,240,000		16,497,171	2,613,343	905,904	18,729,605	45,316,023
Lucerne	407,000	4,409,167				17,151,773	2,613,343	1,097,424	19,457,769	45,136,476
Ribwort plantain	416,250	4,810,000		405,000		16,450,413	2,613,343	892,224	18,677,594	44,264,824
Ryegrass	15,632,500			6,170,400	22,599,000	6,179,425,375	980,003,622	337,662,000	7,015,800,267	14,557,293,164
Tall fescue	373,700			7,200	891,000	5,885,731	909,823	529,488	6,658,830	15,255,772
Timothy	7,400			7,200		2,204,510	454,911	2,579,040	3,303,409	8,556,471
Forestry sector										
Cypress			11,800,000	1,900,000	5,300,000					19,000,000
Douglas fir			124,100,000	19,900,000	56,300,000					200,300,000
Eucalyptus			25,600,000	4,100,000	11,600,000					41,300,000
Pinus Radiata			2,760,500,000	443,700,000	1,249,900,000					4,454,100,000
Arable sector										
Barley	606,779	90,970,513				113,886,279	15,107,551	50,694,528	62,694,403	333,960,053
Oats	290,080	11,254,660				14,483,385	2,050,463	4,474,526	16,334,339	48,887,454
Rye	203,500	1,776,000				8,248,585	1,306,671	452,952	9,364,803	21,352,511
Wheat	1,066,553	51,097,000				224,978,600	23,342,589	137,448,720	30,662,809	468,596,271

Table 5d Species by value

Table 5d must be used in conjunction with Table 5e, 'Data notes on each species'. Direct and dependent industry GDP contribution at each stage of the value chain, dollars.

	Direct impact					Dependent industry impacts				Total Impacts
	Seeds/nursary	Farmgate	Processing	Domestic	Exports	Farmgate	Processing	Domestic	Exports	
Ryegrass	15,632,500			6,170,400	22,599,000	6,179,425,375	980,003,622	337,662,000	7,015,800,267	14,557,293,164
Pinus Radiata			2,760,500,000	443,700,000	1,249,900,000					4,454,100,000
Clover (red & white)	4,227,250			1,566,000	6,367,500	988,708,060	156,800,580	54,025,920	1,122,528,043	2,334,223,352
Kiwifruit	1,850,000	233,204,119	101,534,393	3,946,680	466,626,429					807,161,622
Grapes	2,765,750	132,101,567	14,635,934	76,501,710	529,785,000					755,789,961
Maize - Corn	16,579,413	142,807,420	1,337,625	3,600,000	18,900,000	237,139,973	34,664,895	38,041,696	228,958,434	722,029,457
Brassicas & brassics for fodder	5,488,950	239,575,000	1,848,750	16,403,400	6,363,000	111,446,933	17,615,830	7,040,160	126,422,061	532,204,083
Wheat	1,066,553	51,097,000				224,978,600	23,342,589	137,448,720	30,662,809	468,596,271
Apples	2,886,000	84,344,841	72,115,488	29,219,760	173,520,000					362,086,089
Barley	606,779	90,970,513	-	-	-	113,886,279	15,107,551	50,694,528	62,694,403	333,960,053
Potatoes	4,203,200	52,540,000	12,354,000	81,180,000	52,830,000					203,107,200
Douglas fir			124,100,000	19,900,000	56,300,000					200,300,000
Peas	8,876,629	27,782,856	3,271,621	13,351,968	37,575,000	9,078,413	1,377,374	960,876	9,403,811	111,678,548
Tomatoes	-	38,295,000	6,426,690	25,200,000	4,635,000					74,556,690
Onions	965,700	22,570,000	2,972,500	5,400,000	27,990,000					59,898,200
Cucurbita species	222,000	17,075,500	2,007,525	4,914,000	29,285,100					53,504,125
Avocados	482,850	13,653,000	3,585,141	4,138,200	29,115,000					50,974,191
Oats	290,080	11,254,660				14,483,385	2,050,463	4,474,526	16,334,339	48,887,454
Carrots	6,586,000	14,800,000	3,480,000	5,400,000	17,190,000					47,456,000
Chicory	3,330,000			3,240,000		16,497,171	2,613,343	905,904	18,729,605	45,316,023
Lucerne	407,000	4,409,167				17,151,773	2,613,343	1,097,424	19,457,769	45,136,476
Ribwort plantain	416,250	4,810,000		405,000		16,450,413	2,613,343	892,224	18,677,594	44,264,824
Eucalyptus			25,600,000	4,100,000	11,600,000					41,300,000
Prunus	259,000	16,286,066	1,914,713	6,858,000	14,358,670					39,676,450
Beans (green)	884,300	12,025,000	2,356,250	3,240,000	21,150,000					39,655,550
Browntop	381,100			54,000	792,000	14,714,326	2,274,557	1,323,720	16,647,075	36,186,779
Capsicums	imported	12,099,000	1,422,450	5,274,000	16,245,000					35,040,450
Citrus	52,817	10,563,336	4,139,686	9,343,800	3,015,000					27,114,638
Rye	203,500	1,776,000				8,248,585	1,306,671	452,952	9,364,803	21,352,511
Blueberries	560,665	6,682,940	785,697	3,136,320	8,415,000					19,580,622
Lillies	74,000	6,549,000		2,160,000	10,530,000					19,313,000
Cypress			11,800,000	1,900,000	5,300,000					19,000,000
Lettuce	imported	8,029,000	943,950	7,524,000	720,000					17,216,950
Radish	4,329,000	259,000	539,400	252,000	9,900,000					15,279,400
Tall fescue	373,700			7,200	891,000	5,885,731	909,823	529,488	6,658,830	15,255,772
Cocksfoot	347,800			59,400	697,500	5,885,731	909,823	529,488	6,658,830	15,088,572
Ribes	37,000	4,172,120	490,506	673,560	8,470,800					13,843,986
Orchids	39,775	3,977,500		540,000	8,325,000					12,882,275
Strawberries	1,295,000	4,828,500	567,675	3,834,000	2,160,000					12,685,175
Pears	153,920	2,563,160	2,690,030	4,056,121	2,485,957					11,949,188
Kumara	244,200	3,330,000	681,500	5,040,000	2,277,450					11,573,150

	Direct impact					Dependent industry impacts				Total Impacts
	Seeds/nursary	Farmgate	Processing	Domestic	Exports	Farmgate	Processing	Domestic	Exports	
Timothy	7,400			7,200		2,204,510	454,911	2,579,040	3,303,409	8,556,471
Roses	38,850	3,885,000	-	3,780,000	-					7,703,850
Nuts	37,000	2,670,882	314,009	1,320,696	3,195,000					7,537,587
Persimmons	297,854	2,874,900	337,995	720,000	3,195,000					7,425,749
Asparagus	334,110	2,826,294	332,280	2,160,000	1,440,000					7,092,684
Tulips	22,755	2,275,500		540,000	4,185,000					7,023,255
Hops	43,290	740,000	884,500	540,000	4,140,000					6,347,790
Rubus	18,500	1,979,500	232,725	1,476,000	1,125,000					4,831,725
Beetroot	140,863	2,061,270	242,339	2,005,560	292,500					4,742,531
Sphagnum moss	-	1,040,625	122,344	202,500	2,025,000					3,390,469
Garlic	13,135	1,313,500	154,425	1,170,000	270,000					2,921,060
Aubergines	imported	1,295,000	152,250	1,260,000						2,707,250
Celery	imported	925,000	29,000	900,000	-					1,854,000
Parsnip	8,325	832,500	29,000	810,000	-					1,679,825
Spinach	-	721,500	84,825	702,000						1,508,325
Tea	4,174	417,362	49,068	81,216	812,165					1,363,985
Olives	11,100	518,000	60,900	414,000	225,000					1,229,000
Chrysanthemum	5,550	555,000		540,000	90,000					1,190,550
Silverbeet	7,400	388,500	45,675	378,000						819,575
Feijoas	22,200	351,500	41,325	306,000	90,000					811,025
Passionfruit	11,100	297,679	34,997	234,000	139,083					716,859
Tamarillos	27,750	277,500	32,625	234,000	90,000					661,875
Beans (broad)	20,498	204,980	80,330	199,440		58,447		17,100	65,015	645,809
Chillies	imported	185,000	36,250	180,000	-					401,250

Table 5e Data notes on each species

Name	Data notes
Apples	Export data from SNZ. Good quality industry data. Reliable information
Asparagus	Export data (SNZ). Some industry data available but industry rules of thumb applied (also differing views on domestic sales). Approximate data only.
Aubergines	No SNZ data. Small number of growers with industry rules of thumb applied. Approximate data only.
Avocados	Export SNZ data available. Good industry data with rules of thumb applied.
Barley	No SNZ data. Good industry data through AIMI surveys and AFIC- no information on processing - rule of thumb applied. Data improving.
Beans (broad)	No SNZ data. Some industry data with rules of thumb applied. Approximations only.
Beans (green)	Export SNZ data available. Some industry data with rules of thumb applied. Approximate domestic data only.
Beetroot	Export SNZ data available. Some industry data with rules of thumb applied. Approximate domestic data only.
Blueberries	Export SNZ data available. Good industry data available with rules of thumb applied. Reliable industry data in a small industry.
Brassicas & brassics	Export SNZ and AFIC data available on brassicas for human consumption. Approximations made for livestock dependence on brassicas.
Browntop	Export SNZ data available. Approximate industry data with rules of thumb applied.
Capsicums	Export SNZ data available. Approximate industry data with rules of thumb applied.
Carrots	Export SNZ data available but some combined with other products. Some industry information available. Approximate data only.
Celery	No SNZ data. Industry estimates only. Data approximate.
Chicory	Export SNZ data available. Industry estimates. Approximate data only.
Chillies	No SNZ data. Industry estimates only. Data approximate.
Chrysanthemum	SNZ export data only. Industry data very approximate complicated by a variety of marketing channels.
Citrus	SNZ export data and industry data avaliabe. Industry rules of thumb applied.
Clover (red & white	SNZ export data only. Some industry data available with industry rules of thumb applied. Approximate data only.
Cocksfoot	SNZ export data only. Some industry data available with industry rules of thumb applied. Approximate data only.
Cucurbita species	SNZ export and industry data. Some industry data available with industry rules of thumb applied.
Cypress	SNZ export data only. Some industry data available. Approximate data only.
Douglas fir	SNZ export data only. Some industry data available. Approximate data only.
Eucalyptus	SNZ export data only. Some industry data available. Approximate data only.
Feijoas	SNZ export data available. Some industry data. Approximate data only.
Garlic	SNZ export data available. Some industry data with industry rule of thumb applied. Approximate data only.
Grapes	Export data from SNZ. Good quality industry data. Reliable information
Hops	SNZ export data available Some industry data with rules of thumb applied. Approximate data only.
Kiwifruit	Export data from SNZ. Good quality industry data. Reliable information
Kumara	Export data available from SNZ. Industry information available (differing views on domestic sales). Approximate data only.
Lettuce	Export data available from SNZ. Industry data available with rules of thumb applied. Approximate data only.
Lillies	SNZ export data only. Industry data very approximate complicated by a variety of marketing channels.
Lucerne	SNZ export data available on dependent industries. Some industry data available. Approximate data only.
Maize - Corn	Export SNZ and AFIC data available. Approximate industry data with rules of thumb applied. Based on Booker (2009).
Nuts	SNZ export data available. Industry data very approximate with industry rules of thumb applied.
Oats	No SNZ but some AFIC data. Data based on dependent industries reliable, other data approximate only.
Olives	SNZ export data available. Some industry data with industry rule of thumb applied. Approximate data only.
Onions	SNZ export data available. Some industry data with industry rule of thumb applied. Approximate data only.
Orchids	SNZ export data only. Industry data very approximate complicated by a variety of marketing channels.
Parsnip	No SNZ data. Industry data only with rules of thumb applied. Very approximate.
Passionfruit	SNZ export data only. Industry data approximate with rules of thumb applied.
Pears	Export data from SNZ. Good quality industry data. Reliable information
Peas	Export data from SNZ. Industry data of good quality although rules of thumb applied for processing.
Persimmons	Export data from SNZ. Industry data of good quality. Reliable.
Pinus Radiata	Export data from SNZ. Industry data of good quality. Reliable.
Potatoes	Export data from SNZ. Industry data of good quality with rules of thumb applied on processing. Reliable.
Prunus	Export data from SNZ. Industry data of good qualty. Reliable.
Radish	Export data from SNZ. Industry data avaialbe with rules of thumb applied. Approximate data.
Ribes	Export data from SNZ. Industry data avaialbe with rules of thumb applied. Approximate data.
Ribwort plantain	Export SNZ data available. Approximate industry data with rules of thumb applied.
Roses	No SNZ data. Industry data very approximate complicated by a variety of marketing channels.
Rubus	Export data from SNZ. Industry data avaialbe with rules of thumb applied. Approximate data.
Rye	Export data available on dependent industries. No data on human consumption. Other data approximate.
Ryegrass	Export data available on dependent industries. No data on human consumption. Other data approximate.
Silverbeet	No SNZ data. Industry estimates only. Data approximate.
Sphagnum moss	Export data avalible. Scant information otherwise with rules of thumb applied. Approximate data.
Spinach	No SNZ data. Industry estimates only. Data approximate.
Strawberries	Export SNZ data available. Good industry data available with rules of thumb applied. Reliable industry data in a small industry.
Tall fescue	Export SNZ data available. Approximate industry data with rules of thumb applied.
Tamarillos	Export SNZ data available. Good industry data available with rules of thumb applied. Reliable industry data in a small industry.
Tea	Export SNZ data available. Some industry data with rules of thumb applied. Approximate domestic data only.
Timothy	No SNZ data available. Approximate industry data with rules of thumb applied.
Tomatoes	Export data from SNZ. Industry data of good quality although rules of thumb applied for processing.
Tulips	SNZ export data only. Industry data very approximate complicated by a variety of marketing channels.
Wheat	Data from SNZ. Good industry data being developed through AIMI surveys - no information on processing - rule of thumb applied. Data improving.

SNZ – Statistics New Zealand

AIMI – Arable Industry Marketing Initiative

AFIC – Arable Food Industry Council

5. Conclusions

5.1. We have estimated plant species value

This report has estimated the economic values for the productive activity of 65 important plant species in New Zealand, using contribution to GDP as the primary measure.

The species have a range of uses – feeding directly into consumption in domestic and export markets, supporting manufacturing sectors and energy recovery, and providing crucial input into livestock industries and their associated dependent industries.

5.2. Contribution to GDP is used to value plant species

The valuations show that although the end point is the same, i.e. a measure of contribution to GDP, the means of getting there can be quite different and specific to a particular species. For forestry there is a relative abundance of data about tree planting and production and processing, enabling estimates to be prepared largely from published sources.

The GDP contributions of other species are too small to be readily identified in the aggregate inter-industry Input-Output tables, so information has had to be assembled from a wider range of sources and with requests to industry organisations, peak bodies and others.

Whereas for the forestry example, the method can be validated by reference to other estimates regarding the industry, for the other examples the highly customised sources of data make it difficult to do the same. With small industries that fall below the radar of statistical collection, we have obtained estimates from industry participants where possible and made assumptions where necessary. Even with the forestry example, some of the assumptions about, say, the proportion of different species input into other parts of the economy may create distortions in the apparent value. However, given the dominance of *Pinus radiata* in forestry that is unlikely to make a material difference to the valuation.

5.3. Uncertainties around the valuations

There remain some issues and uncertainties around the valuations. These are shown on the main results table, Table 5e, as well as stated in the calculations in the appendices. One concerns how to deal with values that have an inter-temporal dimension in a way that enables comparison between short and long rotation crops. This is particularly apparent for forestry, kiwifruit and grapes. We examined two possible approaches to inter-temporal valuation: one being a projection of current value added production over specific future time periods, on the assumption that current production levels represent the annual average over these periods; the other drawn from physical forecasts of wood availability. Both have their limitations, and given the range of uncertainties around future market demands, prices and costs neither is likely to provide an accurate prediction of future outcomes. We present results of the wood availability forecast approach for forestry species which is the more conservative method, and which

provides a magnitude of value at risk for future production that can inform the assessment of risks to the species.

Another issue is how to ensure adequate coverage of value sources that may not show up in transactions but rather avoid or reduce some other cost (such as energy recovery, which may through waste digester systems become significant for species other than trees). There is a substantial value derived from energy recovery from wood-fibre residues, most of which is used by industry and implicitly reflected in the national accounts for the value chains concerned, contributing to value added either by providing a source of revenue for other parts of the value chain or as an avoided cost of alternative energy for industries consuming energy. But an indeterminate portion of the 12% of that energy recovery used by the household sector may be supplied through the informal grey economy and not be reflected in the transactions in the Input-Output table, and the value of that is additional to any value derived from the Input-Output table ratios.

For some species there are gaps in the evaluation because information has not been forthcoming because of confidentiality issues or lack of data. To the extent that this understates the value attributable to that species it also implies lower value at potential risk for assessing biosecurity risks. For smaller parts of the value chain in other plant species that may not be a material issue for national assessment, but for those with more substantial economic activity further discussion with industry may be useful in improving the information on which the valuations are based.

However, despite limitations the method provides a way to derive estimates of value to the economy associated with particular species which provide a ready means of scaling the value at potential risk from different biosecurity threats to particular species. Should a threat materialise, further investigation can be done to firm up the estimates that might be used in risk assessments, but the values provided by this method can be used to inform risk and prioritisation in before incursion settings before the details of actual threats are known.

6. References

Beef + Lamb New Zealand (various years), *Farm Facts*.

BERL (2012), *Economic Impact Assessment of Arable Production*. Report to the Arable Food Industry Council.

BERL (2011), *2011 Analysis of the Value of Pasture to the New Zealand Economy*. Report to the Pasture Renewal Charitable Trust.

Bertram, G (1999), The impact of exotic pests on the NZ economy. In Hackwell, K., Be and Bertram, G. (Eds), *Pests & Weeds, A Blueprint for Action*. Wellington: NZ Conservation Authority, 71p.

Booker J W (2009), *Production, distribution and utilisation of maize in New Zealand*. Lincoln University, A dissertation submitted in partial fulfilment of the requirements for the Degree of Masters of Applied Science.

Brown T C (1984), The Concept of Value in Resource Allocation. *Land Economics* 60(3) 231-246.

Deloitte & Access Economics (2013) *Economic value of groundwater in Australia.* http://www2.deloitte.com/au/en/pages/economics/articles/economic-value-groundwater-australia.html

Gee E (2012) Feeding Horses in New Zealand. *Publication of the New Zealand Equine Research Foundation*.

Hampton J, Rolston M, Pyke N, and Green W (2012), Ensuring the long term viability of the New Zealand seed industry. *Agronomy New Zealand, 42, 2012*.

Horticulture New Zealand and Plant and Food Research (various years), *Fresh Facts: New Zealand Horticulture*.

Lincoln University. (2012/13), *Lincoln Financial Budget Manual.* ed Jane Pangborn.

Market Access Solutionz (2014), *Barriers to our Export Trade*. New Zealand Horticulture Export Authority and Horticulture New Zealand.

Meade R, Fiuza G & Lu A (2008), "Forest and Forest Land Valuation: How to Value Forests and Forest Land to Include Carbon Costs and Benefits"; report to Ministry of Agriculture and Forestry, Institute for Study of Competition and Regulation.

Millner J and Roskruge N (2013), The New Zealand Arable industry. In Dymond J (ed) *Ecosystem services in New Zealand: Conclusions and Trends.* Lincoln, New Zealand: Manaaki Whenua Press.

Ministry for Primary Industries (various years), *Situation and Outlook for Primary Industries*.

Moore D & Loan J (2012), "A review of import requirements and border processes in light of the entry of Psa into New Zealand", Sapere Research Group, Wellington

Nimmo-Bell (2009), *Economic cost of pests to New Zealand*. MAF Biosecurity New Zealand Technical Paper No 2009/31.

Winfree R, Gross BJ & Kremen C (2011), Valuing pollination services to agriculture. *Ecological Economics* 71, 80-88.

Appendix A Detailing the process of estimating plant species valuations

The purpose of this Appendix is to detail the workings associated with collating and estimating the plant species valuations. This includes:

- setting out the value chain
- determining how Gross Output/Margins are calculated
- setting out the Gross Output/Margins for reliant industries (livestock industries).

A.1 Value chain analysis

The value chain analysis divides the specific plant species into:

- seeds/root stock/trees or plants
- farmgate values
- processing and wholesaling
- domestic
- export.

The Gross Output value of each stage of the value chain (or marketing channel) is determined by its Gross Output value. While this is straightforward at the farmgate/orchard/vineyard gate level, the value for each stage of the value chain such as processing and wholesaling is determined by the Gross Output value of the product it sells to other parts of the value chain i.e. its output minus any inputs including from the farmgate.[14]

A.2 Determination of Gross Output/Margin

Estimates of Gross Output/margin relate to **Column I** in Table 3.

The Gross Output/margin value of each stage of the value chain is determined by an approximate volume and price estimate based on:

- prices and volumes set out in the literature e.g. the Lincoln Financial Budget Manual, Fresh Facts, and other industry focused literature
- industry experts who have given approximate values particularly for domestic economic activity
- rules of thumb used as an approximate value i.e. particularly for farmgate values e.g. Horticulture New Zealand assisted with this process by suggesting that farmgate returns are approximately 50% of domestic value (+GST) and export values (FOB).

[14] Which we have called a Processing and Wholesaling margin.

While these estimates are rough approximations, they do give us an order-of-magnitude calculation that size each plant industry.

These 'volume-multiplied-by-price' estimates can be described as a Gross Output calculation which is then multiplied by a GDP share of output (to prevent double counting) to arrive at a valued estimate for each industry segment.

These calculations (direct and dependent industry values) are added together to equal the total value added for a plant species.

A.3 Factors determining reliant industry Gross Output/margin estimates

Below we have set out the values provided by the various industries that represent the Gross Output at each stage of the marketing chain. Specifically:

- dairy, beef, sheep, wool, deer and goat estimates were provided by Rob Davison and Beef and Lamb (except for live cattle exports and domestic live cattle sales) and Statistics New Zealand's national accounts data
- live cattle and horse exports are from Statistic NZ (HS codes)
- live domestic traditional livestock sales estimates are based on Treasury/MPI estimates (Treasury 2015, p15)
- poultry egg and meat production at the farmgate are estimates provided by Mr Steven Kerr (personal communication, 24 July 2014)
- pigmeat farmgate estimates were provided by Mr Ian Braugh (personal communication, 12 August 2014)
- domestic sales of poultry (eggs and meat) and pork are based on a 28% retail mark-up from the farmgate (New Zealand Retailers Association 2013, p 16)
- processing and wholesaling margin for poultry (eggs and meat) and pork are based on 33% of the retail value
- horse Gross Output values at the farmgate and domestic stages of the value chain are estimates from the New Zealand Racing Board (IER Pty Ltd 2010).

The Gross Output/margin numbers set out in the two tables below are large relative to the direct impacts of plants. Even significant plants such as kiwifruit are an order of magnitude lower. This has a significant impact on species such as clover and ryegrass.

Relatively minor crops such as chicory, browntop and lucerne have a significant impact because of livestock dependence on them as fodder.

Further, the value attached to plants is closely linked with the rises and falls in livestock industry fortunes. Therefore, year-to-year values are quite volatile.

Table 6 Gross Output / margin for livestock industries

2012 June years, NZ dollars

	Farmgate	Processing	Domestic sales	Exports
Dairy	10,828,000,000	6,552,000,000	348,800,000	12,477,774,000
Beef	2,289,000,000	1,706,081,440	401,900,000	2,469,809,000
Sheep	2,820,000,000	1,121,477,610	804,600,000	3,125,971,000
Wool	675,000,000	147,719,380	43,900,000	984,693,000
Deer (incl. co-products)	174,136,000	57,464,880	8,200,000	270,974,000
Goats				6,668,000
Livestock sales (export)				119,937,761
All traditional livestock industry exports				**19,455,826,761**
Live sales (domestic)			871,000,000	
Horses	93,514,626		57,000,000	
Live horses exported				130,029,252
Poultry (eggs)	165,000,000	24,750,000	211,200,000	
Poultry (meat)	1,000,000,000	150,000,000	1,280,000,000	
Pigs	185,000,000	21,645,000	236,800,000	

Source: Meat + Lamb New Zealand (provided by Rob Davison), Poultry Industry Association of New Zealand, NZ Feed Manufacturers Association, New Zealand Pork, IER Pty Ltd 2010, Gee 2012, Statistics New Zealand HS Code 0101 and Statistics New Zealand's national accounts data

Table 7 Gross Output / margin for traditional livestock groupings

2012 June years, NZ dollars

	Farmgate	Processing	Domestic sales	Exports[3]
All traditional livestock industries	**16,786,136,000**	**9,584,743,310**	**2,478,400,000**	**19,455,826,761**
Dairy	10,828,000,000	6,552,000,000	348,800,000	12,477,774,000
Live sales[2]			696,800,000	95,950,209
Total dairy	**10,828,000,000**	**6,552,000,000**	**1,045,600,000**	**12,573,724,209**
Other traditional livestock industries	5,958,136,000	3,032,743,310	1,258,600,000	6,858,115,000
Live sales			174,200,000	23,987,552
Total other traditional livestock	**5,958,136,000**	**3,032,743,310**	**1,432,800,000**	**6,882,102,552**
Total pigs & poultry	**1,350,000,000**	**196,395,000**	**1,728,000,000**	
Calves[4]	120,600,000	13,590,000		90,600,000

Note (1) Other traditional livestock industries includes: beef, sheep, wool, deer, and goats. (2) For the scale of live exports see: http://www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=10860750 . (3) The figures for "All traditional livestock industries" exports include live exports. (4) Note that calf values have been estimated at the farmgate for both male and females. Only the males are slaughtered hence the lower figures for processing and export.

Source: Meat + Lamb New Zealand (provided by Rob Davison), Poultry Industry Association of New Zealand, NZ Feed Manufacturers Association, New Zealand Pork, IER Pty Ltd 2010, Gee 2012 and Statistics New Zealand HS Code 0101.

Appendix B Relationship between livestock and plants

The purpose of this Appendix is to:

- illustrate how the proportions/intake from plant species for each industry were determined
- reconcile the inputs for each industry.

Estimates of the impact of reliant industries relate to **Column II** in Table 3.

We needed to determine which industries were reliant on particular species e.g. the dairy industry is dependent on a number of grasses, legumes and herbs as feed sources. The livestock reconciliation Table below summarises the key impacts for many species associated with dependent industries.

B.1 How proportions were determined

The proportion that any dependent industry is reliant on a specific plant species is determined by:

- literature from the feed industry e.g. good statistics are available on the amount of domestic maize, barley and wheat that go into the pig and poultry industries
- assumptions about feed intake into the dairy or other livestock industry. We have no firm data on dairy industry intake however DairyNZ has provided us with approximate assumptions
- other assumptions given the plant species characteristics i.e. a grass is used because of its drought tolerance or it tolerates wet and cold conditions.

Note that in some cases, plant species are consumed in only some traditional livestock industries and not others (e.g. browntop is consumed mainly in sheep, beef and horse industries while ryegrass and clover are consumed in all traditional livestock industries).

B.2 Reconciliation of input feed

For the dependent industries the input feed calculations are required to balance, to avoid overstating values. Below we have set out the reconciliation statement for each plant species and their dependent industry(ies).

It should be noted that there is no definitive publication that we can point to that has all the data we needed. Therefore, we have relied on industry sources for their best estimates.

Table 8 Livestock reconciliation

Livestock reconcilation	Dairy	Other livestock	Horses	Pigs	Poultry (eggs)	Poultry (meat)
Barley	1.0%		9.00%	17.40%	17.40%	17.40%
Wheat	0.5%			58.80%	58.80%	58.80%
Rye	0.10%	0.10%	0.10%			
Brassicas & brassics for fodder	1.00%	2.00%				
Browntop		0.50%	0.50%			
Broadbeans			0.25%			
Faba beans			0.24%			
Peas	0.10%	0.10%	0.25%	0.24%	0.24%	0.24%
Chicory	0.20%	0.20%	0.20%			
Clover (red & white)	12.00%	12.00%	7.20%			
Cocksfoot		0.20%	0.20%			
Oats		0.40%	12.00%			
Lucerne	0.20%	0.20%	3.00%			
Maize - Corn	3.70%		5.00%	10.00%	10.00%	10.00%
Ribwort plantain	0.20%	0.20%				
Ryegrass	75.00%	75.00%	45.00%			
Tall fescue		0.20%	0.20%			
Timothy		0.10%				
Weeds and other grasses	2.30%	7.80%	4.76%			
Protein & other supplements			11.10%			
Imports (including palm kernel)	3.70%	1.00%	1.00%	13.80%	13.80%	13.80%
Totals	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Source: approximations from DairyNZ, Gee (2012), Arable Food Industry Council, and http://nzfma.org.nz/media/reference/feed-manufacture/2015-annual-nzfma-feed-overview						

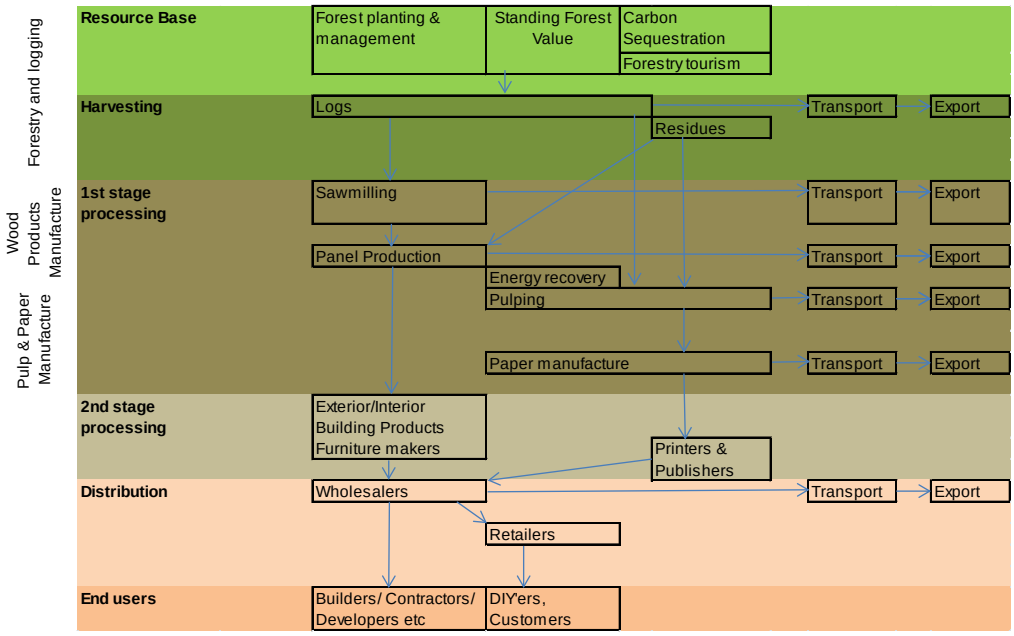
Appendix C Forestry species

Forestry is a substantial part of the New Zealand economy and in recent years the third largest commodity exports after dairy and meat production. Most commercial forestry is now derived from exotic tree species which are both fast growing in the New Zealand environment and yielding a range of wood qualities for use in sawn timber production, reconstituted panel products, pulp and paper manufacture.

Pinus radiata is the predominant species grown in plantation forestry in New Zealand, accounting for about 90% of harvest area, 93% of harvested volume and 94% of exports by value. Douglas fir is the second most important species with about 6% of planted area and 4% of annual harvested volume. The remainder of exotic forests comprise *Eucalyptus*, *Cupressus* and other minor special purpose species. Each species has its own timber qualities and product purposes, but all face a similar marketing chain between growth and use, which is described below.

Forestry in the national accounts comprise forestry and logging, wood products and pulp and paper manufacture. The connections between these and other parts of the value chain are outlined in Figure 2 below.

Figure 2 Connections between industries in the forestry



Source: NZIER

Forestry and logging covers the management of the resource base – the planting and management of plantation forests – and harvesting. First stage processing includes the wood products industry, which produces sawn timber, veneers, plywood and reconstituted panels such as fibreboards, and the pulp and paper manufacturing industry. Second stage processing involves industries whose products have a noticeable proportion of wood-based products, including building materials and the construction industries, furniture making, printing and publishing (other than online and electronic media publishers). The term 'forestry' is commonly applied only to forestry logging and

first stage processing, in which forest products (wood-fibre) comprises 25% or more of the value of inputs (according to Statistics New Zealand's Input-Output tables). In second stage processing, non-wood inputs comprise more than 80% of total input value, and more substitutes exist for wood-fibre (e.g. steel framing in building, metal or plastic furniture) so the share of economic value added attributable to wood or tree species is lower than in first stage processing.

Figure 2 also shows that the wholesale and retail trade and transport operators are also involved in the distribution of forest products to domestic and export markets. If these services are specialised to distributing forest products they would face a short term hit in the event of disruption of forestry production. But such services as building supplies wholesaling and retailing often trade in more than just forest products, and in the longer term, resources in these distribution services would be redeployed to other things, so they are less directly part of the value at risk from threats to forestry activity.

Other features to note from Figure 2 are:

- while the main material flows between forestry-related parts of the value chain are of logs from forestry to wood processing and pulping, there are also large flows of residues from both harvesting and sawmilling activities that are collected and provide inputs to reconstituted wood products and pulp manufacture
- residues are also used to provide heat and power to parts of the manufacturing process, particularly in pulp making, providing value savings in the cost of energy that would otherwise be needed; and wood fibre is also being investigated as a potential feedstock for bioenergy production
- there is commercial value in standing forests, both from their role as the setting for forest-based tourism and because of their storage of carbon under a greenhouse gas accounting system. Both of these values are compromised by the harvesting of trees, at least in the short term until forest growth recovers
- forests in general can also create value or save costs by providing soil stability, reducing erosion and run-off into streams, and moderating water flows, but these effects are often experienced as externalities that do not provide commercial return to those who provide the forests.

Implications for attributing value to species

Although the valuation method applied to tree species is broadly similar to that applied to other plants, some modification is required to take account of the characteristics of tree species. In particular:

- trees are a long lived stock so threats to a species create risk of both reduced annual production and over a stream of years ahead. This is handled by presenting both an annual value and a present value of future expected harvests to indicate the scale of impact of threats to each species
- trees also produce multiple outputs of products and energy when used, and of carbon storage while standing, all of which need to be accounted as part of the value at risk in face of threats.

C.1 Outline of valuation methods

C.1.1 GDP attribution

As outlined in the pilot, we provided estimates for *Pinus radiata* in the Interim Report. The task here is to attribute values for output, exports and GDP to individual species given reliable statistics only on export volumes and values and production volumes. Areas planted by species are given in the NEFD, and these have been used to attribute the volume harvested that is not *Pinus radiata* amongst the other species. An alternative is to use the export value figures for sawn timber, which distinguish *Pinus radiata* and Douglas fir from other species, and allocate the remainder across other species in proportion to their shares of volume harvested. The choice between these species shares only has a material impact on Douglas fir, which has a much lower share of sawn timber exports than its share of harvested volume.

In the pilot, we allocated aggregate forestry figures in proportion to the shares of export value. Applying this across species may understate the attribution to Douglas fir and elevate slightly those to cypress, eucalypts and *Pinus radiata*. Accordingly, for cross species comparison we have allocated each species in proportion to estimated harvest volume. The *Pinus radiata* result has changed slightly from the pilot, but not by a material amount.

C.1.2 Recovered energy

Forestry contributes to the national energy balance in a number of ways:

- firewood collected from forests for use in domestic and industrial burners
- residues from sawmilling collected and fed into furnaces to power forest industry processes
- extracts from the pulping process (black liquor) which can be fed into furnaces to provide heat and power for other production processes
- Biodigestion of wood fibres to convert components into other biofuels, such as ethanol for blending with petrol or diesel.

While wood fibre is attracting attention as a future feedstock for biofuels, such processes are not commercially competitive at present and volumes used are at a low experimental level. Firewood is part of the outputs of forest growing, but its volume and value are probably understated by transactions on the black or grey markets and by unrecorded foraging and collecting from forests for domestic consumption. The use of residues and black liquor are widely used in the industry, and these have a value in the avoided cost of other energy that would otherwise be required to be bought and that would detract from the industry's value added.

NZFOA's *Forestry Facts and Figures* records 61.1 gross petajoules of energy as being derived from forest residues in year ending December 2012. Leaving aside a slight difference in NZFOA's and MBIE's figures for 2012, 61.1 GPJ represents a sizeable contribution to New Zealand's energy needs, equivalent to about 12% of total consumer energy (i.e. energy available for consumption uses, after allowing for energy transformation processes such as oil refining). It is equivalent to about 16,908 GigaWatt hours (GWh), which valued at a wholesale price of 8c/kWh ($80/MWh) in 2012 would be worth $1.358 million. Assuming 93% if that is derived from *Pinus radiata* residues, the energy value attributed to the species is $1.265 million.

This figure is equivalent to about 8% of the Gross Output from *Pinus radiata* across the three forestry stages of the value chain. A value-added estimation is less straight forward, because the activities involved in energy recovery from woody biomass are already implicitly covered in forestry activities in the national accounts. If there was no energy recovery, forestry would need to buy the energy to maintain the same output which, other things held constant, would reduce their value added by $1,265 million on the estimates above. Energy generation, however, would increase its sales by the same amount and create some value added on these sales. The Input-Output tables show the electricity generation and on-selling parts of the value chain had a ratio of value added to Gross Output of 0.26, so assuming this applies to the replacement of woody biomass implies a value added contribution of $329 million.[15] This estimate assumes that electricity is the next best alternative energy source to woody biomass, but in practice that may not be the case if gas or coal is more competitive. There would be a net loss in value added economy-wide of $936 million.

In short, the industry's energy recovery provides an economic surplus for the industry already reflected in industry value added, but without energy recovery that value added would decline. In practice, should a biosecurity threat emerge to threaten production, the forest industries' demand for process energy may fall, which would lower the value of that economic surplus. Conversely, more wood may be diverted to energy recovery in the event that a threat emerged that lowered wood's value in other uses.

About 12% of the estimated value of energy recovery from woody biomass is used for residential heating, amounting to $152 million a year. While most of this is covered by the inter-industry transactions in the input output tables, an indeterminate portion may be outside it because of wood supplied informally through the grey or black economy.

C.1.3 Carbon sequestration

Forests act as a carbon sink when growing, storing carbon in their trunks until such time as they burn, die or decompose, at which point they release it back into the atmosphere. Under the Kyoto Protocol carbon accounting, new forestation since 1990 counts as an addition to New Zealand's carbon storage eligible for earning credits, but any deforestation counts as emission of greenhouse gases at the time the tree is cut down, creating liability for landowners unless they replant.

The existence of standing forest creates a valuable store of carbon which fluctuates year to year according to the rate of land use change and the extent of deforestation, replanting and new afforestation. In 2012, net removals of greenhouse gases in New Zealand under the Kyoto Protocol were 15 million tonnes of CO_2-e from land use change and forestry. Under UNFCCC reporting which includes a broader range of non-forest land categories, net removals were 26.6 million tonnes CO_2-e.

The commercial value of these sequestered stores is highly variable, depending on both the changes in the physical stock of trees and the price attached to carbon credits. Unfortunately, 2012 is problematic as a base year in that it was a year which saw the carbon price fall from NZ$8.06/t$CO_2$-e in January to 0.29c/t$CO_2$-e in December. The price fall was caused by international factors, in particular excessive supply of credits in the EU and New Zealand emissions trading schemes, and the collapse of demand for credits brought on by the global financial crisis. Prices have varied a little since then, but in March 2014 were still just 30c/tCO_2-e.

[15] Note we only consider the generation and selling of electricity as an incremental activity associated with finding alternative energy. Transmission and distribution networks have fixed capacities and a higher proportion of fixed cost which we assume will be unchanged by marginal change in electricity supplied.

We estimate the value attributable to species by calculating the net carbon removals from land use change and forestry from the MfE's Kyoto Protocol inventory, valuing this by the carbon price and attributing this to species in proportion to the volume harvested. Effectively this is the liability created by harvesting the volume of species, or the value of carbon stored by those growing trees in the year prior to felling. We provide estimates at two price levels, of \$8.06 t/CO_2-equivalent in January 2012 before the price crash, and \$0.29/tonne CO_2-e in December after the crash.

C.1.4 Forest tourism and other wider benefits

Exotic forests are not without amenity value and some may attract recreational and tourist use. Activities such as tramping, picnicking and mountain biking take place in exotic forests. There are commercial values associated with this, arising from gate fees for access to specific attractions, guiding fees for visits to the areas, or ancillary activities such as hospitality, retailing and transport services that are used in association with these forests.

Forest recreation and tourism in New Zealand is dominated by indigenous forests, and even for this, there is very patchy information on the amount of activity in the forests and the commercial value created by them. There has been relatively little study of recreation and tourism in exotic forests with which to infer general value.

Some recent studies have attempted to infer wider values for exotic forests from the ecosystem services of value they provide to other human activities.[16] These ecosystem services include values for recreation and tourism activity, contributions towards water quality improvement, micro-climate regulation and amelioration of soil erosion and flooding. Such studies infer economic values for such services with a variety of methods, such as estimating the averted losses from fewer flood events or various non-market valuation techniques to estimate the public's willingness to pay for such services. Such methods estimate a consumer surplus associated with use of these forests, but these are not generally commercial values and are not strictly comparable with other national accounting aggregates unless consumer surplus estimates are made for all other activities covered by the accounts. Accordingly, this is beyond the scope of this report and not pursued further here.

We have found no reliable information on commercial values for recreation and tourism in exotic forests, and have no basis for estimating a figure for tourism, recreation or other ecosystem services attributable to individual exotic species.

C.1.5 Net present value over time

The estimates of Gross Output and value added in the national accounts are annual values recording activity within a single calendar year. But forest crops are long-lived assets that take years to reach harvestable stage. A biosecurity threat that attacked a tree species would affect not just the current year's activity but also that for years to come. A full measure of the value associated with tree species needs to reflect the inter-temporal impact of such threats on the growing stock.

Assessments of forest pests once they have arrived (e.g. the white spotted tussock moth) this has been done by postulating a level of impact and projecting this as a loss of productive value in future years to estimate a net present value of potential future loss.

[16] See chapters by Yao et al on Planted Forests, Simmonds on Tourism, and Clough on Recreation in Dymond J (Ed.) *Ecosystem Services in New Zealand: conditions and trends*, Manaaki Whenua Press, Lincoln, New Zealand 2013.

Given knowledge of the stock of forests and the age classes and types of trees within them, modelling the availability of trees for harvest into the future can be done with some precision. Forecasting the actual production levels varies with predictions of the volume demanded, the price of products and the future level of costs of production, changes in which have in the past led to marked shifts in the rates of felling and use of wood fibre between log exports, wood processing and pulp manufacture. Broader economic influences like global growth and demand and exchange rate variations also affect the future volume and timing of forest offtake. This range of influential variables can cloud the valuation with questions around the detailed assumptions, distracting from the bigger picture of value at risk of threat.

One way to reduce this cloud would be to present the one-year national accounting figures as an indicator of immediate or short term value at risk, to give some comparability with other estimates for plants with annual or shorter term rotations, then supplement this with a net present value calculation of the value of future production at risk. Different forecasts would produce different results and if a real pest emerged more effort would be directed at refining forecasts of potential impacts, but relatively simpler estimates of future values suffice for before for before incursion scaling of values at risk.

Wood availability forecasts exist for the period to 2010-2040 which provide an indication of how much wood is in principle available for harvest in future years.[17] The forecasts include a range of separate scenarios, but two scenarios for *Pinus radiata* are illustrated in our estimates: scenario 1, which assumes all wood is harvested at age 30 (which results in a distinct bulge in the middle years of the forecast); and scenario 3, which is described as "Non-declining yield with a target of 30 years", in which the bulge is smoothed out in a manner more in keeping with maximising the utilisation of capital equipment over the lifetime of the forest rotation. The value of such wood into the future is difficult to predict, but it would be reasonable to start with the assumption that it would earn in real terms no less than the current Value Added of $173 per cubic metre earned across the forestry industries. Combining the volume and value information in a discounted cash flow indicates a net present value for the species in question (using discount rates of 3%, 6% and Treasury's default 8% rate).

The wood availability forecasts also include one for Douglas fir, which we use to calculate the present value at risk for that species. There are no published forecasts for eucalypts or cypress species, so we compile a forecast from the age classes of plantings in the NEFD, assuming harvesting at 35 years.

C.2 *Pinus radiata* estimates

Pinus radiata is the most widely planted commercial tree species in New Zealand, with a range of uses from sawn timber for framing and building to pulp and paper and reconstituted boards. A slight revision to the pilot estimates is required because of the relativities between tree species.

Attribution of industry output value and value added to *Pinus radiata* in proportion to harvested volume shares results in the following break-down of value across forestry.

[17] MAF (2010) New Zealand Wood Availability Forecasts 2007-2040, Wellington.

Table 9 *Pinus radiata* summary

Year ending December 2012, $ M

Stage of the value chain	Outputs used by other industry	Outputs to domestic final consumption	Outputs to export	Gross Output value $m	GDP share of Gross Output (source: SNZ: Input-Output tables, Tab 4)	GDP value
Forestry & logging	4,053	1,038	1,463	**6,555**	0.35	**2,314**
Wood product manufacture	2,996	156	1,469	**4,621**	0.29	**1,321**
Pulp & paper manufacture	1,731	120	1,147	**2,997**	0.27	**820**
Total *Pinus radiata*	**8,781**	**1,314**	**4,079**	**14,173**	**0.31**	**4,454**[1]
Note (1) numbers rounded.						

Source: NZIER, using Statistics New Zealand's Input-Output tables, NZFOA Facts and Figures, Exports by product

This table implies that the annual value at risk from biosecurity threat to *Pinus radiata* is $4.5 billion in value added (2.2% of national GDP) and $4.1 billion of export value (6.5% of total New Zealand exports).[18]

C.2.1 Value outside the annual national accounts

The value added and output estimates do not cover all the potential value at risk should *Pinus radiata* be subject to biosecurity threat. Two quantifiable sources of commercial value potentially at risk are recovered energy and carbon sequestration.

Recovered energy value

Applying the methodology for value to energy generation, we estimate the contribution of *Pinus radiata* to equate to around $1.26 billion in reduced energy costs that would have created $329 million in value added for electricity (other things held constant). The net value gain is therefore $936 million[19], which is implicit in, and hence enhances GDP.

Carbon sequestration value

Carbon sequestration value is estimated for two assessments of carbon storage from the Kyoto Protocol recording purposes and those for the UNFCCC. It also uses two prices of carbon to reflect the range of recent prices. The outcome from the range of values and volumes used is shown Table 10.

[18] GDP and total export comparisons are based on Statistics New Zealand's estimate of annual GDP expenditure, Table 19, at http://www.stats.govt.nz/browse_for_stats/economic_indicators/GDP/GrossDomesticProduct_HOTPDec12qtr/Tables.aspx

[19] This figure is not in the summary table because it is an avoided cost figure that cannot be incorporated the national accounts without adjusting all other items in the accounts. Without energy recovery forest products industries would pay for alternative energy, reducing their value added but enlarging the value added of other energy sectors. There would be a net loss in GDP across forestry and energy supply sectors, but as this is an avoided loss it is already included in the forest industries' value added, and cannot be added to other values without double counting.

Table 10 Value of sequestered carbon in *Pinus radiata*

$ M 2012 values, assuming 94% of sequestration is in *Pinus radiata*

Price NZ$/tCO2-e	Kyoto volume 15 Mt CO2-e	UNFCCC volume 26.6 Mt CO2-e
$8.06	$112.1m	$199.6m
$0.29	$ 4.1m	$ 7.2m

Source: NZIER using data from MfE on sequestered volumes and carbon prices

As prices currently lie at the lower end of this range, the value of carbon sequestration is negligible in the scheme of values reported here.

Effect on net present value of long term production

The value of wood into the future is difficult to predict, but an indication is given by New Zealand Wood Availability Forecasts 2010-2040. Assuming that it would earn in real terms no less than the current Value Added of $173 per cubic metre of timber earned across the forestry industries, and combining the volume and value information in a discounted cash flow indicates the following valuations.

Table 11 Value of standing stock of *Pinus radiata* forests[20]

Net present value of Value Added (contribution to GDP) 2013-2040

Discount rate	Forecast years	Scenario 1 Mean cut tonnes/year	Scenario 1 27 year NPV $m	Scenario 3 Mean cut tonnes/year	Scenario 3 27 year NPV $m
8%	27	25,320	58,791	25,024	55,856
6%	27	25,320	71,420	25,024	68,173
3%	27	25,320	99,274	25,024	96,020

Source: NZIER using data from MAF Wood Availability Forecasts 2010-2040

This can be interpreted as a maximum present value at risk should *Pinus radiata* be rendered unusable by some threat. More likely a threat will reduce the productive value by some proportion, which can be inferred from these estimates.

C.3 Douglas fir (*Pseudotsuga menziesii*)

Douglas fir (*Pseudotsuga menziesii*) is the second most commonly planted exotic forestry species in New Zealand, producing wood with a reputation for structural timber and some feature beams. It is mostly grown in the South Island. Its rotation is commonly longer (at 45 years) than that for *Pinus radiata* and its end uses are similar but complementary to those of *Pinus radiata*.

Applying the same attribution of industry output value and value added as for *Pinus radiata* results in the following break-down of value across forestry.

[20] The value of the expected stream of future timber from harvesting trees that are currently planted, valued on the assumption that the current Value Added per hectare will continue into the future. It is thus a value that growing trees will have when they reach harvest age at some time in future, discounted back to present value terms.

Table 12 Douglas fir summary

Year ending December 2012, $ M

Stage of the value chain	Outputs used by other industry	Outputs to domestic final consumption	Outputs to export	Gross output value $m	GDP share of Gross Output (source: SNZ: Input-Output tables, Tab 4)	GDP value
Forestry & logging	182	47	66	**295**	0.35	**104**
Wood product manufacture	135	7	66	**208**	0.29	**59**
Pulp & paper manufacture	78	5	52	**135**	0.27	**37**[1]
Total Douglas fir	**395**	**59**	**183**	**637**	**0.31**	**200**[2]

Notes (1) This is the Value Added (GDP) contribution of each of the three stages of the value chain attributable to Douglas Fir. The total ($200M) appears in Table 3. Table 21 at the end of this section is the linking table, which shows for each species the GDP values per stage of the value chain per species and the distribution of their output across other industries (e.g. processing and wholesaling), domestic consumption and exports). Those output distribution figures from Table 18 also appear in Table 3, albeit in a different scale format. (2) Numbers rounded.

Source: NZIER, using Statistics New Zealand's Input-Output tables, FOA Facts and Figures, Exports by product

This table implies that the annual value at risk from biosecurity threat to Douglas fir is $200 million in value added (0.1% of national GDP) and $183 million of export value (0.3% of total New Zealand exports).[21]

C.3.1 Value outside the annual national accounts

The value added and output estimates do not cover all the potential value at risk should Douglas fir be subject to biosecurity threat. Two quantifiable sources of commercial value potentially at risk are recovered energy and carbon sequestration.

Recovered energy value

Applying the methodology for value to energy generation, we estimate the contribution of Douglas fir to equate to around $57 million in reduced energy costs that would have created $15 million in value added for electricity (other things held constant). The net value gain is therefore $42 million.

Carbon sequestration value

Carbon sequestration value is estimated for carbon storage estimates under the Kyoto Protocol and UNFCCC recording processes. The outcome from the range of values and volumes used is shown in Table 13.

[21] GDP and total export comparisons are based on Statistics New Zealand's estimate of annual GDP expenditure, Table 19, at http://www.stats.govt.nz/browse_for_stats/economic_indicators/GDP/GrossDomesticProduct_HOTPDec12qtr/Tables.aspx

Table 13 Value of sequestered carbon in Douglas fir

$ M, 2012 values, assuming 94% of sequestration is in *Pinus radiata*

Price NZ$/tCO2-e	Kyoto volume 15 Mt CO2-e	UNFCCC volume 26.6 Mt CO2-e
$8.06	$5.06m	$8.97m
$0.29	$0.18m	$0.32m

Source: NZIER using data from MfE on sequestered volumes and carbon prices

As prices currently lie at the lower end of this range, the value of carbon sequestration is negligible in the scheme of values reported here.

Effect on net present value of long term production

The value of wood into the future is difficult to predict, but an indication is given by New Zealand Wood Availability Forecasts 2010-2040. Starting with the assumption that it would earn in real terms no less than the current Value Added of $173 per cubic metre of timber earned across the forestry industries, and combining the volume and value information in a discounted cash flow indicates the following valuations.

Table 14 Value of standing stock of Douglas fir forests

Net present value of Value Added (contribution to GDP) 2013-2040

Discount rate	Forecast years	Scenario 1 Mean cut tonnes/year	Scenario 1 27 year NPV $m
8%	27	1,019	1,827
6%	27	1,019	2,343
3%	27	1,019	3,583

Source: NZIER using data from MAF Wood Availability Forecasts 2010-2040

C.4 *Cupressus* species

Cupressus species include a range of species like cypress and macrocarpa (*Cupressus macrocarpa*) that are commonly used in farm woodlots and shelterbelts. It produces a durable heartwood and clear timber with some decorative uses, and it matures in approximately 35 years given suitable sites and management.

Applying the same attribution of industry output value and value added as for *Pinus radiata* results in the following break-down of value across forestry.

Table 15 Cupressus summary

Year ending December 2012, $ M

Stage of the value chain	Outputs used by other industry	Outputs to domestic final consumption	Outputs to export	Gross Output value $m	GDP share of Gross Output (source: SNZ: Input-Output tables, Tab 4)	GDP value
Forestry & logging	17[1]	4	6	28	0.35	10
Wood product manufacture	13	1	6	20	0.29	6
Pulp & paper manufacture	7	1	5	13	0.27	4
Total *Cupressus*[2]	38	6	17	61	0.31	19[3]

Notes (1) These figures are shares of outputs for total forestry, attributed to each species in proportion to volume harvested. The figures are from the IO tables, uprated in line with changes in export stats. (2) Numbers rounded. (3) This figure can be reconciled with Table 3 with reference to Table 21.

Source: NZIER, using Statistics New Zealand's Input-Output tables, NZFOA Facts and Figures, Exports by product

This table implies that the annual value at risk from biosecurity threat to *Cupressus* species is $19 million in value added (0.01% of national GDP) and $17 million of export value (0.03% of total New Zealand exports).

C.4.1 Value outside the annual national accounts

The value added and output estimates do not cover all the potential value at risk should *Cupressus* species be subject to biosecurity threat. Two quantifiable sources of commercial value potentially at risk are recovered energy and carbon sequestration.

Recovered energy value

Applying the methodology for value to energy generation, we estimate the contribution of *Cypress* species to equate to around $5.4 million in reduced energy costs that would have created $1.4 million in value added for electricity (other things held constant). The net value gain is therefore $4.0 million.

Carbon sequestration value

Carbon sequestration value is estimated for carbon storage estimates under the Kyoto Protocol and UNFCCC recording processes. The range of values using these volumes two prices of carbon to reflecting the range is shown in the Table below.

Table 16 Value of sequestered carbon in *Cupressus* species

$ M, 2012 values, assuming 94% of sequestration is in *Pinus radiata*

Price NZ$/tCO2-e	Kyoto volume 15 Mt CO2-e	UNFCCC volume 26.6 Mt CO2-e
$8.06	$0.48 m	$0.55m
$0.29	$0.02m	$0.03

Source: NZIER using data from MfE on sequestered volumes and carbon prices

As prices currently lie at the lower end of this range, the value of carbon sequestration is negligible in the scheme of values reported here.

Effect on net present value of long term production

The value of wood into the future is difficult to predict, given the low volume and scattered nature of the plantings. There are no published forecasts of future *Cupressus* wood availability, but the NEFD Table 9.10 gives areas planted for 5-year age groupings. We have assumed these age classes are evenly distributed though the five year periods (i.e. each year 1/5th of the area was planted, that they will be felled at age 35 years, and that the average yield will be 570 m^3 per hectare).[22] Starting with the assumption that the resulting volume yield would earn in real terms no less than the current Value Added of $173 per cubic metre of timber earned across the forestry industries, a discounted cash flow indicates the following valuations.

Table 17 Value of standing stock of *Cupressus* forests

Net present value of Value Added (contribution to GDP) 2013-2040

Discount rate	Forecast years	Scenario 1 Mean cut tonnes/year	Scenario 1 27 year NPV $m
8%	27	105	157
6%	27	105	212
3%	27	105	347

Source: NZIER using data from NEDF

Note that the NPV is calculated over a 27-year period, to be consistent with that of pinus radiata and Douglas fir, which were set at 27 years in line with the 2040 forecasts.

C.5 Eucalyptus

The *Eucalyptus* genus includes over 450 species and more than 200 hybrids, over 100 of which are found in New Zealand. Only a small proportion have commercial value in New Zealand, and recent planting has focused on species *E. regnans, E. fastigata* and *E. nitens*, which produce long fibres for use in pulp for high quality papers.

While *Eucalyptus* timber has grain features, patterns and colour that makes it suited for furniture, veneers and high value uses, it also has properties that require careful cutting.

[22] Special Purpose Timber Species, http://maxa.maf.govt.nz/forestry/publications/SpecialPurposefinal.pdf

Growing eucalypts over 35 year rotations has weak returns, so some recent papers suggest shorter rotations of 18-19 years could be optimal. Eucalypts respond well to coppicing and regenerate quickly from stumps and have attracted attention as potential feedstock for biofuel manufacture with shorter rotations of 10 to 15 years. It tends to spit when burned, so as fuelwood is best used in enclosed stoves.

Applying the same attribution of industry output value and value added as for *Pinus radiata* results in the following break-down of value across forestry.

Table 18 *Eucalyptus* summary

Year ending December 2012, $ M

Stage of the value chain	Outputs used by other industry	Outputs to domestic final consumption	Outputs to export	Gross Output value $m	GDP share of Gross Output (source: SNZ: Input-Output tables, Tab 4)	GDP value
Forestry & logging	38	10	14	**61**	0.35	**21**
Wood product manufacture	28	1	14	**43**	0.29	**12**
Pulp & paper manufacture	16	1	11	**28**	0.27	**8**
Total *Eucalypts*	**81**	**12**	**38**	**132**	**0.31**	**41**[1]
Note (1) numbers rounded.						

Source: NZIER, using Statistics New Zealand's Input-Output tables, NZFOA Facts and Figures, Exports by product

This table implies that the annual value at risk from biosecurity threat to *Eucalyptus* species is $41 million in value added (0.02% of national GDP) and $38 million of export value (0.06% of total New Zealand exports).

C.5.1 Value outside the annual national accounts

The value added and output estimates do not cover all the potential value at risk should *Eucalyptus* species be subject to biosecurity threat. Two quantifiable sources of commercial value potentially at risk are recovered energy and carbon sequestration.

Recovered energy value

Applying the methodology for value to energy generation, we estimate the annual contribution of *Eucalyptus* species to equate to around $11.7 million in reduced energy costs that would have created $3.1 million in value added for electricity (other things held constant). The net value gain is therefore $8.7 million.

Carbon sequestration value

Carbon sequestration value is estimated for carbon storage estimates under the Kyoto Protocol and UNFCCC recording processes. The outcome from the range of values and volumes used is shown in Table 13.

Table 19 Value of sequestered carbon in *Eucalyptus* species

$ M, 2012 values, assuming 94% of sequestration is in *Pinus radiata*

Price NZ$/tCO2-e	Kyoto volume 15 Mt CO2-e	UNFCCC volume 26.6 Mt CO2-e
$8.06	$1.05m	$1.85m
$0.29	$0.04m	$0.07m

Source: NZIER using data from MfE on sequestered volumes and carbon prices

The value of carbon sequestration is negligible in the values reported here.

Effect on net present value of long term production

There are no published forecasts of future *Eucalyptus* wood availability, but the NEFD Table 9.12 gives areas planted for 5 year age groupings. Assuming each year 1/5th of the area was planted, that trees are felled at age 35 years, that the average yield will be 400 m^3 per hectare,[23] and that the resulting volume yield would earn in real terms no less than the current Value Added of $173 per cubic metre of timber earned across the forestry industries, a discounted cash flow calculated over a 27-year period at 3%, 6% and 8% discount rates yields the following valuations. Table 20 Value of standing stock of *Eucalyptus* forests

Net present value of Value Added (contribution to GDP) 2013-2040

Discount rate	Forecast years	Scenario 1 Mean cut tonnes/year	Scenario 1 27 year NPV $m
8%	27	193	281
6%	27	193	381
3%	27	193	631

Source: NZIER using data from NEDF

C.6 Value added component of the species

The foregoing sections have identified the gross value of species. Table 21 presents the value added for species at each stage of the value chain, and the four species combined.

[23] *Eucalypts* New Zealand http://ieabioenergytask43.org/wp-content/uploads/2013/09/IEA_Bioenergy_Task43_PR2011-01.pdf

Table 21 Value added by species and stage of the value chain

Species	Outputs used in other stages of the value chain	Outputs used in domestic consumption	Outputs sent for export	Total outputs
Pinus radiata	$m	$m	$m	$m
Forestry & logging	1,431	366	516	2,314
Wood products	856	45	420	1,321
Pulp & paper	473	33	314	820
Total	**2,760**	**444**	**1,250**	**4,454**
Douglas fir	$m	$m	$m	$m
Forestry & logging	64	16	23	104
Wood products	39	2	19	59
Pulp & paper	21	1	14	37
Total	**124**	**20**	**56**	**200**
Cupressus	$m	$m	$m	$m
Forestry & logging	6	2	2	10
Wood products	4	0	2	6
Pulp & paper	2	0	1	4
Total	**12**	**2**	**5**	**19**
Eucalyptus	$m	$m	$m	$m
Forestry & logging	13	3	5	21
Wood products	8	0	4	12
Pulp & paper	4	0	3	8
Total	**26**	**4**	**12**	**41**
Four species	*$m*	*$m*	*$m*	*$m*
Forestry & logging	1,514	388	547	**2,449**
Wood products	906	47	444	**1,398**
Pulp & paper	501	35	332	**868**
Total	**2,922**	**470**	**1,323**	**4,715**

Source: NZIER

Table 21 is calculated by applying the GDP: Output ratio to each stage of the value chain's Gross Output distributed to other industries (for processing), to the domestic consumption and to export. Hence the Table shows how much value added each stage of the value chain creates in distributing its output to the different uses, and the relative scale of value added created by forestry and logging, wood products and pulp and paper manufacture. The four species totals are the summation of the corresponding figures for each of the individual species, hence the four species forestry and logging figures are the sum of forestry and logging value added for each of the four species above. The Total rows for each species in this table are the figures that appear as Direct Impact columns in Table 5 above.

C.7 Limitations and potential refinements of forestry values

The method applied to forestry tree species is very high level, and as such may miss some of the distinctions between different species. It effectively attributes shares of industry value to species according to the volume harvested of each species. This has a number of limitations. If the tree species differ markedly in the average value per unit volume – for instance due to different qualities of wood fibre or different product mixes – some species may be over-valued and others under-valued. The estimation of future value streams at risk is itself at some risk of missing changes in future value or future cutting profiles reflecting varying market influences at the time.

Some of these issues (like uncertainty about future prices and harvest volumes) are common to all future-focused valuations, and manageable with sensitivity testing of input assumptions or predictions of ranges around a central forecast. Some are less problematic in the case of forestry species because of the characteristics of forestry in New Zealand. *Pinus radiata* is so dominant in New Zealand that average values and wood product mixes for *Pinus radiata* are likely to be close to those for all forestry.

There is more of an issue for species grown for special purpose timbers, which include some *Eucalyptus* and *Cupressus* species. But these are such a small part of the current forestry mix that the current method is unlikely to miss significant value.

That said, the method can obviously be improved by refining each of the smaller species so that the model reflects their average price per volume, or their mix of pulping, timber and biofuel uses. This would require more elaborate recording of harvesting activity and distribution of offtake to different uses. Both the cypress and eucalypt categories contain multiple species with distinct characteristics and uses. Obtaining reliable data specific to these species could be costly and possibly not justifiable for species with small scale value contribution.

The values described here are values associated with particular species, not the residual economic rent attributable to species after all other capital and labour inputs have covered their opportunity cost. Clearly value is created or added to a species by labour and capital inputs, but without detailed information on the assets and other inputs employed to determine an appropriate return to each factor, calculation of a residual rent attributable to a species will be problematic.

Appendix D Other plants

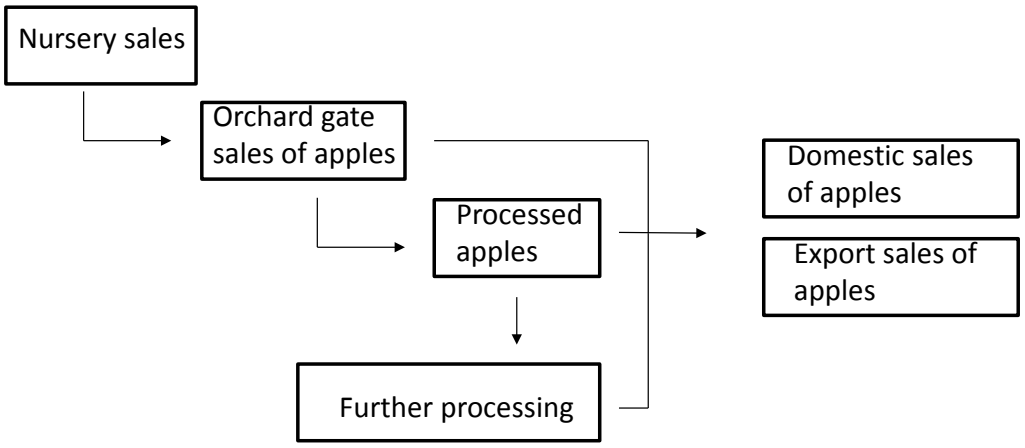
D.1 Apples (*Malus domestica*)

Apples (*Malus domestica*) arrived in New Zealand with the first European settlers. First exports occurred in 1888[24] and today while under gone radical change with deregulation, the industry is still a major contributor to the New Zealand economy.

Figure 3 sets out the apple value chain. Major points include:

- the best data is for exports. There is no other official data for other parts of the value chain. Therefore, we have worked backward through the value chain from the export value
- estimates are made for processed apples and other parts of the value chain.

Figure 3 Apple value chain



Source: NZIER

D.1.1 Nursery (Trees/root stock) Gross Output value

The following Table sets out the approximate value of apple nursery Gross Output value in 2012. While very approximate, we have used volumes and prices from a major nursery (personal communication, Kate Marshall, Waimea Nurseries, 16 May 2014) to identify domestic nursery Gross Output value. Total exports of live plants and root stock are relatively small.[25]

[24] http://www.teara.govt.nz/en/apples-and-pears/page-1

[25] No root stock was exported in 2012.

Table 22 Estimated apple nursery Gross Output value

2012, June year

	Trees	Per unit sales	Nursery Gross Output value (per annum)
Apple nursery stock	600,000	$13	$7.8 million[1]
Notes (1) includes value per hectare, labour costs, and wholesale mark-up.			

Source: Waimea Nurseries and NZIER

D.1.2 Orchard gate Gross Output value

Total production is estimated to be 480,000 tonnes[26]. This has been calculated by taking the total export tonnage (284,451 tonnes), adding estimates of domestic consumption ((61,871 tonnes = 63,000 tonnes less imports of 1,129 tonnes) and estimates of the amount removed at the processing stage (133,678 tonnes).

Orchard gate return estimates are calculated at:

- $650 per tonne (June year 2012) for the export crop (MPI estimates derived from 2012 MPI Pipfruit Monitoring Report)[27]
- $480 per tonne for the domestic market (MPI estimates derived from 2012 MPI Pipfruit Monitoring Report)[28]
- $100 per tonne for the processing market (MPI estimates derived from 2012 MPI Pipfruit Monitoring Report). [29]

The following Table sets out the orchard gate returns.

Table 23 Orchard gate Gross Output value

2012, December year

	Tonnes	Price per tonne	Gross output value
Exports	284,451	$650	$184,893,150
Domestic	61,871	$480	$29,698,080
Processing	133,678	$100	$13,367,800
Total			**$227,959,030**

Source: USDA FAS GAIN Report (2013) and MPI 2012 Pipfruit Monitoring Report

D.1.3 Processing and Wholesaling margin

The Processing and Wholesaling margin equals the Processing Gross Output value minus the Orchard Gate Gross Output.

[26] Pipfruit Monitoring Report https://www.mpi.govt.nz/document-vault/4191 and USDA FAS GAIN Report. May 2013. New Zealand Apple and Pear Sector Report.

[27] Pipfruit Monitoring Report https://www.mpi.govt.nz/document-vault/4191

[28] Pipfruit Monitoring Report https://www.mpi.govt.nz/document-vault/4191

[29] Pipfruit Monitoring Report https://www.mpi.govt.nz/document-vault/4191

Processing may occur on-orchard or in a processing facility nearby. Therefore, the distinction between orchard gate Gross Output value and processing Gross Output value can be artificial for a grower (since the packhouse can be on-orchard).

Processing consists of the raw material purchased from the orchard (estimated by the Gross Output value at the orchard gate), packaging, grading, sorting, handling, freight, wholesaling, and further processing (such as juicing).

Table 24 Processing and Wholesaling margin

2012, June and December year

	Tonnes	Price per tonne	Gross Output value
Packing, packaging and cool storage of export crop	284,451	1,275	362,675,025[1]
Packing, packaging and cool storage of domestic crop	61,871	1,100	68,058,100[1]
Processing into juice and other products	133,678	Not known	45,900,000[2]
Processing Gross Output (minus)			**$476,633,125**
Orchard gate Gross Output (equals)			**$227,959,030**
Processing and Wholesaling margin			**$248,764,095[3]**
Notes: (1) MPI estimates. (2) Fresh Facts (2012) p15 estimate of wholesale gross output value. (3) Numbers rounded			

Source: MPI and NZIER

D.1.4 Domestic Gross Output value

Domestic Gross Output value for fresh apple is approximately $106.8 million (estimate from Statistics New Zealand Household Economic Survey 2012/2013).

Fresh Facts (2013) estimates that the wholesale value of juice is $45.9 million for the domestic market. The Retailers Association (2013) estimates a retail margin for fruit and vegetables at 21%. Therefore, juice Gross Output value is estimated at $45.9 million x 1.21 equalling $55.5 million.

The total Gross Output value estimate is $162.3 million (fresh and juice Gross Output value).

D.1.5 Export Gross Output value

In 2012, export Gross Output value was made up of $341.6 million of fresh apple sales[30], and $44 million of processed apples (apple juice $29.1 million and apple preparation of $14.9 million). The total export value was $385.6 million (Fresh Facts, 2012 P2 and P15).

[30] The Fresh Facts data is slightly different from the Statistics New Zealand data and MPI estimates. Some of the difference is because SNZ and MPI are December years while Fresh Facts is June years. For consistency we have used Fresh Facts estimates.

D.1.6 Summary

Table 25 sets out the GDP output share of apples to the New Zealand economy.

Table 25 Apple summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($7.8 million)	100%	0.37	$3.0 million
Orchard ($227.9 million)	100%	0.37	$84.3 million
Processing and Wholesaling margin ($248.7 million)	100%	0.29	$72.1 million
Domestic ($162.3 million)	100%	0.18	$29.2 million
Export ($385.6 million)	100%	0.45	$173.5million
Total GDP output share			**$362.1 million[1]**
Note (1) Numbers rounded.			

Source: MPI and NZIER estimate

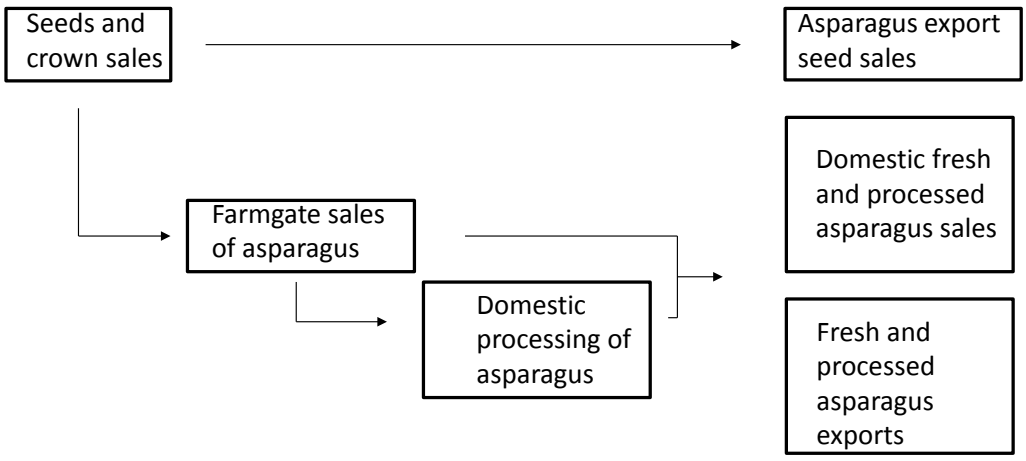
D.2 Asparagus (*Asparagus officinalis*)

Asparagus (*Asparagus officinalis*) is a small industry with approximately 60 asparagus growers. In 2012 production was in the vicinity of 1,800 tonnes.

Production is destined for fresh local supply, processing and wholesaling, and export. About 70% of the asparagus grown is consumed by the local market; the rest is exported or processed. Japan is the major overseas market for the fresh product. Waikato, the south west North Island, and Hawke's Bay are the main producing areas.

The Figure below sets out the value chain for asparagus.

Figure 4 Asparagus value chain



Source: NZIER

D.2.1 Asparagus seed/crowns Gross Output value

Asparagus seeds are both imported and grown domestically. In 2012, imports and exports were approximately even ($84,000 was imported and $85,000 was exported). Unlike other industries, the seed is not sold directly to growers. Typically, they are grown for about a year and the crowns are transplanted by a nursery to the grower. The value of this process is worth approximately $0.9 million (personal communication, Peter Falloon, Aspara Pacific Ltd, 10 March 2015).

D.2.2 Farmgate Gross Output value

Farmgate Gross Output value has been estimated at $7.6 million. To estimate this figure, we have used farmgate export and domestic prices quoted by the Lincoln Financial Budget Manual (pA73 2012/13). We are unsure of the volume split between exports and domestic, although we know the approximate total volumes produced (Fresh Facts 2012, p16).

To estimate volumes, we have used value as a proxy i.e. 79% of the Gross Output value is generated in the domestic market therefore we have assumed that the domestic market volume is 79% of the total crop.

Calculations are set out in the following table.

Table 26 Farmgate Gross Output values for asparagus

2012 June year

Farmgate returns	Price (per tonne)	Volume (estimated) tonnes	Gross Output value
Domestic	$2,850[1]	1,421.05	$3.6 million[2]
Export	$9,479[1]	378.95	$4.1 million[2]
Total			**$7.6 million**[3]
Notes (1) Prices per tonne, Lincoln Financial Budget Manual (2) Values: Fresh Facts. (3) Numbers rounded.			

Source: NZIER, Fresh Facts, and Lincoln Financial Budget Manual 2012/2013

D.2.3 Processing and Wholesaling margin

As with many horticultural products pack houses are located on the farm. Therefore, the distinction between farmgate and processing activities can be artificial for the grower. Processing consists of freighting, handling, sorting, wholesaling, and packing for the domestic and export markets. Some markets at the processing and wholesaling stage require extra attention to meet biosecurity regulations. For example, the Japanese market requires a water bath treatment to remove pests.

We have used a rule of thumb processing estimate since the amount processed for the domestic is unknown i.e. we have assumed that the Processing and Wholesaling margin is approximately 15% of the farmgate value: $7.6 million x 0.15 = $1.2 million.

D.2.4 Domestic Gross Output value

Domestic Gross Output values are estimated by Fresh Facts to be approximately $12 million (Fresh Facts 2012, p16), although industry sources suggest $15.9 million. We have stuck with the Fresh Facts estimate since it is the only published estimate.

D.2.5 Export Gross Output value

Export Gross Output value is estimated by Fresh Facts to be approximately $3.2 million in 2012 (Fresh Facts 2012, p16).

Table 27 sets out the GDP output share of asparagus to the New Zealand economy.

Table 27 Asparagus summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed/crown ($0.9 million)	100%	0.37	$0.3
Farmgate ($7.6 million)	100%	0.37	$2.8 million
Processing and Wholesaling margin ($1.2 million)	100%	0.29	$0.3 million
Domestic ($12.0 million)	100%	0.18	$2.2 million
Export ($3.2 million)	100%	0.45	$1.4 million
Total GDP output share			**$7.1 million**[1]
Note (1) Numbers rounded.			

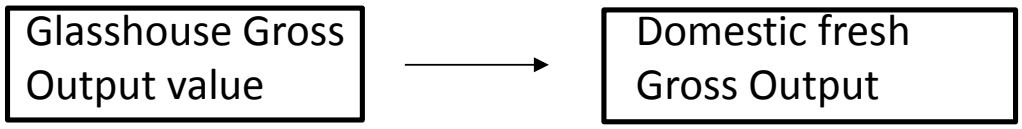
Source: Fresh Facts various years, Statistics New Zealand,

D.3 Aubergines/eggplant (*Solanum melongena*)

Aubergines (*Solanum melongena*) are produced year round in glasshouses. Glasshouse growing is a capital-intensive form of production (with high energy, fertiliser and labour inputs) with high yields. In good conditions, crops such as aubergines can yield 10 to 20 times more each year than a similar outdoor crop.

Aubergine growing in New Zealand is a small business with 4 growers servicing the domestic market.[31] The Figure below shows that the marketing chain is relatively straight forward.

Figure 5 Aubergine value chain



[31] http://www.epa.govt.nz/search-databases/HSNO%20Application%20Register%20Documents/APP202097_SUBMISSION110662_Market_Access_Solutionz.pdf p33.

Source: NZIER

D.3.1 Aubergine seed Gross Output value

Aube rgine seeds are imported (personal communication, Warren Hobson, Lefroy Valley, March 12 2015).

D.3.2 Glasshouse gate Gross Output value

We have used the rule of thumb provided by Horticulture New Zealand (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014) to provide an approximate estimate of Glasshouse Gate returns. Domestic Gross Output value divided by 2 equals $3.5 million dollars.

D.3.3 Processing and Wholesaling margin

There is little or no processing of aubergines beyond packing, handling, sorting, storing, wholesaling, and freight. We have assumed a value of $0.53 million for the processing and wholesaling stage of the value chain ($3.5 million x 0.15).

D.3.4 Domestic Gross Output value

According to Market Access Solutionz[32] domestic Gross Output value for aubergines are approximately $7.0 million per annum.

D.3.5 Export Gross Output value

There are no export Gross Output values.

D.3.6 Summary

Table 28 sets out the GDP output share of aubergines to the New Zealand economy.

[32] ibid p33.

Table 28 Aubergine summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed	100%	0.37	Imported
Glasshouse ($3.5 million)	100%	0.37	$1.3 million
Processing and Wholesaling margin ($0.53 million)		0.32	$0.2 million
Domestic ($7.0 million)	100%	0.18	$1.3 million
Export	100%	0.45	No exports
Total GDP output share			**$2.7 million**[1]
Note (1) Numbers rounded.			

Source: Market Access Solutionz 2014, Horticulture New Zealand and NZIER

D.4 Avocados (*Persea Americana*)

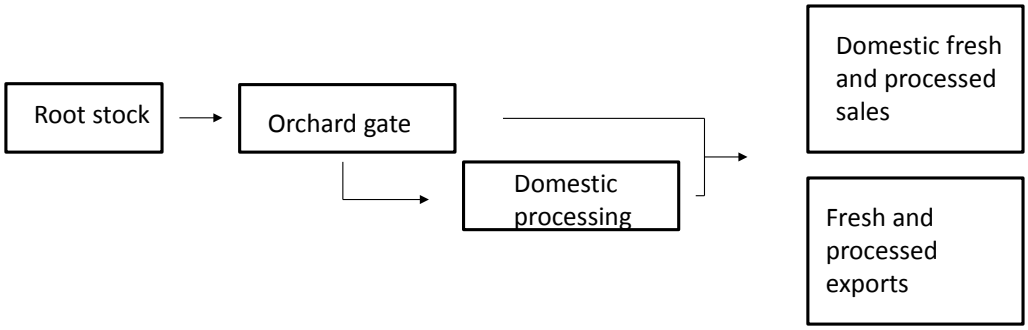
Avocado (*Persea Americana*) seeds were brought to New Zealand in the early 1900s and since that time the industry has developed to become a major fresh fruit business. The industry consists of 1,600 growers who collectively manage 5000+ hectares of mainly the Hass variety of avocados.

A number of packhouses, fruit marketing companies and exporters are involved in the industry to market and sell New Zealand avocados both domestically and overseas. Avocados are harvested for export from late August through to late March. About 80% of export grade fruit goes to the Australian market with the balance going to Japan, USA and South East Asian markets.[33]

The figure below sets out the value chain for avocados.

[33] We should also note that the avocado industry has a major issue with alternate bearing. A large crop one year has a depressing impact on the next year's crop. This has the impact of producing uneven year-to-year growth. In 2012 the crop was large with domestic and export sales of $115.9 million while in 2013 the value was $62.4 million (Fresh Facts, 2012 and 2013).

Figure 6 Avocado value chain



Source: NZIER

D.4.1 Trees/root stock Gross Output value

Industry has estimated that 45,000 trees were sold to growers in the 2012 year. The costs range from $19 per tree to $39 per tree depending on whether the trees are under patent or not. Approximately half of all trees sold are patented.

Table 29 Estimated Gross Output for cultivars sold to industry

2012 year

	Volume	Price	Gross Output value
Non patented	22,500	19	$0.4 million
Patented varieties	22,500	39	$0.9 million
Total			**$1.3 million**

Source: Personal communication, Colin Partridge, Southern Produce Ltd, 19 March 2015

D.4.2 Orchard gate Gross Output value

The orchard gate estimates are taken from the Avocado New Zealand Annual Report (2015) p19 which proves a consistent benchmark and comparisons over many years. The orchard gate Gross Output value is estimated at $36.9 million.

D.4.3 Processing and Wholesaling margin

Avocados New Zealand estimates the processing as being an additional $2 per tray for each for the 6.2 million trays in the 2011/12 year. Therefore, the Processing and Wholesaling margin is approximately $12.4 million (personal communication, Jay Bent Avocados NZ, December 2015).

Processing in the avocado industry consists of packaging, handling, sorting, grading, freight, cool-store for fresh avocado, ripening, wholesaling, and further processing (such as into avocado oil).

D.4.4 Domestic Gross Output value

The domestic Gross Output value estimates are complicated by the irregular fruit bearing problem where a bumper crop one year reduces the crop for the next year. We do have good information for the June year ending 2013. Statistics New Zealand estimate in the 2013 season domestic consumption was $35.1 million (Statistics New Zealand, Household Economic Survey). This estimate is similar to the Fresh Facts

domestic consumption estimate ($28.7 million – first point of sale or sales from processing to the domestic stage of the value chain) multiplied by a retail mark up of 21% (New Zealand Retail Association (2013) p16) for the same year.

Therefore, for the June year 2012 the estimates for the first point of sale are 19.0 million (the wholesale or Gross Output value). Multiplying this by New Zealand Retail Association mark-up (21%) equals $23 million.

D.4.5 Export Gross Output value

Avocados New Zealand estimate that the export Gross Output value is approximately $64.7 million (June year). This is comparable to the Statistics New Zealand figures of $53.2 (December year) but much smaller than the Fresh Facts estimate of $96.9 million (2012, June year). Here we have used the Avocados New Zealand estimate given its comparability with Statistics New Zealand estimates.

D.4.6 Summary

Table 30 sets out the GDP output share of avocado to the New Zealand economy.

Table 30 Avocado summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Cultivar ($1.3 million	100%	0.37	$0.5 million
Orchard gate ($36.9 million)	100%	0.37	$13.7 million
Processing and Wholesaling margin ($12.4 million)	100%	0.29	$3.6 million
Domestic ($23.0 million)	100%	0.18	$4.1 million
Exports ($64.7million)	100%	0.45	$29.1 million
Total GDP output share			**$51.0 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts various years, Statistics New Zealand and USDA 2013

D.5 Barley (*Hordeum vulgare*)

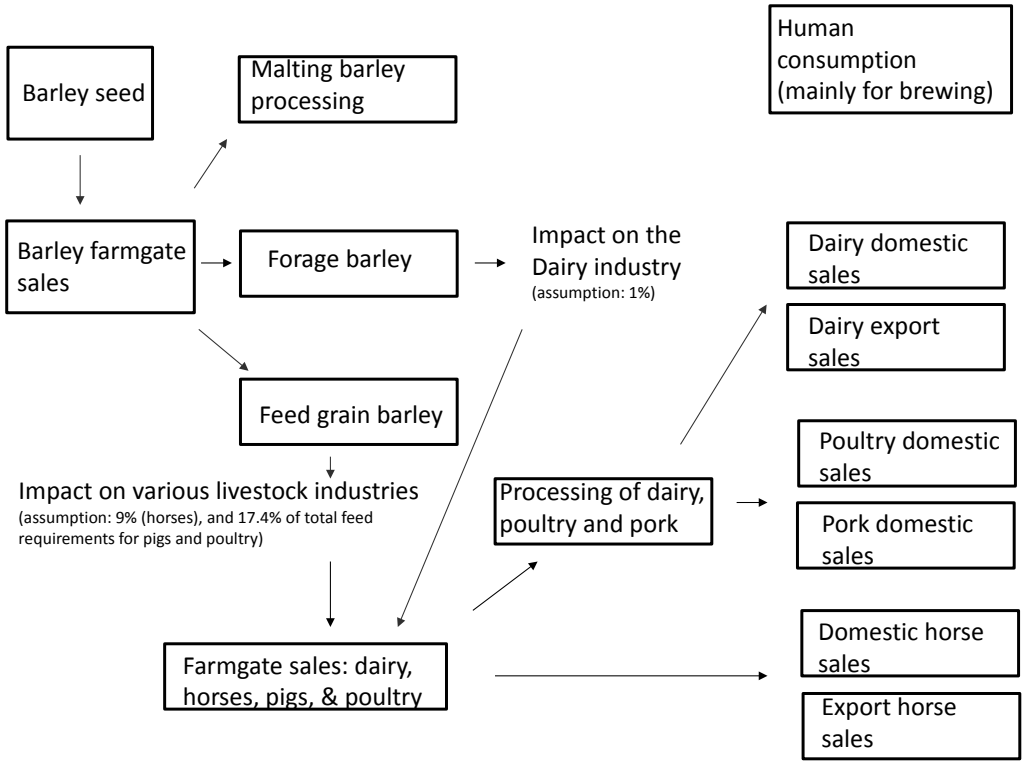
Barley (*Hordeum vulgare*) is mostly grown in New Zealand for malting, other consumer consumption, or stock feed (grain and forage). Stock feed comprises of grain (mainly used in the pork and poultry industries) and barley forage (used mainly in the dairy industry). Barley exports fluctuate, depending on international prices. Barley marketing

has never been regulated in New Zealand, and growers sell directly to domestic and export seed, malting companies, and as feed.

Almost three-quarters of the barley crop is grown in Canterbury. Barley grown in the North Island is grown predominately for malting barley (Millner and Roskruge 2013, p104).

The Figure below sets out the value chain for barley.

Figure 7 Barley value chain



Source: NZIER

D.5.1 Barley seed Gross Output value

Barley seed-for-sowing production was 4,800 tonnes in 2011 (Hampton et al, p131). This was divided between malt barley, forage, and feed barley seed. We have assumed that malt barley is 9% of the barley seed-for-sowing produced in line with barley malt production (based on volume of malt barley sold).

Seed for sowing prices have been estimated from grain-for-consumption prices using the Lincoln Financial Budget Manual 2012/13 pA52 (malt barley grain $480 per tonne and feed barley grain $380 per tonne). An additional premium of $60 per tonne was assumed for grain destined for use as seed-for-sowing for both malt, and forage & feed barley crops (Lincoln Financial Budget Manual 2012/13, pA53). The calculations are set out in Table 31.

Table 31 Estimated barley seed Gross Output value

Volume	Proportion	Price	Gross Output value
4,800 tonnes	9% malting barley	$542 per tonne	$0.23 million
	46% feed barley	$440 per tonne	$0.97 million
	45% forage barley	$440 per tonne	$0.40 million
Total			**$1.6 million**[1]
Note (1) Numbers rounded.			

Source: Lincoln Financial Budget Manual, Hampton et al 2012

D.5.2 Farmgate Gross Output value

The farmgate value is calculated from:

- farmgate production at 69,826 tonnes produced for malting barley (AIMI 2013) multiplied by $482 per tonne (Lincoln Financial Budget Manual 2012/2013, pA52)
- farmgate production of forage barley is estimated at approximately $72 million (Arable Food Industry Council)
- the 368,974 tonnes produced for feed barley (AIMI 2013) multiplied by the $380 per tonne (Lincoln Financial Budget Manual 2012/2013, pA52).

This gives an estimate of $245.9 million at the farmgate.

D.5.3 Human consumption (malting barley)

We have little information on the processing costs associated with malting barley. Barley is used for a range of products from brewing to baking. We have estimated:

- a Processing and Wholesaling margin: 15% of farmgate Gross Output ($33.7 million x 0.15 = $5.1 million)
- using Horticulture New Zealand's rule of thumb estimate of 2 times the farmgate value ($33.7 million) domestic Gross Output value was approximately ($67.3 million).

D.5.4 Animal consumption (forage barley)

The farmgate Gross Output value for forage barley is approximately $72.0 million (Arable Food Industry Council). Forage barley provides approximately 1% of the fodder requirements for the dairy industry (mainly in the South Island). Typically, forage barley is sold green (from the paddock) or used on the farm it is grown on, therefore we have only an estimate of value is available (Arable Food Industry Council). The impact on the dairy industry is set out in the following Table.

Table 32 Estimated dairy value at each stage of the marketing chain

2012, $ M

	Dairy values	Impact	Share of output value	Gross Output value
Farmgate	$10,828 million	1%	0.49	$53.1 million[1]
Processing and Wholesaling margin	$6,552 million	1%	0.13	$8.5 million[1 2]
Domestic	$1,046 million	1%	0.18	$1.9 million[1]
Export	$12,773.7 million	1%	0.48	$59.9 million[1]
Note (1) Numbers rounded. (2) Note a margin rather than Gross Output value				

Source: Beef + Lamb New Zealand estimates and Statistics New Zealand

D.5.5 Animal consumption (feed barley)

Most feed barley is consumed by the horse, pig, and poultry industries. The New Zealand Feed Manufacturers Association estimated that for 2012 17.4% of all feeds were barley. In the absence of any industry information, we have assumed that barley represents 9% of horse feed requirements (NZIER estimate based on Gee 2012).

Farmgate value of the produce for the horse, pork and poultry industries are estimates taken from industry publications and communications with New Zealand Pork and the Poultry Industry Association of New Zealand.

Table 33 Contribution of barley to farmgate Gross Output value of poultry, pork and horse industries

2012, $ M, June year

	Estimated farmgate value (Gross Output) ($m)	Impact of barley[1]
Layer-hen feed[2]	$165.0 million	17.4%
Poultry feed[2]	$1,000.0 million	17.4%
Pig feed[3]	$185.0 million	17.4%
Pig and poultry total	**$1,350.0 million**	
Horses	**$93.5 million**	**9.0%[4]**
Notes: (1) NZ Feed Manufacturers Association (2015). (2) pers comm, Mr Steven Kerr, Poultry Industry Association of New Zealand, 24 July 2014. (3) pers comm, Mr Ian Braugh, New Zealand Pork, 12 August 2014. (4) Gee E (2012).		

Source: Poultry Industry Association of New Zealand, NZ Feed Manufacturers Association, New Zealand Pork, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

Processing and Wholesaling margin

Processing and Wholesaling margins are based on assumptions from other livestock industries such as Beef + Lamb New Zealand and Horticulture New Zealand (personal communications, Mr Rob Davison, Beef + Lamb New Zealand, July 30 2014 and Statistics New Zealand) and are set out in the following table. The Processing and Wholesaling

margin is estimated at 15% of the farmgate value). The only exception is pork where we have been able to obtain accurate processing cost data (11.7% of the farmgate value) from New Zealand Pork (personal communication, Mr Ian Braugh, 12 August 2014).

Table 34 Processing and Wholesaling margin

2012, June year, $ M

	Estimated processing value (Gross Output) of each industry[2]	Impact of barley[1]
Layer-hen feed	$165 m x 0.15 = $24.8 million	17.4%
Poultry feed	$1,000 m x 0.15 = $150.0 million	17.4%
Pig feed[3]	$185 m x 0.117 = $21.7 million	17.4%
Estimated total value	**$196.4 million**	
Notes: (1) NZ Feed Manufacturers Association (2015). (2) Estimates are based on discussions with Mr Rob Davison, Beef + Lamb New Zealand, 30 July 2014 and Statistic NZ estimates for Dairy and Sheep and Beef processing (Domestic Gross Output value multiplied by 13%). (3) Processing costs for pigs is estimated by New Zealand Pork at 11.7% (pers comm, Mr Ian Braugh, 12 August 2014).		

Source: Beef + Lamb New Zealand, Poultry Industry Association, New Zealand Pork

Domestic consumption of poultry and pork

The domestic retail margin is estimated at approximately 128% of farmgate value.[34] Therefore, the total domestic Gross Output value is the sum of each identified livestock value (farmgate value multiplied by impact of barley), plus an additional 28%.

Table 35 Domestic sales Gross Output value of poultry, horse, and pork products

2012, June year, $ M

	Estimated value (Gross Output) [1]	Impact of barley
Hen-layer feed	$165m x 1.28 = $211.2 million[2]	17.4%
Poultry growers	$1,000m x 1.28 = $1,280 million[2]	17.4%
Pigs	$185m x 1.28 = 236.8 million[2]	17.4%
Total pigs and poultry	**1,728.0 million[2]**	**17.4%**
Horse	**$57.0 million**	**9.0%**
Note (1) New Zealand Retailers Association (2013, p16) suggests that meat retail margins are around 28%. (2) Numbers rounded.		

[34] Estimated from New Zealand Retailers Association (2013 p16).

D.5.6 Exports Gross Output value

Export of horses was approximately $130.0 million in 2012 (Statistics New Zealand HS code 0101).

D.5.7 Summary of barley consumption

Table 36 sets out known values for barley production and value generated from industries that use barley as an input.

Table 36 Barley summary

2012, $ M

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Barley production			
Domestic seed value ($1.6 million)	100%	0.37	$0.6 million
Farmgate ($245.9 million)	100%	0.37	$91.0 million
Barley Production for human consumption (malting barley)			
Processing and Wholesaling margin ($5.1 million)	100%	0.29	$1.5 million
Domestic ($67.3 million)	100%	0.18	$12.1 million
Forage Barley as an input into the dairy industry			
Farmgate dairy ($10,828 million)	1%	0.49	$53.1 million
Processing and Wholesaling margin: dairy ($6,552 million)	1%	0.13	$8.5 million
Domestic dairy ($1,045.6 million)	1%	0.18	$1.9 million
Export ($12,573.7 million)	1%	0.48	$60.3 million
Barley production as an input into various industries (feed barley)			
Farmgate (pig, and poultry, $1,350.0 million)	17.4%	0.25	$58.7 million
Farmgate horses ($93.5 million)	9.0%	0.25	$2.1 million
Processing and Wholesaling margin (pig and poultry livestock, $196.4 million)	17.4%	0.15	$5.1 million
Domestic (pig and poultry $1,728.0 million)	17.4%	0.12	$36.0 million
Domestic horses ($57.0 million)	9.0%	0.12	$0.6 million
Exports			
Live horse exports ($130.0 million)	9.0%	0.20	$2.3 million
Total			**$334.0 million**

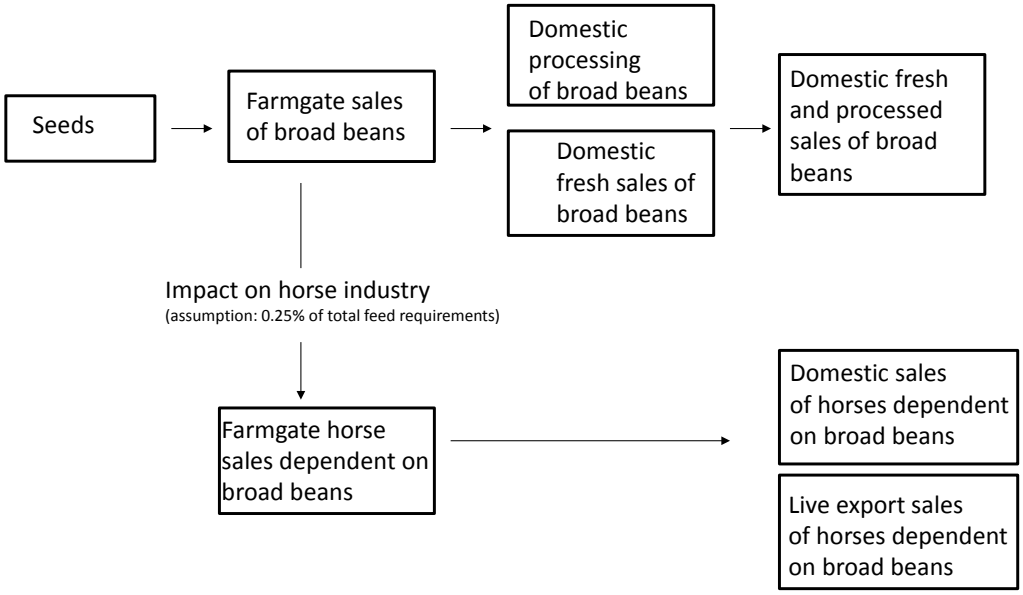
Source: Beef + Lamb New Zealand, DairyNZ, Poultry Industry Association of New Zealand, New Zealand Pork, IER Pty Ltd 2010, Statistics New Zealand HS Code 0101, and Arable Food Industry Council

D.6 Broad beans (*Vicia faba*)

Broad beans (*Vicia faba*) are one of the oldest vegetables grown in New Zealand. For over a hundred years, they have been grown commercially and by the New Zealand home gardener. Canterbury is the biggest growing area.

Figure 8 sets out the value chain for broad beans.

Figure 8 Broad bean value chain



Source: NZIER

D.6.1 Seed Gross Output value

We have little information on broad bean seed revenue. We have assumed (as in the case of green beans) that seed Gross Output value was approximately 1% of farmgate prices. This equates to $55,000 worth of Gross Output value.

D.6.2 Farmgate Gross Output value

Horticulture New Zealand has provided us with processed vegetable Gross Output value for the 2014 season (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014). In the case of broad beans, Gross Output value has been stable over time and since most broad beans are processed it provides a good approximation of farmgate Gross Output value ($0.6 million) in 2012.

D.6.3 Processing and Wholesaling margin

The Processing and Wholesaling margin consists of packing, handling, coolstore storage, wholesaling and freight. Some broad beans are frozen but the amount is small. Processing and Wholesaling margin are estimated to be 25% of the farmgate Gross Output value (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014). This equates to $0.3 million.

Table 37 Broad bean Processing and Wholesaling margin

	Farmgate Gross Output value	Adjustment factor	Processing and Wholesaling margin estimate
Green bean processing and wholesaling	$0.6 million[1]	0.25	$0.3 million[1]
Note (1) Numbers rounded.			

Source: NZIER and Horticulture New Zealand

D.6.4 Domestic Gross Output value

Domestic sales are estimated to be twice farmgate returns (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014). This is set out Table 38.

Table 38 Broad bean domestic Gross Output value

	Farmgate	Adjustment factor	Broad bean domestic Gross Output value estimate
Broad bean domestic value	$0.6 million	2	$1.1 million[1]
Note (1) Numbers rounded.			

Source: NZIER and Horticulture New Zealand

D.6.5 Dependent industries

Broad beans are used as feed for horses to supplement their diet (Gee, 2012). They are a good source of protein for horses and contain no starch. Small amounts are often combined with other feeds. We have assumed that broad beans make up 0.25% of a horses' diet.

Horses contribute at the farmgate, domestic, and live exports of horses. The contributions are set out in Table 39.

Table 39 Dependent industry contribution (horses)

Section of the value chain	Gross Output value of each stage of the value chain	Dependence
Farmgate	$93.5 million	0.25%
Domestic	$57.0 million	0.25%
Export	$130 million	0.25%

Source: IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.6.6 Summary

Table 40 below sets out known values for broad bean production.

Table 40 Broad bean summary

2012, June year, $M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($0.06)	100%	0.37	$0.02 million
Farmgate ($0.6 million)	100%	0.37	$0.2 million
Processing and Wholesaling margin ($0.3 million)	100%	0.29	$0.1 million
Domestic ($1.1 million)	100%	0.18	$0.2 million
Dependent industry (horses)			
Farmgate ($93.5 million)	0.25%	0.25	$0.1 million
Domestic horses ($57.0 million)	0.25%	0.12	$0.02 million
Export live horses ($130 million)	0.25%	0.20	$0.07 million
Total GDP output share			**$0.7 million**[1]
Note (1) Numbers rounded.			

Source: Horticulture New Zealand, NZIER, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

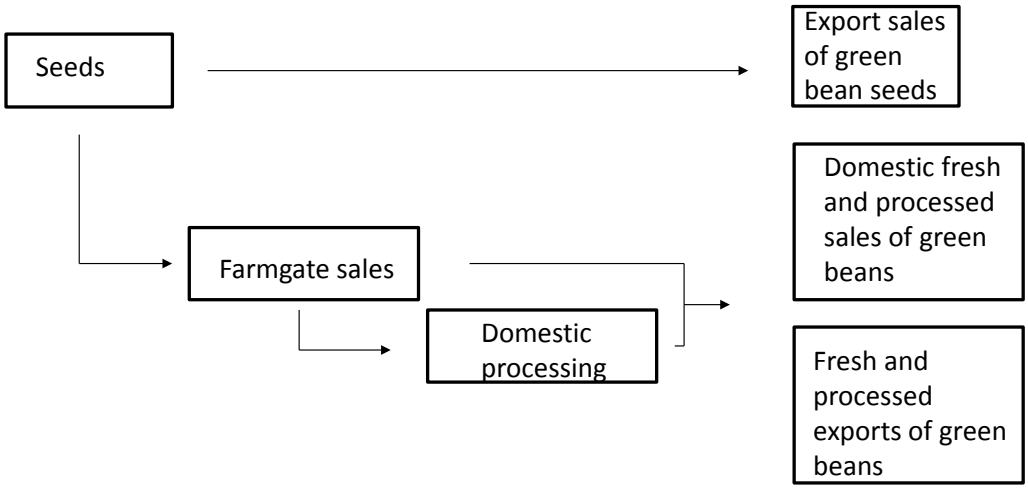
D.7 Green beans (*Phaseolus vulgaris*)

Green beans (*Phaseolus vulgaris*) have been grown in New Zealand for many years. The most important growing area is the Canterbury plains. Exports of green beans (like many other vegetables) have increased in recent years as Australian supermarkets begin to source more New Zealand product.

Good information is available on domestic, exports and seed production. However, a number of assumptions have been made about farmgate and processing.

Figure 9 sets out the value chain for green beans.

Figure 9 Value chain for green beans



Source: NZIER

D.7.1 Seed Gross Output value

BERL (2012, p14) sets out the value of green bean seed production for New Zealand. For the 2011 year, Gross Output is valued at $2.39 million.

D.7.2 Farmgate Gross Output value

Horticulture New Zealand estimates that for many vegetable industries' farmgate Gross Output values are approximately a half of the domestic and export Gross Output value. Fresh Facts (2012) estimate that domestic Gross Output value was $18 million and export Gross Output value was $47 million in 2012 (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014).

Table 41 Green beans Gross Output value at farmgate

	Domestic and export Gross Output value	Adjustment factor	Farmgate Gross Output value estimate
Green bean farmgate Gross Output value	$65 million	0.5	$32.5 million

Source: NZIER and Horticulture New Zealand

D.7.3 Processing and Wholesaling margin

Green bean production consists of packing, sorting, handling, freight, wholesaling, and coolstore storage. Green beans are transported to a central processing facility for processing by companies such as Heinz-Wattie and McCain's. The returns to processing and wholesaling are estimated to be 25% of the domestic Gross Output value (NZIER estimate based on Statistics New Zealand's national accounts data and Horticultural NZ estimates).

Table 42 Green beans Processing and Wholesaling value

	Farmgate value	Adjustment factor	Processing and Wholesaling margin estimate
Green bean Processing and Wholesaling margin	$32.5 million	0.25	$8.1 million

Source: NZIER and Horticulture New Zealand

D.7.4 Domestic Gross Output value

Fresh Facts (2012, p16) estimate domestic Gross Output value at $18.0 million for 2012.

D.7.5 Export Gross Output value

Fresh Facts (2012, p16) estimate export Gross Output value at $47.0 million for 2012.

D.7.6 Summary

The Table below sets out known values for green bean production.

Table 43 Green bean summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seeds ($2.39 million)	100%	0.37	$0.9
Farmgate ($32.5 million)	100%	0.37	$12.0 million
Processing and Wholesaling margin ($8.1 million)	100%	0.29	$2.4 million
Domestic ($18.0 million)	100%	0.18	$3.2 million
Export ($47.0 million)	100%	0.45	$21.2 million
Total GDP output share			**$39.7 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts, Horticulture New Zealand and NZIER

D.8 Beetroot (*Beta vulgaris*)

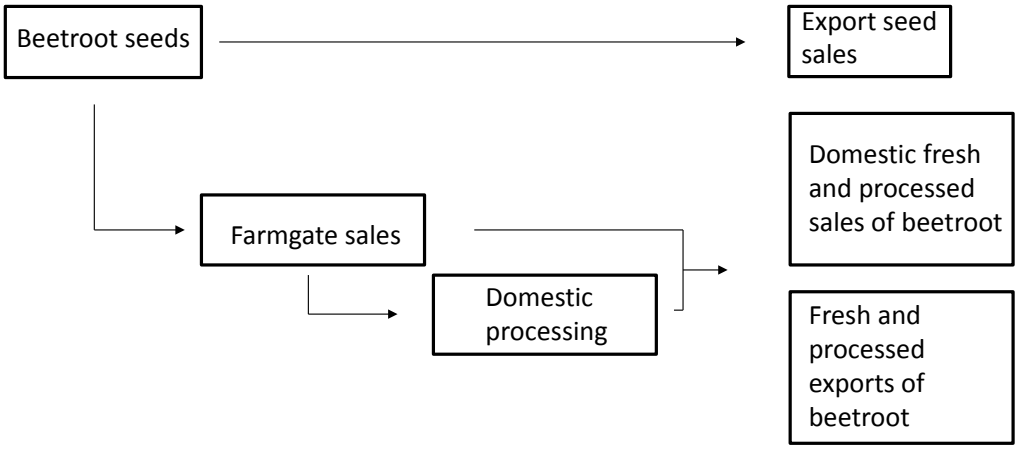
A native of Southern Europe, beetroot (*Beta vulgaris*) has a vibrant crimson colour which comes from pigments that no other vegetable has. In New Zealand, typically the roots are eaten; however, young beetroot leaves are sometimes available. Beetroot is frequently consumed pickled.

The crop is relatively small in value terms; however, there is a thriving export seed trade because of the ideal growing conditions on the Canterbury plains.

Good estimates are available on export seeds, domestic and export Gross Output value. Assumptions have been made about farmgate and processing returns based on domestic and export sales.

Figure 10 sets out the value chain for beetroot.

Figure 10 Beetroot value chain



Note: Fodder beet (a different variety of *Beta vulgaris*) is used as a winter feed for the livestock industry – particularly in the last few years for dairy. We have not included fodder beet in this study because of the small size of the industry in 2012.

Source: NZIER

D.8.1 Seed production

Seed production is divided by export and domestic Gross Output values. Export Gross Output value was approximately $0.65 million in 2011 (BERL 2012, p14). Domestic seed Gross Output values are not well documented but are expected to be 1% of farmgate Gross Output values for the vegetable crop in line with other vegetable seed sales ($5.6 million multiplied by 1% equals $0.06 million).

To obtain farmgate Gross Output value we have used Horticultural New Zealand's rule of thumb of 50% of export ($0.3m) plus 1% of farmgate ($0.056m) Gross Output values.

Table 44 Beetroot seed Gross Output value

	Export plus	Domestic	Equals total seed Gross Output value farmgate estimate
Beetroot seed value	$0.65 million divided by 2 = $0.325 m	$0.056 million	$0.4 million[1]
Note (1) Numbers rounded.			

Source: NZIER and BERL 2012

D.8.2 Farmgate Gross Output value

Horticulture New Zealand estimates that for many vegetable industries farmgate prices are approximately half of the domestic Gross Output values. Fresh Facts (2012) estimate that consumption of beetroot in New Zealand is approximately $11.1 million (unpublished data and personal communication, Alastair Aitken, Martech, 13 February 2015).

Table 45 Beetroot Gross Output value at farmgate

	Domestic Gross Output values	Adjustment factor	Farmgate Gross Output value estimate
Beetroot farmgate Gross Output value	$11.1 million	0.5	$5.6 million

Source: NZIER, Martech and Horticulture New Zealand

D.8.3 Processing and Wholesaling margin

Processing of beetroot consists of handling, sorting, packing, wholesaling, and freight. Some beetroot is further processed but this amount is very small.

Returns to processing and wholesaling are estimated to be 15% of the domestic Gross Output value (NZIER estimate based on Statistics New Zealand's national accounts data).

Table 46 Beetroot Processing and Wholesaling margin

	Farmgate Gross Output value	Adjustment factor	Processing and Wholesaling margin estimate
Beetroot Processing and Wholesaling margin	$5.6 million	0.15	$0.8 million

Source: NZIER and Horticulture New Zealand

D.8.4 Domestic Gross Output value

Domestic Gross Output value is approximately $11.1 million. This is based on unpublished data from Martech (sourced from Statistics New Zealand) on consumption of beetroot. There are few imports therefore consumption estimates give a reasonable proxy of the processed and fresh consumption (personal communication, Alastair Aitken, Martech, 13 February 2015).

D.8.5 Export Gross Output value

Export Gross Output value was mainly seeds. This is reported by BERL (2012, p14) at $0.65 million.

D.8.6 Summary

Table 47 sets out known Gross Output values for beetroot.

Table 47 Beetroot summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($0.4 million)	100%	0.37	$0.2 million
Farmgate ($5.6 million)	100%	0.37	$2.1 million
Processing and Wholesaling margin ($0.8 million)	100%	0.29	$0.2 million
Domestic ($11.1 million)	100%	0.18	$2.0 million
Export ($0.65 million)	100%	0.45	$0.3 million
Total GDP output share			**$4.7 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts, Horticulture New Zealand and NZIER

D.9 Blueberries (*Vaccinium* species)

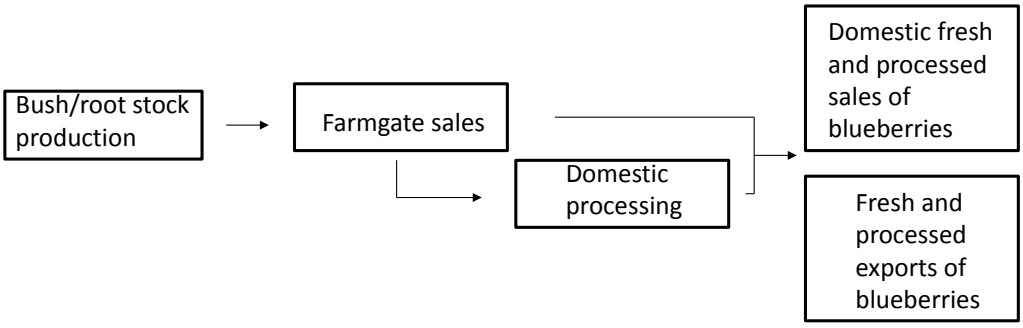
While blueberries (*Vaccinium* species) have been grown in New Zealand for some time, it was not until the 1980s that commercial growing began for export. According to Blueberries New Zealand (Blueberries New Zealand, 2015), there are three types of blueberry cultivated in New Zealand: Northern Highbush, Southern Highbush and Rabbiteye. The scientific names of these blueberry types are *Vaccinium corymbosum*, *Vaccinium formosum* (syn. *V. australe*) and *Vaccinium virgatum* (syn. *V. ashei*) respectively (GRIN 2015).

Blueberries are grown commercially mainly in Canterbury, Waikato, Kerikeri, and Bay of Plenty.

The best information we have is on domestic and export Gross Output values. Estimates have been for plant Gross Output values and approximations for farmgate and processing.

Below we set out the blueberry value chain.

Figure 11 Blueberry value chain



Source: NZIER

D.9.1 Blueberry plant Gross Output value

Domestic Gross Output value for plants is not well documented but is expected to be 0.5% of farmgate Gross Output value for berries (personal communication, Dan Peach, Oakberry Farm, 11 March 2015).

In addition, a further 300,000 plants are purchased for new plantings at $3.50 for a six-month old plant and $6 for an 18-month old plant. We have assumed that grower preferences are split 50%/50% between buying six-month and 18-month old plants. Costs are therefore approximately $1.425 million (personal communication, Dan Peach, Oakberry Farm, 11 March 2015).

Table 48 Blueberry bush Gross Output value

	Replacement plants	New Plantings	Total Gross Output plant value estimates
Blueberry plant Gross Output value	$0.083 million	$1.425 million	$1.5 million[1]
Note (1) Numbers rounded.			

Source: NZIER

D.9.2 Farmgate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries orchard gate prices are approximately a half of export and domestic Gross Output values. Fresh Facts (2012, p14) estimate that Gross Output values for blueberries was $17.4 million (domestic) and $18.7 million (exports).

Table 49 Blueberries Gross Output value at orchard gate

	Domestic + export Gross Output value	Adjustment factor	Farmgate Gross Output value estimate
Blueberry Orchard-gate Gross Output value	$36.1 million	0.5	$18.1 million

Source: NZIER, Martech and Horticulture New Zealand

D.9.3 Processing and Wholesaling margin

Processing consists of packaging, handling, sorting, freight, wholesaling, and storage. Some blueberries are frozen or further processed but the returns from these activities are minor. Returns to processing and wholesaling are estimated to be 15% of farmgate Gross Output value and is set out in the following Table.

Table 50 Blueberries Processing and Wholesaling margin

	Farmgate Gross Output value	Adjustment factor	Processing and Wholesaling margin estimate
Blueberry Processing and Wholesaling margin	$18.1 million	0.15	$2.7 million

Source: NZIER and Horticulture New Zealand

D.9.4 Domestic Gross Output value

Domestic Gross Output value is approximately $17.4 million (Fresh Facts 2012, pp14-15) for first point of sale (the value that processing part of the value chain sells to the retailer or the wholesale price). To estimate domestic Gross Output value, we have used the mark-up from Retailers Association (2013) p16 of 21%.

The Gross Output is $14.4 million x 1.21 equals $17.4 million.

D.9.5 Export Gross Output value

Export Gross Output value is estimated at $18.7 million (Fresh Facts 2012, pp14-15).

D.9.6 Summary

Table 51 sets out known Gross Output value for blueberries.

Table 51 Blueberry summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery stock ($1.5 million)	100%	0.37	$0.6 million
Orchard gate ($18.1 million)	100%	0.37	$6.7 million
Processing and Wholesaling margin ($2.7 million)	100%	0.29	$0.8 million
Domestic ($17.4 million)	100%	0.18	$3.1 million
Export ($18.7 million)	100%	0.45	$8.4 million
Total GDP output share			**$19.6 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts, Horticulture New Zealand and NZIER

D.10 *Brassicas* (including brassicas for fodder)

Brassicas are divided into two: brassicas for human consumption and brassicas for animal consumption.

Brassicas for human consumption include cauliflower, broccoli, and cabbage (*Brassica olearacea* varieties).[35] While brassicas for fodder include oil seed rape & turnips (*Brassica rapa* varieties), kale (a variety of *Brassica oleraceae*), and swede (*Brassica napus*). Brassicas are traditional crops and have been grown in New Zealand since the 19th century.

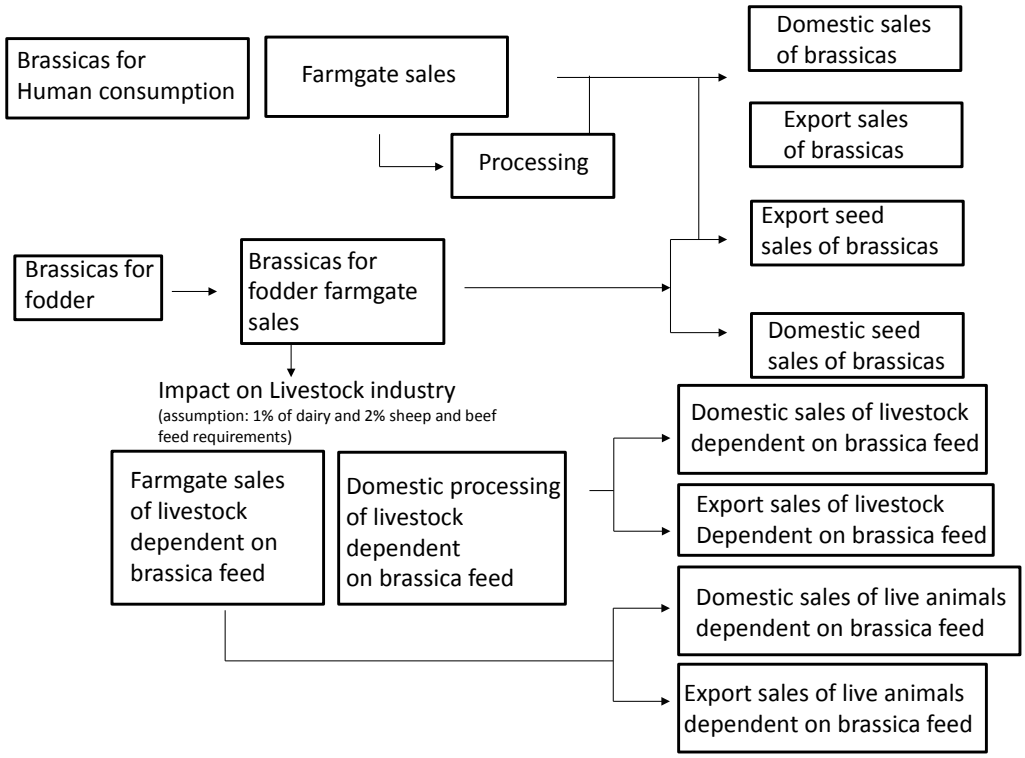
Good data is available for traditional brassicas for human consumption (seeds, processing and wholesaling, domestic and export Gross Output value). Farmgate Gross Output value is estimated using industry wide assumptions.

Information for brassicas for animal consumption relies upon total seed estimates from the industry and revenue per hectare estimates. Dependent industry information is well documented.

Below we set out the value chain for brassicas.

[35] Some brassicas are excluded because reliable estimate are unavailable e.g. Chinese vegetables such as bok choy.

Figure 12 Value chain for brassicas



Note that we have assumed that brassicas are mainly consumed by the sheep, beef, and dairy industries.

Source: NZIER

A key assumption is the 1% impact on the dairy industry and a 2% impact on the traditional livestock industry (mainly sheep and beef). These are approximate figures provided by DairyNZ (personal communication, Matthew Newman, DairyNZ, 20 March 2015 and NZIER assumptions for traditional livestock industries)

D.10.1 Seed Gross Output value (human consumption)

Brassica seed Gross Output values are estimated at $4.7 million Fresh Facts (2012, p20).

D.10.2 Brassicas for human consumption

Farmgate Gross Output value

Horticulture New Zealand estimates that for many industries farmgate prices are approximately half of export and domestic Gross Output value. Fresh Facts (2012, p14) estimate that sales of brassicas were $85.0 million.

Table 52 Brassicas Gross Output value at farmgate

	Domestic + export Gross Output value	Adjustment factor	Farmgate Gross Output value estimate
Brassicas for human consumption Gross Output farmgate value	$85.0 million	0.5	$42.5 million

Source: Fresh Facts

Processing and Wholesaling margin

Brassicas are mainly sold fresh. Processing consists of handling, sorting, storage, packing, wholesaling and freight. NZIER have estimated that the Processing and Wholesaling margin value at 15% of farmgate Gross Output value i.e. $42.5 x 0.15 = $6.4 million.

Domestic Gross Output value

Domestic Gross Output value is estimated by Fresh Facts (2012, p16) at $80.3 million.

Export Gross Output value

Export Gross Output value is estimated by Fresh Facts (2012, p16) at $4.7 million.

D.10.3 Brassicas for fodder

Seed production, domestic, and export Gross Output value

Seed production is estimated at $10.1 million to the seed producers. We have used the Horticulture New Zealand rule of thumb to produce this estimate: Domestic Gross Output value ($10.8 million, BERL 2012, p14) and export Gross Output value ($9.44 million, Hampton et al 2012, p133) multiplied by 50%.

Farmgate Gross Output value

Farmgate Gross Output value for brassicas for fodder are estimated by the Arable Food Industry Council at $600 million. Fodder is mainly consumed in the sheep and beef sector (approximately 60%) and the dairy industry (approximately 40%). A small amount of oil seed rape is also grown (at approximately $5.0 million).

Dependent industries

We have assumed that most forage brassicas are being consumed by the dairy and sheep and beef industries. We have further assumed that it contributes 1% of the protein for the whole dairy industry and a 2% impact on traditional livestock industries (sheep and beef) (personal communication, Matthew Newman, DairyNZ, 20 March 2015).

The value chain impacts for the dairy and traditional livestock industries are set out below using Beef + Lamb New Zealand's and Statistic NZ estimates (personal communication, Mr Rob Davison, 5 June 2014) of farmgate value, processing and wholesaling, domestic and export sales.

Table 53 sets out the summary of value for the dependent industry. In each case, the value at the stage of the value chain is multiplied by the impact on the industry and the

GDP output share to obtain a value for brassicas to the economy (also set out in Appendix B).

Table 53 Estimated dairy and traditional industries value at each stage of the marketing chain

2012, $ M

	Farmgate Gross Output value	Processing and Wholesaling margin	Domestic Gross Output value	Export Gross Output value
Dairy values	$10,828.0 m	$6,552.0 m	$1,045.6 m	$12,573.7 m
Traditional livestock industries	$5,958.1 m	$3,033.0 m	$1,432.8 m	$6,882.1 m

Source: Beef + Lamb New Zealand estimates and Statistics New Zealand

D.10.4 Summary

Table 54 sets out the summary of brassica contribution to GDP.

Table 54 Brassica summary

2012, $ M

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Brassicas for human consumption			
Domestic seed Gross Output value ($4.7 million)	100%	0.37	$1.7 million
Farmgate Gross Output value ($42.5 million)	100%	0.37	$15.7 million
Processing and Wholesaling margin ($6.4 million)	100%	0.29	$1.9 million
Domestic Gross Output value ($80.3 million)	100%	0.18	$14.5 million
Export Gross Output value ($4.7 million)	100%	0.45	$2.1 million
Sub total: Brassicas: human consumption			*$35.9. million*
Brassicas for fodder			
Seed Gross Output value ($10.1 million)	100%	0.37	$3.8 million
Farmgate Gross Output value ($605 million)	100%	0.37	$223.9 million
Domestic Gross Output value ($10.8 million)	100%	0.18	$2.0 million
Export seed Gross Output value ($9.4 million)	100%	0.45	$4.3 million
Sub total			*$233.8 million*
Dependent industries for brassicas			
Dairy farmgate dependent on brassicas ($10,828 million)	1%	0.49	$53.1 million
Dairy Processing and Wholesaling margin dependent on brassicas ($6,552.0 million)	1%	0.13	$8.5 million
Dairy domestic dependent on brassicas ($1,045.6 million)	1%	0.18	$1.9 million
Dairy exports dependent on brassicas ($12,573.7 million)	1%	0.48	$60.4 million
Farmgate traditional industries dependent on brassicas ($5,958.1 million)	2%	0.49	$58.4 million
Processing and Wholesaling margin: traditional industries dependent on brassicas ($3,033.0 million)	2%	0.15	$9.1 million
Domestic: traditional industries dependent on brassicas ($1,432.8 million	2%	0.18	$5.2 million
Export: traditional industries dependent on brassicas ($6,882.1 million)	2%	0.48	$66.1 million
Sub total			*$262.1 million*
Total Brassicas: Fodder			**$496.3 million[1]**
Total brassica contribution (fodder + human consumption)			**$532.2 million**
Note (1) Numbers rounded.			

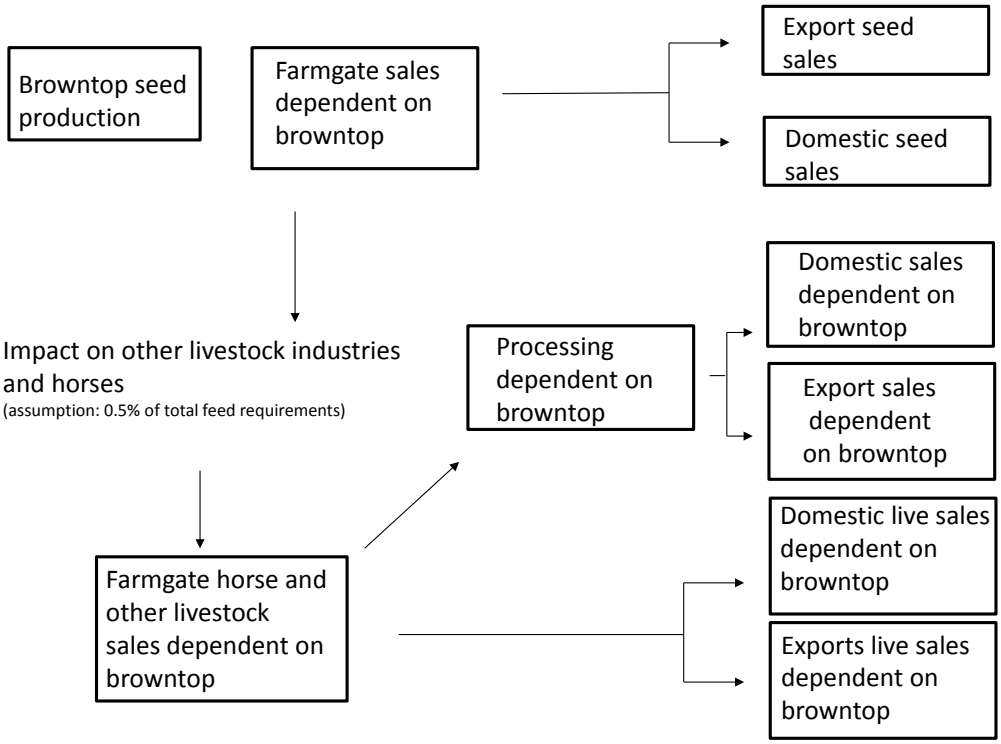
Source: NZIER

D.11 Browntop (*Agrostis capillaris*)

Browntop (*Agrostis capillaris*) is a widespread perennial grass found to some extent in nearly all older pastures in New Zealand. The main focus of browntop production has been as an off-season grass seed supplier to the Northern Hemisphere. We have limited information on most aspects of the small browntop market so we have relied on industry to provide us with an indication of the market size.

Figure 13 sets out the value chain for browntop production.

Figure 13 Browntop value chain



Note that livestock industries include live animals, wool, meat processing, velvet and other co-products sold. Horses are also included.

Source: NZIER

D.11.1 Browntop seed Gross Output value

Seed production is valued at $1.0 million or 50% of the export plus domestic Gross Output value (Horticulture New Zealand's rule of thumb for farmgate returns).

D.11.2 Domestic Gross Output value

Browntop production of seeds is geared to the off-season supply in the Northern Hemisphere. The main use is turf for amenity uses. A much smaller amount of browntop seed is sold into the domestic market for similar purposes. We have assumed that the domestic market is value at $0.3 million (or 20% of the export Gross Output value in line with other small exported species).

D.11.3 Export Gross Output value

Export Gross Output value for the 2011 year were $1.76 million (Hampton et al 2012).

D.11.4 Dependent industries

Most of the browntop production is focused on turf and amenity use. The browntop pastures have typically been old and lower producing pastures. These pastures are predominantly in hill country regions.

We have assumed that browntop contributes to the beef, sheep, deer, goat, and horse industries. We have further assumed that it contributes 0.5% of the energy needs for those industries.

Values for dependent industries (other livestock and horses) Gross Output values are set out in Appendix B.

D.11.5 Summary

Table 55 below sets out known Gross Output value for browntop.

Table 55 Browntop summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seeds ($1.0 million)	100%	0.37	$ 0.4million
Domestic ($0.3 million)	100%	0.18	$0.05 million
Export ($1.76 million)	100%	0.45	$0.8 million
Dependent industries: sheep, goats, beef, deer (other traditional livestock) and horses			
Farmgate livestock (sheep, deer, goats and beef: $5,039.0 million)[1]	0.5%	0.49	$14.6 million
Processing and Wholesaling margin: livestock (sheep, deer, goats and beef: $3033.0 million) [1]	0.5%	0.15	$2.3 million
Domestic livestock (sheep, deer, goats and beef: $1,432.8 million)[1]	0.5%	0.18	$1.3 million
Exports (sheep, deer, goats and beef: $6,882.1 million)[1]	0.5%	0.48	$16.5 million
Horse farmgate ($93.5 million)[1]	0.5%	0.25	$0.1 million
Horse domestic ($57 million)[1]	0.5%	0.12	$0.03 million
Horse export ($130 million)[1]	0.5%	0.20	$0.1 million
Total GDP output share			**$ 36.2 million**[2]
Notes: (1) Values set out in Appendix B. (2) Numbers rounded.			

Source: Fresh Facts, Horticulture New Zealand and NZIER

D.12 Capsicums (*Capsicum annuum*)

Traditionally green capsicums were grown for the domestic market. However, since 2000 capsicum exports from New Zealand have grown to $36 million in 2012. All export grade capsicums (*Capsicum annuum*) are produced in greenhouses.

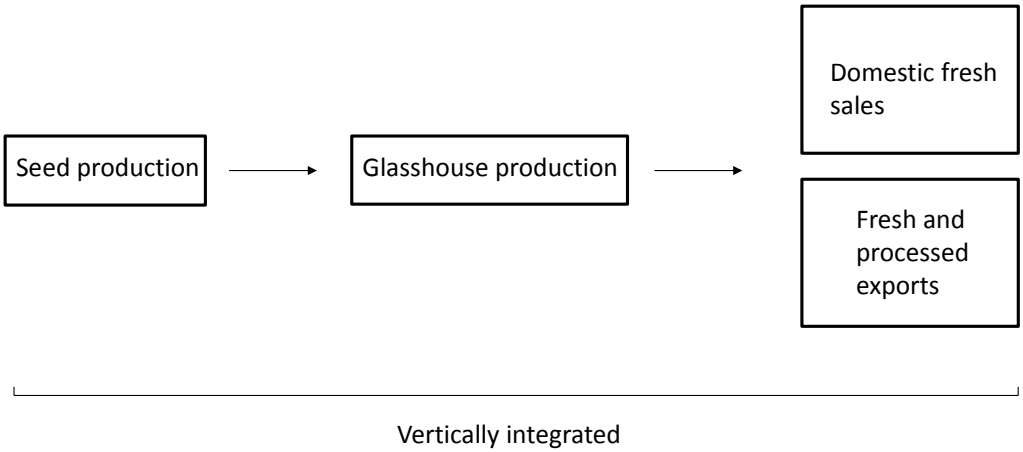
Production requires a high level of capital investment and while there are over 130 growers the industry is dominated by three key operators in the Auckland area.

The Japanese and Australian markets make up 97% of all capsicum exports, although the industry is seeking improved access to the USA and new access into Korea and China.

Good information is available on domestic and export Gross Output values but little information on farmgate Gross Output value given the vertical integration of the business. Capsicum seeds are imported and there is very little processing.

Figure 14 sets out the value chain for capsicums.

Figure 14 Capsicum value chain



Source: NZIER

D.12.1 Capsicum seed Gross Output value

Seeds for commercial growing are imported.

D.12.2 Glasshouse Gross Output value

Horticulture New Zealand estimates that for many horticultural industries farmgate prices are approximately a half of export and domestic Gross Output value. Fresh Facts (2012, p14) estimate that Gross Output value for capsicums was $29.3 million (domestic) and $36.1 million (exports).

Table 56 Capsicum Gross Output value at Glasshouse gate

	Domestic + export Gross Output value	Adjustment factor	Glasshouse Gross Output value estimate
Capsicum farmgate Gross Output value	$64.4 million	0.5	$32.7 million

Source: NZIER and Horticulture New Zealand

D.12.3 Processing and Wholesaling margin

Horticulture New Zealand suggests that the processing of capsicums is minimal. Handling, sorting, freight, wholesaling and packing costs are estimated at 15% of the farmgate value. The value of processing and wholesaling is estimated at $32.7 million x 0.15 equals $4.9 million.

D.12.4 Domestic Gross Output value

Fresh Facts (2012, p16) estimates the size of the domestic Gross Output value at $29.3 million.

D.12.5 Export Gross Output value

Fresh Facts (2012, p16) estimates the size of the domestic Gross Output value at $36.1 million.

D.12.6 Summary

Table 57 sets out known Gross Output value for capsicum.

Table 57 Capsicum summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed			Imported
Glasshouse ($32.7 million)	100%	0.37	$12.1 million
Processing and Wholesaling margin ($4.9 million)	100%	0.29	$1.4 million
Domestic ($29.3 million)	100%	0.18	$5.3 million
Export ($36.1 million)	100%	0.45	$16.3 million
Total GDP output share			**$35.0 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts, Horticulture New Zealand and NZIER

D.13 Carrots (*Daucus carota*)

New Zealand has a long history of growing vegetables such as carrots (*Daucus carota*) for the domestic and export markets. Current production ranges from fresh carrots (for local and export markets) to juiced carrots (mainly for the Japanese export market).

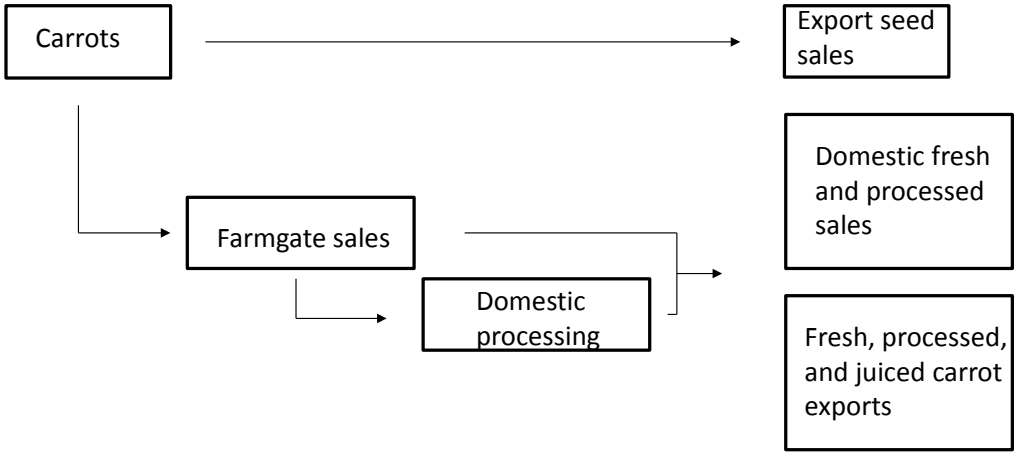
Good information is available on the value of carrots through the marketing chain.

The extent of knowledge includes:

- the value of carrot seed exports. Most carrot seed exports are contract grown for large multinational agricultural entities. Seed is then imported by New Zealand growers from these multinationals
- production and value of carrots in New Zealand
- processed carrots production including:
  - juiced carrot exports and domestic tonnage and values
  - processed for domestic consumption and export Gross Output values.

Figure 15 sets out the carrot value chain. Seed is grown for export. Imported seed (possibly re-imported) is then used to grow carrots. Fresh carrots are sold domestically and or exported. The majority of carrots are juiced (a proportion are also diced) and either sold domestically or exported.

Figure 15 Carrot value chain



Source: NZIER

D.13.1 Seed Gross Output value

Seed used for carrot production in New Zealand is imported. However, New Zealand also exports seeds to the value of $17.8m (Fresh Facts, 2012, June years, p20).[36]

[36] This shows the importance of globalised value chains. We have specialist seed producers contracted to agricultural multinational seed companies who grow seed on contract. This seed is exported, mainly to the USA. Carrot seed is then imported (possibly seed originated in New Zealand) for the new season's crop.

D.13.2 Farmgate Gross Output value

In 2012, there was approximately 85,000 tonnes of carrots grown in New Zealand. Carrot prices were approximately between $400 and $650 (fob export price in March 2007) per tonne (quoted by the Lincoln Financial Budget Manual 2012/2013, pA74). While the prices are taken from different years it gives an approximate indication of the value, given that we have export and domestic Gross Output value for 2012 (Fresh Facts 2012, p16). Dividing 400/650 multiplied by total Gross Output value (export and domestic – approximately $68 million) suggest that the farmgate Gross Output value is approximately $40m per annum (in June year 2012).

D.13.3 Processing and Wholesaling margin

The GDP output share of the carrot processing and wholesaling is confidential. It consists of cleaning fresh carrots, processing including production of frozen vegetables, wholesaling, and juiced and pureed carrots. In the absence of processing and wholesaling information, we assume that the Processing and Wholesaling margin is 30% of farmgate Gross Output values ($40.0m multiplied by 0.3 equals $12.0 million).

D.13.4 Domestic Gross Output value

Domestic Gross Output value is approximately $30 million (Fresh Facts 2012, p16). The majority of revenue domestically is fresh carrots although recent consumption figures are not available.

D.13.5 Export Gross Output value

Exports are made up of fresh ($9 million, Fresh Facts 2012, p16), processed ($2.2 million, Fresh Facts 2012, p16) and juiced and pureed carrots ($27 million, personal communication, Mr Damian Honsis, RD2 International, 6 May 2014).[37]

[37] Communication with the exporter RD2 International (RD2 has the sole South Canterbury factory juicing carrots).

D.13.6 Summary

Table 58 sets out the GDP output share of carrots to the New Zealand economy.

Table 58 Carrot summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Export seed ($17.8 million)	100%	0.37	$6.6 million
Farmgate ($40 million)	100%	0.37	$14.8 million
Processing and Wholesaling margin ($12.0 million)	100%	0.29	$3.5 million
Domestic fresh and processed ($30 million)	100%	0.18	$5.4 million
Fresh, processed, and juiced carrot exports ($38.2 million)	100%	0.45	$17.2 million
Total GDP output share			**$47.5 million[1]**
Note (1) numbers rounded.			

Source: Statistics New Zealand, Fresh Facts 2013, and RD2 International

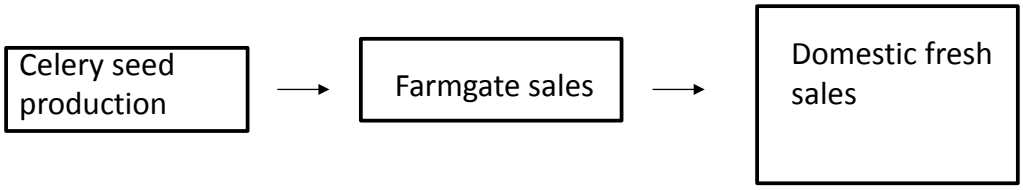
D.14 Celery (*Apium graveolens*)

Celery (*Apium graveolens*) has been a staple vegetable grown in New Zealand for the domestic market. Many of the European varieties of celery are white. In the United States, a green-stemmed celery was developed and successfully introduced into New Zealand in the 1960s. New Zealanders prefer celery to be bright green.

Good information is available on domestic Gross Output value and seed production (mainly imported).

The celery value chain is set below.

Figure 16 Celery value chain



Source: NZIER

D.14.1 Seed Gross Output value

The celery seed industry is very small; most seed is imported. (personal communication, Warren Hobson, Lefroy Valley, 4 March 2015).

D.14.2 Farmgate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries farmgate prices are approximately a half of domestic Gross Output value. Domestic Gross Output value for celery were approximately $5.0 million (unpublished data supporting Fresh Facts (2012 p24), personal communication, Alastair Aitken, Martech, 13 February 2015).

Table 59 Celery Gross Output value at farmgate

	Domestic Gross Output value	Adjustment factor	Farmgate Gross Output value estimate
Celery farmgate Gross Output value	$5.0 million	0.5	$2.5 million

Source: NZIER, and Horticulture New Zealand

D.14.3 Processing and Wholesaling margin

Horticulture New Zealand advise that there was very little processing of celery in New Zealand. Possibly an additional $0.1 million (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014).

Processing consists of handling, storage, sorting, wholesaling, and freight.

D.14.4 Domestic Gross Output value

New Zealand consumers bought approximately $5.0 million worth of celery in 2012 (unpublished data supporting Fresh Facts (2012, p24), personal communication, Alastair Aitken, Martech, 13 February 2015).

D.14.5 Summary

The following table sets out the GDP output share of celery to the New Zealand economy.

Table 60 Celery summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Export seed ($million)	100%	0.37	Imported
Farmgate ($2.5 million)	100%	0.37	$1.0 million
Domestic Processing and Wholesaling margin ($0.1 million)	100%	0.29	$0.03 million
Domestic ($5.0 million)	100%	0.18	$0.9 million
Total GDP output share			**$1.9 million**[1]
Note (1) numbers rounded.			

Source: Statistics New Zealand, Fresh Facts 2012

D.15 Chicory (*Cichorium intybus*)

Chicory (*Cichorium intybus*) is a herb with a deep tap root that produces high yields of quality forage. It is best suited as a re-growth special purpose summer crop sown with clover.

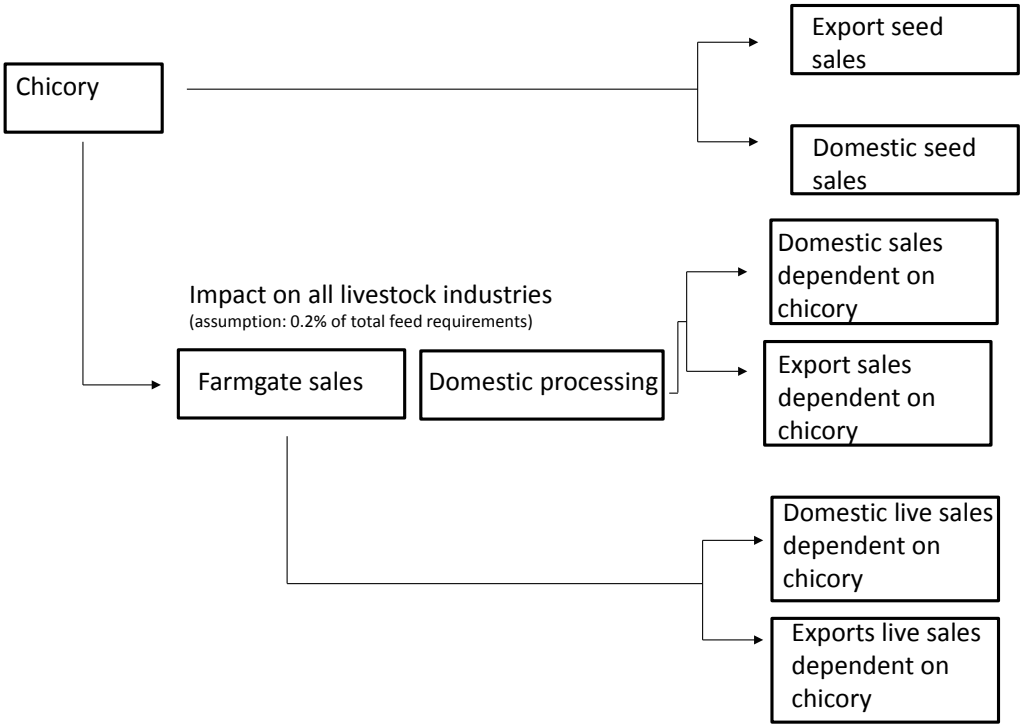
The increase in profitability in the dairy industry has driven increased demand for chicory. Therefore, the growth of chicory is linked closely with the rises and falls in livestock industry fortunes.

In addition to this chicory has good disease resistance and insect tolerance and with the right grazing management can provide viable stands for at least five years.

We have some information on seed Gross Output values and good information in dependent industry Gross Output values. Despite this chicory Gross Output values are relatively minor.

Figure 17 sets out the chicory value chain.

Figure 17 Chicory value chain



Note that all livestock industries include live animals (including horses), wool, dairy, meat processing, velvet and other co-products sold.

Source: NZIER

D.15.1 Seed Gross Output value

Seed Gross Output value is approximately $9.0 million (300 tonnes multiplied by $30,000 per tonne), (personal communication, David Green, PGG Wrightson, 20 March 2015).

D.15.2 Domestic Gross Output value

Domestic Gross Output value is estimated at twice seed production: $18.0 million in line with other horticultural industries.

D.15.3 Dependent industries

We have assumed that most chicory is being consumed by the dairy industry. We have further assumed that it contributes 0.02% of the protein for the whole dairy industry. This is an approximate figure based on discussions with DairyNZ (personal communication, Matthew Newman, 20 March 2015).

The value chain impacts for the dairy industry are set out in the Table below using Beef + Lamb New Zealand's estimates (personal communication, Mr Rob Davison, 5 June 2014) of farmgate value, processing, domestic and export Gross Output values.

Table 61 Estimated dairy Gross Output value at each stage of the marketing chain

2012, $ M

	Farmgate Gross Output value	Processing and Wholesaling margin	Domestic Gross Output value	Export Gross Output value
Dairy values	$10,828.0 million	$6,552.0 million	$1,045.6 million	$12,573.7 million
Other livestock values	$5,958.1 million	$3,033.0 million	$1,432.8 million	$6,882.1 million
Horse values	$93.5 million	No processing estimate	$57.0 million	$130.0 million
Note (1) How these values are determined is set out in Appendix B. (2) All traditional livestock exports including live sales equals $19,455.8 million.				

Source: Beef + Lamb New Zealand estimates and Statistics New Zealand

Table 62 sets out the summary of value for the dependent industry. In each case, the value at each stage of the value chain is multiplied by the impact on the industry and the GDP output share to obtain a value for chicory to the economy.

Table 62 Chicory for fodder summary for dependent industries

2012, $ M

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed value ($9.0 million)	100%	0.39	$3.3 million
Domestic ($18.0 million)	100%	0.18	$3.2 million
Chicory for fodder production as an input into the dairy and other livestock industries			
Farmgate Dairy estimate ($10,828.0 million)[1]	0.2%	0.49	$ 10.6 million
Farmgate Other traditional livestock ($5,958.1) million) [1]	0.2%	0.49	$ 5.8 million
Farmgate horses ($93.5 million) [1]	0.2%	0.25	$0.05 million
Traditional livestock Processing and Wholesaling margin ($3,033.0 million)[1]	0.2%	0.15	$ 1.0 million
Dairy Processing and Wholesaling margin ($6,552.0 million) [1]	0.2%	0.13	$1.7 million
Traditional livestock domestic estimate ($1,432.8 million)[1]	0.2%	0.18	$ 0.5 million
Dairy domestic ($1,045.6 million) [1]	0.2%	0.18	$0.4 million
Domestic horses ($57.0 million)[1]	0.2%	0.12	$0.01 million
All traditional livestock export ($19,455.8 million)[1]	0.2%	0.48	$ 18.7 million
Export horses ($130.0 million)[1]	0.2%	0.20	$0.05 million
GDP output share (total)			**$ 45.3 million[2]**
Notes: (1) Values set out in Appendix B. (2) Numbers rounded.			

Source: Beef + Lamb New Zealand, DairyNZ, IER Pty Ltd (2010) and Statistics New Zealand HS Code 0101

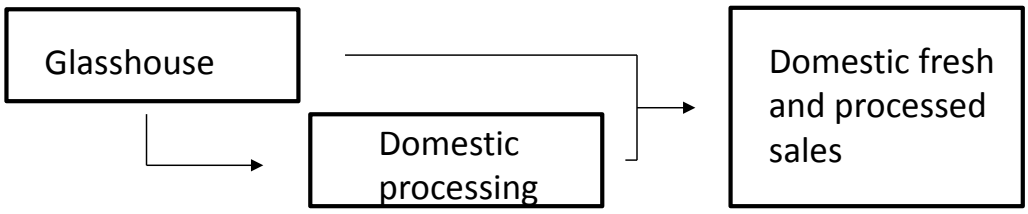
D.16 Chillies (*Capsicum* species, excluding *C. annuum*)

Chillies are a comparatively new and niche crop in New Zealand, and include the species *Capsicum frutescens, C. chinense, C. pubescens*, and *C. baccatum*. Production is exclusively for the domestic market and used for processing and fresh markets. Chillies are mainly grown indoors sometimes in tandem with other crops.

Little information is available on chilli Gross Output values. Farmgate Gross Output values have been estimated with the help of seed merchants.

The value chain for chillies is set in Figure 18.

Figure 18 Value chain for chillies



Source: NZIER

D.16.1 Seed Gross Output value

Seeds are mainly imported from other growing areas.

D.16.2 Glasshouse Gate Gross Output value

A very approximate estimate of Glasshouse Gross Output value nationally is $0.5 million in 2012 (personal communication, Warren Hobson, Lefroy Valley, 4 March 2015).

D.16.3 Processing and Wholesaling margin

Processing and wholesaling is mainly for various chilli sauces produced for the domestic market and is approximately $0.1 million (personal communication, Warren Hobson, Lefroy Valley, 4 March 2015).

Processing consists of handling, storage, sorting, freight, wholesaling, and some further processing.

D.16.4 Domestic Gross Output value

To estimate the domestic Gross Output values, we have used the Horticulture New Zealand suggested estimate of twice the Glasshouse gate value ($1.0 million). This includes processed and fresh for the domestic market in 2012 (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014).

D.16.5 Summary

Table 63 sets out the GDP output share of chillies to the New Zealand economy.

Table 63 Chillies summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Glasshouse gate ($0.5 million)	100%	0.37	$0.19 million
Processing and Wholesaling margin ($0.1 million)	100%	0.29	$0.04 million
Domestic fresh and processed ($1.0 million)	100%	0.18	$0.18 million
Total GDP output share			**$0.40 million[1]**
Note (1) numbers rounded.			

Source: Statistics New Zealand, Fresh Facts 2013, and RD2 International

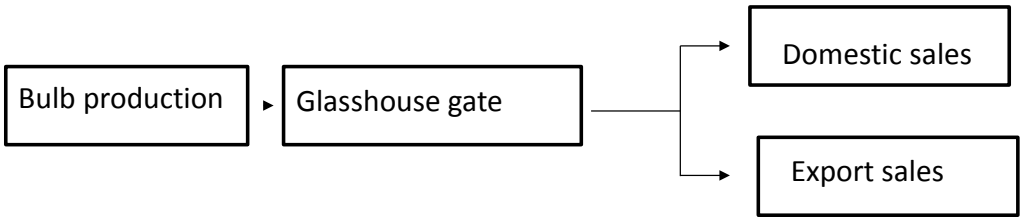
D.17 Chrysanthemums

Chrysanthemums originated in China and their cultivation dates back to at least 500 B.C. In New Zealand they are mainly grown for the domestic market but also some are exported.

Estimating the various parts of the value chain is very difficult. The large number of marketing channels means that only approximations can be made by industry experts.

The value chain for chrysanthemums is set out in Figure 19.

Figure 19 Chrysanthemum value chain



Source: NZIER

D.17.1 Seed Gross Output value

The value of the chrysanthemum seed market is unknown. Some growers generate their own seeds while others buy them from seed growers. We have assumed a 1% value of seed production for the chrysanthemum seed market to approximate value based on observations of other industries. This is in line with seed providers in other vegetable industries (approximately $0.015 million).

D.17.2 Farmgate Gross Output value

Farmgate Gross Output value approximations are problematic. Estimates are complicated by buyers buying directly from flower markets, florists buying from agents, and supermarkets buying direct from growers. Any estimate is likely to be an approximation only. FloraMax suggest the farmgate revenues for chrysanthemums are approximately $1.5 million (personal communication, Andre der Kwaak, GM FloraMax, 10 December 2014).

D.17.3 Domestic Gross Output value

Domestic Gross Output value estimates of chrysanthemums are subject to the same caveats. An approximate estimate is approximately $3.0 million in 2012 (personal communication, Andre der Kwaak, GM FloraMax, 10 December 2014).

D.17.4 Export Gross Output value

Export Gross Output value is estimated at $0.2 million (Fresh Facts 2012, p20).

D.17.5 Summary

Table 64 sets out the GDP output share of chrysanthemums to the New Zealand economy.

Table 64 Chrysanthemum summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Export seed ($0.015 million)	100%	0.37	$0.005 million
Farmgate ($1.5 million)	100%	0.37	$0.6 million
Domestic ($3.0 million)	100%	0.18	$0.54 million
Export ($0.2 million)	100%	0.45	$0.09 million
Total GDP output share			**$1.2 million[1]**
Note (1) numbers rounded.			

Source: Statistics New Zealand, Fresh Facts 2012

D.18 Citrus

Citrus arrived with European settlers and the first commercial orchards were planted in Northland, Auckland, and the Bay of Plenty. Most products are grown for the domestic market.

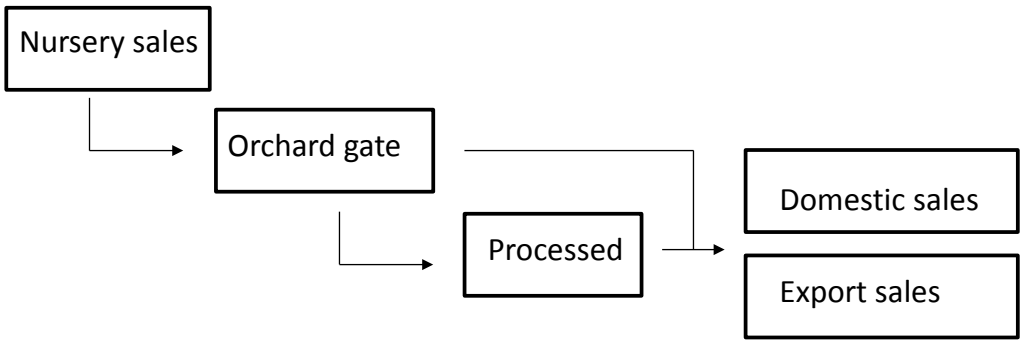
Citrus growers were protected from imports after the Second World War when the Citrus Marketing Authority had the power to acquire all oranges and lemons that weren't sold directly to the consumer. These restrictions were eliminated in the 1980s.

Today the main citrus products are oranges, lemons, limes, tangelos, mandarins, and grapefruit.

We have good estimates of value for exports and for the domestic market. Also we have estimates for replacement trees and new plantings and orchard gate values. Assumptions are made about the citrus market.

Figure 20 sets out the citrus marketing chain.

Figure 20 Citrus value chain



Source: NZIER

D.18.1 Citrus trees/root stock Gross Output value

The value of citrus tree Gross Output value is unclear. However, indications from the nurseries supplying the citrus industry (personal communication, Kate Marshall, Waimea Nurseries, 16 May 2014) suggest that Gross Output value is approximately 0.5% of orchard gate Gross Output values ($28.6 million multiplied by 0.5% equals $0.14 million).

D.18.2 Orchard gate Gross Output value

Orchard gate Gross Output value has been determined by tonnes estimated (Fresh Facts 2012, p14) and orchard gate prices (Lincoln Financial Budget Manual 2012/2013, pA66).

Table 65 Estimated Gross Output orchard gate value

	Tonnes[1]	Prices[2] per tonne	Gross Output value
Lemons	5,137	$1155	$6.4 million
Oranges	11,762	$700	$8.2 million
Mandarin	10,358	$1265	$13.1 million
Grapefruit	300	$440	$0.1 million
Tangelo	800	$418	$0.3 million
Limes	300	$1,247[3]	$0.4 million
Total			**$28.6 million**[3]
Notes (1) Fresh Facts 2012, p14. (2) Citrus NZ. (3). Numbers rounded.			

Source: NZIER

D.18.3 Processing and Wholesaling margin

Processing mainly involves juicing citrus, freezing, packaging, packing, wholesaling, and freight.

Most juice is imported so competition is fierce.[38] We have little verifiable information on the citrus processing and wholesaling stage of the value chain. We have assumed that processing and wholesaling is 50% on-orchard gate values (Citrus NZ).

Table 66 Citrus Processing and Wholesaling

	Domestic + export Gross Output value	Adjustment factor	Processing and Wholesaling margin
Citrus processing and wholesaling	$28.5 million	0.50	$14.3 million

Source: NZIER and Citrus NZ

D.18.4 Domestic Gross Output value

Domestic Gross Output values are estimated by Citrus NZ and Fresh Facts (2012, p14) and are set out in Table 67.

[38] The value of the fruit processing sector (fruit juice in particular) is not normally included as part of the citrus industry value calculation. The calculations in this section of the report have focussed on the value of the fruit to the processor, not the value of the fruit when sold by the grower.

Table 67 Estimated domestic citrus Gross Output value

	Tonnes	Estimated domestic Gross Output value
Lemons	5,524	$8.0 million
Oranges	11,762	$15.8 million
Mandarins	10,358	$26.0 million
Grapefruit	300	$0.3 million
Tangelo	800	$0.8 million
Limes	300	$1.0 million
Total	**29,044**	**$51.9 million**

Source: Fresh Facts and Citrus NZ

D.18.5 Export Gross Output value

Export Gross Output value is estimated in Fresh Facts (2012, p14) and are set out in Table 68.

Table 68 Estimated export citrus Gross Output value

		Estimated export Gross Output value
Grapefruit		$0.03 million
Lemons		$2.5 million
Oranges		$0.9 million
Mandarin		$3.2 million
Tangelos		$0.04 million
Limes		$0.03 million
Total		**$6.7 million**[1]
Note: (1) Numbers rounded		

Source: Fresh Facts 2012

D.18.6 Summary

The following table sets out the GDP output share of citrus to the New Zealand economy.

Table 69 Citrus summary

2012[1], $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Tree/root stock ($0.14 million)	100%	0.37	$0.05 million
Orchard gate ($28.6 million)	100%	0.37	$10.6 million
Processing and Wholesaling margin ($14.3 million)	100%	0.29	$4.1 million
Domestic ($51.9 million)	100%	0.18	$9.3 million
Export ($6.7 million)	100%	0.45	$3.0 million
Total GDP output share			**$27.1 million[2]**
Notes (1) Based on an April year 2012/2013. (2) Numbers rounded.			

Source: Statistics New Zealand and Citrus NZ

D.19 Clover (red and white) (*Trifolium species*)

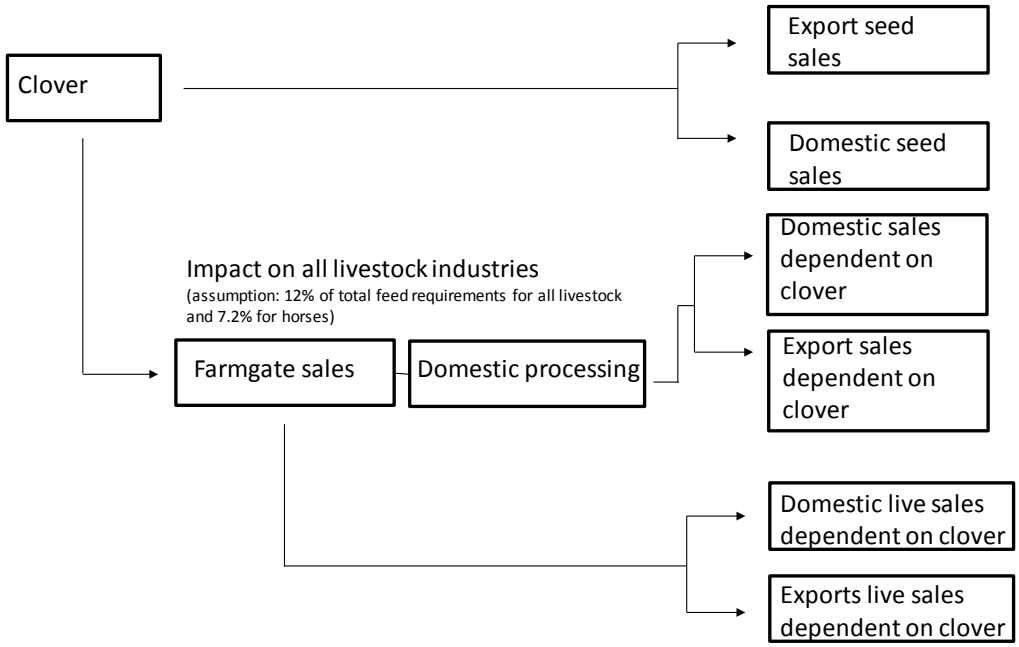
Red and white clover (*Trifolium pratense and T. repens* respectively) are major contributors to the livestock industry. It makes an important economic contribution to New Zealand by supporting the sheep, beef and dairy industries.

For industries that rely on clover Beef + Lamb New Zealand have credible estimates of livestock Gross Output value at the farmgate, processing and export values (personal communication, Mr Rob Davison, 5 June 2014). The main assumption made is that clover makes up approximately 12% of all livestock nutrient requirements (correspondence with Mr Matthew Newman (DairyNZ) and Mr Nick Pyke (FAR)).[39]

The clover value chain is set in Figure 21.

[39] Also see http://www.beeflambnz.com

Figure 21 Clover value chain[40]



Note that all livestock industries include live animals, wool, dairy, meat processing, velvet and other co-products sold.

Source: NZIER

D.19.1 Clover seed Gross Output value

Most seed production takes place in Canterbury. Total clover seed production in 2011 (December year)[41] was 3,745 tonnes (BERL 2011; Statistics New Zealand; Hampton et al 2012, p131).[42] The total Gross Output value for clover seed (domestic and export Gross Output value) is approximately $22.9 million (BERL 2012, p14). Most clover seed is sold into the export market ($14.15 million).

Farmgate Gross Output value for seed production is $11.4 million (see Table below).

[40] We have assumed that hay and other processed grass (e.g. silage) are incorporated into the value of farmgate production.

[41] The latest year available where exports and domestic production is reported.

[42] Note that we have used 2011 June year to get consistent export and domestic use figures.

Table 70 Seed Gross Output value at farmgate, domestic and exports

2011

Specific part of the value chain	Calculation	Gross Output value	Source/assumption
Farmgate Gross Output value	50% of export and domestic Gross Output value	$11.4 million	Hort NZ assumption
Domestic Gross Output value	Total sales minus export Gross Output value	$8.7 million	Derived from BERL 2012, p14 and Hampton et al 2012, p133
Export Gross Output value	Statistics NZ	$14.2 million	Hampton et al 2012, p133

Source: BERL 2012, Hampton et al 2012 and Horticulture New Zealand

C.19.2 Value chain impact of dependent industries

Clover contributes approximately 12% of all nutrition needs for livestock industries (personal communication, Mr Matthew Newman, DairyNZ, 24 February 2015). Horse nutritional needs are assumed to be 7.2% (based on Gee 2012). This makes clover one of New Zealand's preeminent economic plants in value terms.

Table 71 illustrates clover's importance by setting out the livestock and horse values for farmgate, processing, domestic and export Gross Output values that depend upon clover. Export data comes from Statistics New Zealand through Beef + Lamb New Zealand (personal communication, Mr Rob Davison, 5 June 2014). Beef + Lamb New Zealand have also estimated processing margins and farmgate returns (personal communication, Mr Rob Davison, 30 July 2014) specifically for this project. Livestock (live) Gross Output value sales are based Treasury and Statistic New Zealand estimates.

Table 71 Livestock industries that depend on clover[1]

2012, June year, $ M per annum

	Farmgate Gross Output value	Processing and Wholesaling margin	Domestic Gross Output estimate	Export Gross Output value
Dairy values	$10,828.0 million	$6,552.0 million	$1,045.6 million	$12,573.7 million
Other traditional livestock values	$5,958.1 million	$3,033.0 million	$1,432.8 million	$6,882.1 million
Horse values	$93.5 million	No processing estimate	$57.0 million	$130.0 million
Note (1) See Appendix B for further detail.				

Source: Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.19.2 Clover summary

Table 72 sets out the summary of clover seed production and its dependent livestock and horse industries. Estimates of the value at each stage of the value chain have been calculated in the Table below. These values are summed to get the total GDP share of output, which demonstrates the importance of clover to the economy.

Table 72 Clover summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Farmgate seed ($11.4 million)[1]	100%	0.37	$4.2 million
Domestic seed ($8.7 million)	100%	0.18	$1.6 million
Export seed ($14.2 million)	100%	0.45	$6.4 million
Dependent livestock industries			
Farmgate Dairy ($10,828.0 million)	12%	0.49	$636.7 million
Farmgate Other livestock ($5,958.1 million)	12%	0.49	$350.3 million
Farmgate horses ($93.5 million)	7.2%	0.25	$1.7 million
Domestic Processing and Wholesaling margin traditional livestock ($3,033.0 million)	12%	0.15	$54.6 million
Domestic Processing and Wholesaling margin dairy ($6,552.0 million)	12%	0.13	$102.2 million
Domestic all livestock (processing and live) ($2,478.4 million)	12%	0.18	$53.5 million
Domestic horses ($57.0 million)	7.2%	0.12	$0.5 million
Export all livestock ($19,445.8 million)	12%	0.48	$1,120.6 million
Export horses ($130.0 million)	7.2%	0.20	$1.9 million
Total GDP output share			**$2,334.2 million[2]**
Note (1) December year 2011. (2) Numbers rounded.			

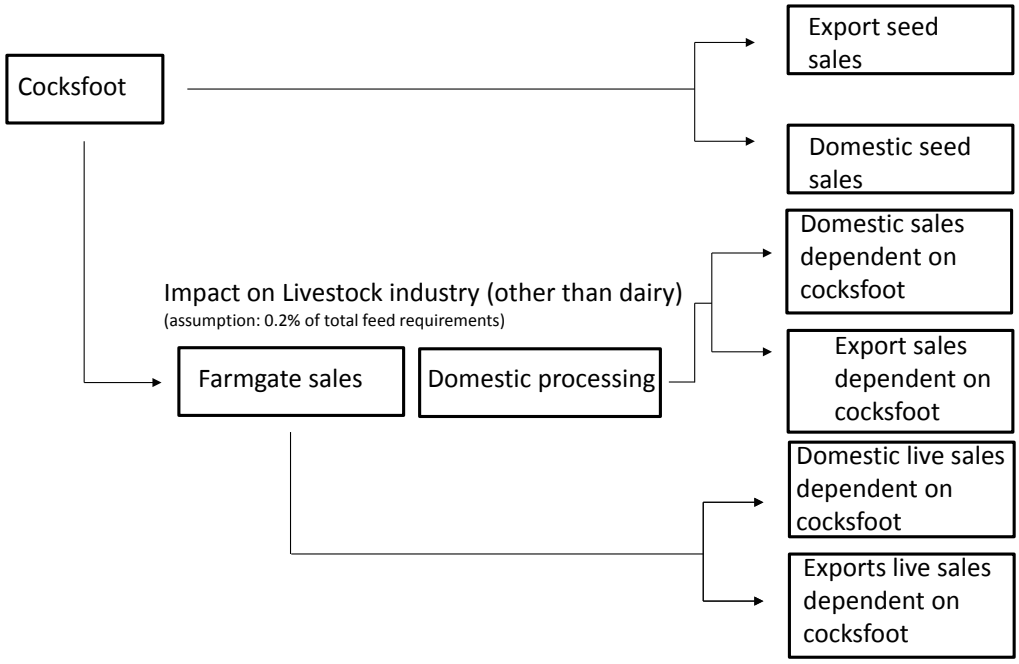
Source: BERL 2012, Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.20 Cocksfoot (*Dactylis glomerata*)

Cocksfoot (*Dactylis glomerata*) is a very persistent perennial grass that tolerates moisture stress, moderate soil fertility, insect attack and continual set stocking.

Cocksfoot is used to enhance the growth and persistence of permanent pasture in summer dry areas. It also adds variety to the stock diet. It is moderately slow to establish and has lower digestibility than most other grasses. Cocksfoot has limited winter growth but good summer growth. Cocksfoot is predominately used on sheep and beef farms and we have limited the dependent industries to sheep, beef and deer.[43]

Figure 22 Cocksfoot value chain



Note that livestock industries include live animals, wool, meat processing, velvet and other co-products sold. Horses are also included.

Source: NZIER

D.20.1 Cocksfoot seed Gross Output value

Most seed production takes place in Canterbury. The farmgate value of cocksfoot seed production is approximately $0.9 million (approximately half of exports plus domestic Gross Output values).

[43] www.agricom.co.nz/products/cocksfoot

Table 73 Cocksfoot Gross Output value at farmgate

	Domestic plus export Gross Output value	Adjustment factor	Farmgate Gross Output value estimate
Cocksfoot farmgate value	$1.88 million	0.5	$0.9 million

Source: BERL 2012 and Hampton et al 2012

D.20.2 Domestic Gross Output value

Domestic seed Gross Output value is estimated at $0.33 million (BERL 2012, p14).

D.20.3 Export Gross Output value

Export seed Gross Output value is estimated at $1.55 million (Hampton et al, 2012).

D.20.4 Value chain impact of dependent industries

Cocksfoot contributes 0.2% of all nutrition needs for livestock industries (other than dairy). While much smaller in volume than other grasses it still makes a significant contribution in value terms. Cocksfoot is best suited for grazing sheep and dry stock because it persists well in dry, moderately fertile, and free draining soil.[44] Dairy is excluded from this value chain because cocksfoot is less suited to dairy production relative to other grasses (e.g. clover and ryegrass).

The table below illustrates its importance by setting out the other livestock value of farmgate, processing, domestic and export Gross Output value that depend upon cocksfoot. Export data comes from Statistics New Zealand through Beef + Lamb New Zealand (personal communication, Mr Rob Davison, 5 June 2014). Beef + Lamb New Zealand have also estimated processing margins and farmgate returns (personal communication, Mr Rob Davison, 30 July 2014) specifically for this project. Livestock (live) sales are Statistics New Zealand estimates.

Table 74 Livestock industries that depend on cocksfoot[1]

2012, June year, $ M per annum

	Farmgate Gross Output value	Processing and Wholesaling margin	Domestic Gross Output estimate	Export Gross Output value
Other traditional livestock values	$5,958.1 million	3,033.0 million	$1,432.8 million	$6,822.1million
Horse values	$93.5 million	No estimate	$57.0 million	$130.0 million
Note (1) Other traditional livestock values are set out in Appendix B.				

Source: Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

[44] www.agricom.co.nz/products/cocksfoot and PGG Wrightsons cocksfoot advice, e.g.: http://www.pggwrightsonseeds.com/index.php?page=cocksfoot

Cocksfoot summary

Table 75 sets out the summary of cocksfoot seed production and its dependent livestock industries (including horses). Estimates of the Gross Output value at each stage of the value chain have been calculated in the table below. These values are summed to get the total GDP share of output, which demonstrates the importance of cocksfoot to the economy.

Table 75 Cocksfoot summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed farmgate value ($0.9 million)[1]	100%	0.37	$0.4 million
Domestic ($0.33 million)	100%	0.18	$0.06 million
Export ($1.6 million)	100%	0.45	$0.7 million
Dependent livestock industries			
Farmgate Other livestock ($5,958.1 million)[2]	0.2%	0.49	$5.9 million
Farmgate horses ($93.5 million)[2]	0.2%	0.25	$0.05 million
Processing and Wholesaling margin ($3,033.0 million)[2]	0.2%	0.15	$0.9 million
Domestic (processing and live) ($1,432.8 million)[2]	0.2%	0.18	$0.5 million
Domestic horses ($57.0 million)[2]	0.2%	0.12	$0.01 million
Export ($6,882.1 million)[2]	0.2%	0.48	$6.6 million
Export horses ($130.0 million)[2]	0.2%	0.20	$0.05 million
Total GDP output share			**$15.1 million[3]**
Note (1) December year 2011. (2) Values set out in Appendix B. (3) Numbers rounded.			

Source: BERL 2012, Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.21 *Cucurbita* species

Cucurbita species valued in this study include buttercup squash (*Cucurbita maxima*), butternut pumpkin (*Cucurbita moschata*), and zucchini and other pumpkins (*Cucurbita pepo*).

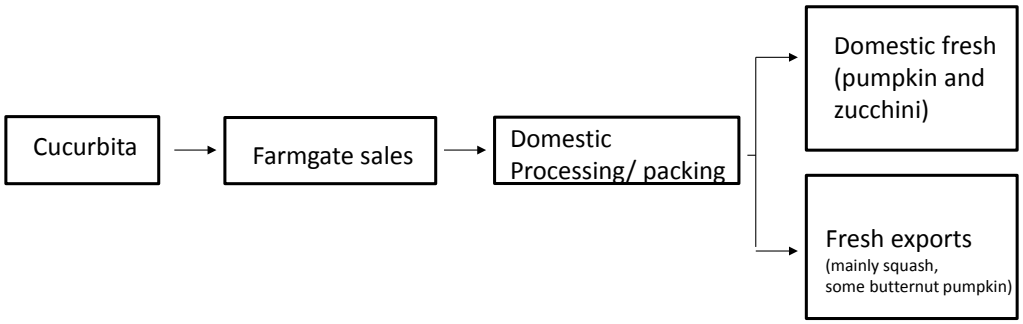
Butternut squash

Buttercup squash

The export focus is on buttercup squash. The main export markets are Japan and South Korea. A very small amount of other pumpkin (less than $100,000 FOB) was also exported in 2012. The main focus for butternut pumpkin and zucchini and other pumpkins is the domestic market.

These species are grown in variety of places including Gisborne, Hawke's Bay, South Auckland, Horowhenua and Canterbury. The value chain is set out below.

Figure 23 *Cucurbita* species value chain



Source: NZIER

D.21.1 Cucurbita seed Gross Output value

Cucurbita seeds are a mixture of imported seeds (squash and zucchini) and domestically grown (pumpkin), (personal communication, Warren Hobson, Lefroy Valley, 13 March 2015).

An approximate estimate of pumpkin seed Gross Output value in 2012 is $0.6 million (personal communication, Warren Hobson, Lefroy Valley, 13 March 2015).

D.21.2 Farmgate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries that farmgate prices are approximately half of export and domestic Gross Output values. Below we set out the estimated farmgate Gross Output value estimates.

Table 76 Cucurbita value at farmgate

	Domestic + export Gross Output values	Adjustment factor	Farmgate value estimate
Squash farmgate value	$67.9 million[1]	0.5	$34.0 million
Zucchini farmgate value	$12.0 million[2]	0.5	$6.0 million
Pumpkin			$6.2 million[3]
Notes (1) Fresh Facts (2012, p17). (2) Fresh Facts (2012, p27) based on consumption. (3) 31,000 tonnes multiplied $200 per tonne (pers comm John Seymour, Horticulture New Zealand, 12 December 2014.			

Source: NZIER, and Horticulture New Zealand

Pumpkin farmgate value is calculated 31,000 tonnes multiplied by $200 per tonne (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014) which equals $6.2 million.

D.21.3 Processing and Wholesaling margin

There is little or no further processing of Cucurbita products in New Zealand. Processing values are related to handling, storage, packing, wholesaling and a very small amount of further processing. We have estimated these costs at 15% of farmgate Gross Output values. The value of the processing and wholesaling stage of the value chain is approximately $6.9 million ($46.2m x 0.15).

D.21.4 Domestic Gross Output value

Domestic Gross Output value is set out in Table 77.

Table 77 Cucurbita domestic Gross Output value

	Squash	Pumpkin	Zucchini
Domestic Gross Output value	$2.9 million[1]	$12.4 million[2]	$12.0 million[3]
Notes (1) Fresh Facts (2012, p17). (2) Twice the farmgate value (pers comm, John Seymour, Horticulture New Zealand, 12 December 2014). (3) Fresh Facts (2012, p27) based on consumption.			

Source: NZIER and Horticulture New Zealand

D.21.5 Export Gross Output value

Squash is the major exported *Cucurbita* species. Exports were $65.0 million in 2012 (Fresh Facts 2012, p16). Some butternut pumpkin was also exported ($0.08 million).

D.21.6 Summary

Table 78 sets out the GDP output share of Cucurbita to the New Zealand economy.

Table 78 Cucurbita summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($0.6 million)	100%	0.37	$0.2 million
Farmgate ($46.2 million)	100%	0.37	$17.1 million
Processing and Wholesaling margin ($6.9 million)	100%	0.29	$2.0 million
Domestic ($27.3 million)	100%	0.18	$4.9 million
Export ($65.1 million)	100%	0.45	$29.3 million
Total GDP output share			**$53.5 million**[1]
Note (1) numbers rounded.			

Source: Statistics New Zealand and Fresh Facts 2012

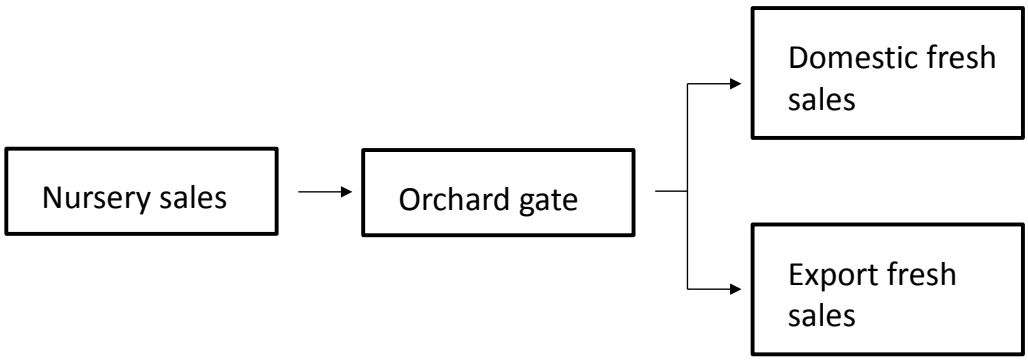
D.22 Feijoas (*Acca sellowiana*)

Feijoas (*Acca sellowiana*) have been grown in New Zealand since the beginning of the 20th century. The feijoa industry is a small industry with a stable domestic market and small export market.

While exports statistics are readily available, domestic information on the industry is reliant on nurseries and industry estimates.

The value chain for feijoas is set out below.

Figure 24 Feijoa value chain



Source: NZIER

D.22.1 Trees/root stock Gross Output value

The number of trees sold in New Zealand is approximately 6,000 multiplied by $10 per tree equalling $0.06 million (personal communication, Kate Marshall, Waimea Nurseries, 13 March 2015).

D.22.2 Orchard gate Gross Output value

The farmgate Gross Output value of feijoa is estimated at approximately $0.95 million based on the domestic and export Gross Output value approximations suggested by Horticulture New Zealand (see Table 79).

Table 79 Feijoa Gross Output value at orchard gate

	Domestic plus export Gross Output value	Adjustment factor	Orchard Gross Output value estimate
Feijoa orchard gate Gross Output value	$1.9 million	0.5	$0.95 million

Source: Fresh Facts and Horticulture New Zealand

D.22.3 Processing and Wholesaling margin

The Processing and Wholesaling margin is estimated at $0.14 million ($0.95 multiplied by 0.15). Processing consists of packaging, handling, storage, wholesaling and freight.

D.22.4 Domestic Gross Output value

Domestic Gross Output value is estimated at $1.7 million (Fresh Facts 2012, p14).

D.22.5 Export Gross Output value

Export Gross Output value is estimated at $0.2 million (Fresh Facts 2012, p14).

D.22.6 Summary

Table 80 sets out the GDP output share of feijoa to the New Zealand economy.

Table 80 Feijoa summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($0.06 million)	100%	0.37	$0.02 million
Farmgate ($0.95 million)	100%	0.37	$0.4 million
Processing and Wholesaling margin ($0.14 million)	100%	0.29	$0.04 million
Domestic ($1.7 million)	100%	0.18	$0.3 million
Export ($0.2 million)	100%	0.45	$0.1 million
Total GDP output share			**$0.8 million[1]**
Note (1) numbers rounded.			

Source: Statistics New Zealand, Fresh Facts 2012 and Waimea Nurseries

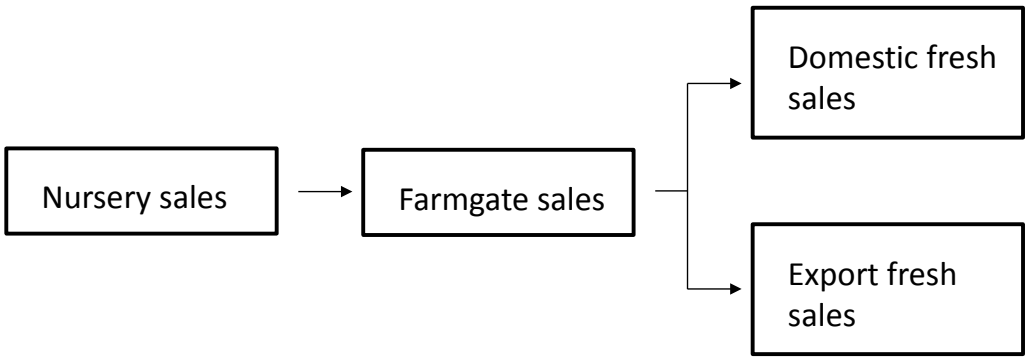
D.22.7 Garlic (Allium sativum)

Garlic (*Allium sativum*) growing in New Zealand is a small industry catering mainly for the domestic market.

Information on Gross Output values is scarce so we have relied on local experts and Fresh Facts.

The value chain for garlic is set out below.

Figure 25 Garlic value chain



Source: NZIER

D.22.8 Garlic corms Gross Output value

The amount of garlic corms grown is unknown however we expect the value to be approximately 1% of the farmgate Gross Output value (based on other vegetable and horticultural production ($0.04 million).

D.22.9 Farmgate Gross Output value

The farmgate Gross Output value of garlic is estimated at approximately $3.6 million based on the domestic and export Gross Output value approximations (see Table 81).

Table 81 Garlic value at Gross Output farmgate value

	Domestic plus export Gross Output value	Adjustment factor	Farmgate Gross Output value estimate
Garlic farmgate value	$7.1 million	0.5	$3.6 million

Source: Fresh Facts and Horticulture New Zealand

D.22.10 Processing and Wholesaling margin

The Processing and Wholesaling margin is estimated at $0.5 million in 2012 ($3.6 million multiplied by 0.15). Processing consists of packing, sorting, handling, wholesaling and freight. Some further processing occurs but quantities are very small.

D.22.11 Domestic Gross Output value

Domestic Gross Output value was estimated at $6.5 million in 2012 (Fresh Facts 2012, p14).

D.22.12 Export Gross Output value

Export Gross Output value was estimated at $0.6 million in 2012 (Fresh Facts 2012, p14).

D.22.13 Summary

The following table sets out the GDP output share of garlic to the New Zealand economy.

Table 82 Garlic summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($0.04 million)	100%	0.37	$0.01 million
Farmgate ($3.6 million)	100%	0.37	$1.3 million
Processing and Wholesaling margin[1] ($0.5 million)	100%	0.29	$0.2 million
Domestic ($6.5 million)	100%	0.18	$1.2 million
Export ($0.6 million)	100%	0.45	$0.3 million
Total GDP output share			**$2.9 million[2]**
Notes (1) Assumed to be crushed garlic, added to sauces, hummus etc. (2) Numbers rounded.			

Source: Statistics New Zealand, Fresh Facts 2012

D.23 Grapes (*Vitis* species)

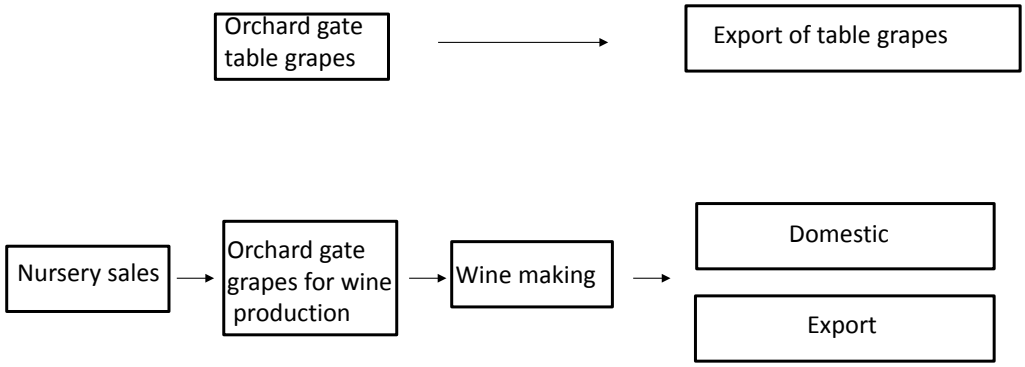
Grapes (*Vitis* species) consist of table grapes (servicing very small high value niche export markets) and the wine industry (very large). Table grapes are grown in greenhouses and air-freighted to Japan.

The wine industry grows grapes outdoors and ships product to a large number of industrialised and rapidly industrialising nations at premium prices. The key to success of the wine industry is the consistent high quality and distinct New Zealand varieties reinforced by the skill of the wine maker.

Good information is available on all aspects of the marketing chain.

Below the value chain is set out.

Figure 26 Table grape and vineyard value chain



Source: NZIER

D.23.1 Vines/root stock Gross Output value

Nursery Gross Output value was approximately $7.5 million per annum (personal communication, Ben Wickham, New Zealand Wine Growers, 19 August 2014). This includes new plantings and replacements.

D.23.2 Vineyard gate Gross Output value

It is difficult to place an accurate figure on the vineyard gate returns. The estimates are somewhat artificial since in many cases the grapes are harvested and processed on the vineyard. However, a general understanding can be gained from the New Zealand Wine Growers (2013 Annual Report, p22). This is set out in Table 83 where the total vintage is multiplied by the weighted average price per tonne to give a vineyard value.

Table 83 Wine vineyard gate Gross Output value

	Total vintage for 2012	Average price per tonne	Vineyard gate Gross Output value
Vineyard gate	269,000 tonnes	$1,399	$375.8 million less 5% for waste. $357.0 million

Source: New Zealand Wine Growers Annual Report

A further $0.1 million was added to vineyard gate returns for table grapes.

D.23.3 Processing and Wholesale margin

To estimate the Processing and Wholesaling margin we have calculated the processing Gross Output values less the Gross Output value at the vineyard gate.

The Gross Output for processing is calculated from the value of bulk wine[45] per litre multiplied by the volume of bulk wine produced: $2.10 per litre multiplied by 194 million litres equalling $407.0 million (Deloitte 2012 p18 and NZIER estimate). This includes activities such as wine making, packaging, bottling, labelling, storage, handling, and freight.

The price paid by large wineries on the open market for bulk wine was $1.84. Smaller wineries (29% of all volume) pay more for their bulk wine. However, we expect that the transfer price paid internally for wine produced on-vineyard will be less than that bought on the open market. Therefore, we have used $2.10 as a proxy for the Gross Output value of processing (including, wine crushed, bottling, labelling, freight and handling).

In estimating the $2.10 per litre value, we took into account documented winemaking costs by Deloitte. The 2012 Deloitte survey (p13) suggests that bulk wine makes up 14% of total costs of wine production while other activities (labelling and packing) make up roughly 10% of total costs of wine production for large wineries.

Table 84 Calculating the Processing and Wholesaling margin

	Gross Output Processing	Gross Output vineyard gate	Processing and Wholesaling margin
Processing and Wholesaling margin	$407.4 million	$357.0 million	$50.5 million

Source: NZIER, Deloitte and NZ Wine Growers Annual Report

[45] There is a significant bulk wine market where vineyards buy bulk wine from other vineyards or contract grape growers. Bulk wine is transported in specially fitted out tankers around New Zealand from vineyard to vineyard. See for example: http://www.gisbornewine.co.nz/regionalwineawards/sponsors/alexander-transport

D.23.4 Domestic Gross Output value

Domestic Gross Output value of wine was $425.0 million in 2012. The calculation comprises of: domestic volume (64.6 million litres) multiplied by the export value ($1,177.0 million) divided by the export volume (178.9 million litres) (New Zealand Wine Growers 2013).

We have used the export fob prices as a conservative estimate since there is no average domestic price recorded. NZ Wine advise (February 2016) that the price would at least be the fob price per litre and more likely to be higher. Although they have no information on how much higher the value should be.

D.23.5 Export Gross Output value

Export Gross Output value for wine comprise of $1,177.0 million (New Zealand Wine Growers Annual Report 2013 p22) plus $300,000 worth of table grape exports.

D.23.6 Summary

Table 85 sets out the summary of grapes. Estimates of the Gross Output value at each stage of the value chain are calculated in the Table below. These values are summed to get the total GDP share of output, which demonstrates the importance of grapes to the economy.

Table 85 Grape summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Vine nursery Gross Output value ($7.5 million)	100%	0.37	$2.7 million
Vineyard gate ($357.0 million)	100%	0.37	$132.1 million
Processing and Wholesaling margin ($50.5 million)	100%	0.29	$14.6 million
Domestic (wine) ($425.0 million)	100%	0.18	$76.5 million
Export ($1,177.3 million)	100%	0.45	$529.8 million
Total GDP output share			**$755.8 million**[1]
Note (1) Numbers rounded.			

Source: New Zealand Wine Growers Annual Report 2013, Deloitte 2012, Statistics New Zealand and NZIER

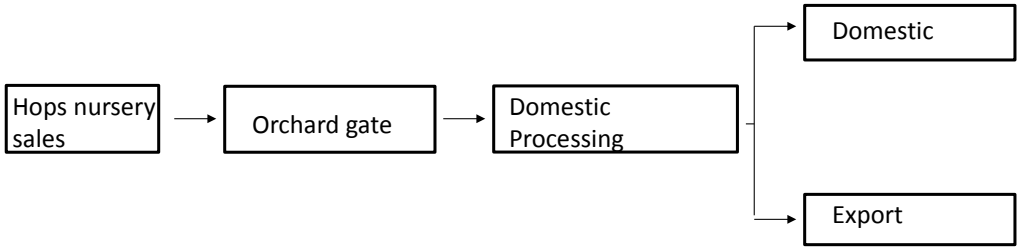
D.23.7 Hops (Humulus lupulus)

English and German settlers first planted hops (*Humulus lupulus*) in the Nelson region during the mid- 19th century. In the latter part of the 20th century New Zealand has developed high quality seedless varieties with bittering and aroma characteristics desired by beer brewers around the world.

Information is available on the nursery, farmgate, domestic, and export stages of the value chain. Assumptions have been made about the processing stage of the value chain.

The value chain for hops is set out below.

Figure 27 Hops value chain



Source: NZIER

D.23.8 Hops plant Gross Output value

The number of hops plants supplied to growers was approximately $0.12 million in value (personal communication, Kate Marshall, Waimea Nurseries, 13 March 2015).

D.23.9 Farmgate Gross Output value

Farmgate Gross Output value was estimated by Plant and Food Research Limited at approximately $2.0 million.[46]

D.23.10 Processing and Wholesaling margin

Processing and Wholesale margin value consists of kilning, freight, grading, wholesaling, and brewing.

Most processing occurs in the Nelson area which is where hops are predominantly grown. The Processing and Wholesaling margin is approximately 25% of domestic and export Gross Output values ($3.1 million). The Processing and Wholesaling margin value is tightly held; we have used 25% to illustrate the capital intensive nature of the hops business.

D.23.11 Domestic Gross Output value

Domestic Gross Output value is estimated at $3.0 million by Fresh Facts (2012, p15).

D.23.12 Export Gross Output value

Export Gross Output value is estimated at $9.2 million by Fresh Facts (2012, p15).

D.23.13 Summary

Table 86 sets out the summary of hops GDP contribution. Estimates of the Gross Output value at each stage of value chain have been calculated in the Table below.

[46] http://www.plantandfood.co.nz/

Table 86 Hops summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Plants orchard gate ($0.12 million)	100%	0.37	$0.04 million
Orchard gate ($2.0 million)	100%	0.37	$0.7 million
Processing and Wholesaling margin ($3.1 million)	100%	0.29	$0.9 million
Domestic ($3.0 million)	100%	0.18	$0.5 million
Export ($9.2 million)	100%	0.45	$4.1 million
Total GDP output share			**$6.4 million[1]**
Note (1) Numbers rounded.			

Source: Waimea Nurseries, Plant and Food Research, Horticulture New Zealand and NZIER

D.24 Kiwifruit (*Actinidia* species)[47]

The kiwifruit (*Actinidia* species) industry has its origins in seeds bought from China in the early part of the 20th Century. From these seeds, the Hayward variety was developed and kiwifruit began its growth from a small local market operation to a major export crop.

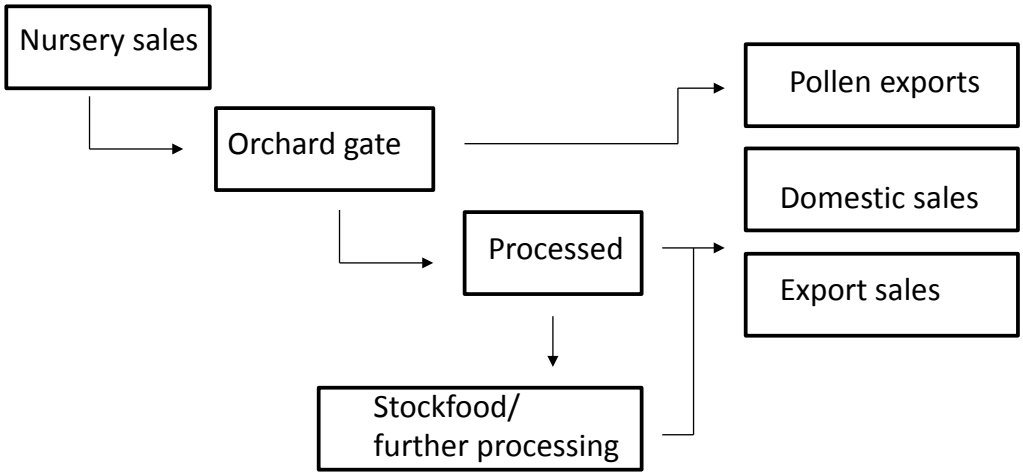
Valuing kiwifruit has been made more difficult with the PSA incursion. Given the expected "bounce" back of gold kiwifruit we have used 2012 figures.[48] These data show production prior to the major impact of PSA particularly on gold kiwifruit. Figure 28 below sets out the kiwifruit value chain. Major points include:

- the best data is for exports. There is no other official data for other parts of the value chain. Therefore, we have worked backward through the marketing chain from the export value
- estimates for other parts of the value chain including processing and wholesaling, domestic market, and exports.

47 Includes *A ctinidia chinensis* (gold), *Actinidia deliclosa* (green), and *Actinidia arguta* (berry).

48 The PSA (Pseudomonas syringae pv. actinidiae) disease has devastated particularly gold kiwifruit (Hort 16A variety). A new gold variety (G3) has shown good resistance to PSA and the industry are expecting gold volumes to return to pre PSA levels by 2015 (see for example http://www.nzherald.co.nz/bay-of-plenty-times/news/article.cfm?c_id=1503343& objected=1120 3065).

Figure 28 Kiwifruit value chain



Source: NZIER

D.24.1 Nursery Gross Output value

Table 22 sets out the approximate Gross Output value for kiwifruit nursery value in 2012. We have used estimates from Fruition (personal communication, Ms Ruth Underwood, Fruition, 15 May 2014) to identify approximate domestic nursery Gross Output value. Total exports of live plants and root stock is relatively small.[49]

Table 87 Estimated kiwifruit nursery Gross Output value

2012, June year, $ M

	Hectares	Estimated per hectare value (per annum)	Nursery Gross Output value (per annum)
Kiwifruit nursery stock	500	$10,000 per hectare	$5m[1]
Notes (1) Includes value per hectare, labour costs, and wholesale mark-up.			

Source: Personal communication with Fruition and NZIER

D.24.2 Orchard gate Gross Output value

Total production is estimated to be 390,000 tonnes. This has been calculated by taking the total export tonnage, adding estimates of domestic consumption and the estimates of the amount removed at the processing stage.

Orchard gate return estimates are calculated in the following way:

- MPI's Bay of Plenty Orchard model results (March year 2012)[50] estimate the gross returns to green and gold are $35,335 and $92,080 per hectare, respectively

[49] No root stock was exported in 2012. The average for the period 2000-2012 was $100,000 per annum. (HS code 0602900019 Plants, live, Kiwifruit stock, Statistics New Zealand http://www.stats.govt.nz /)

[50] www.**mpi**.govt.nz

- gross returns are multiplied by the number of hectares of green (9,500 hectares), gold (3,070 hectares) and other kiwifruit (187 hectares)[51] (Statistics New Zealand final production estimates, supplied by Mr Rod Forbes, MPI, personal communication, 15 May 2014).

From this NZIER has estimated the orchard gate value as being approximately $630 million.

D.24.3 Processing and Wholesaling margin

Processing consists of sorting, handling, (cool) storage, freight, wholesaling, and some further processing activities.

Kiwifruit processing value varies depending on the variety, although the vertical nature of the business means that it is difficult to estimate. The Processing and Wholesaling margin is estimated at $350 million (Zespri Annual Accounts) in 2012.

D.24.4 Domestic value

Domestic value is estimated by Statistics New Zealand from the Household Economic Survey for the June Year 2013. Statistics New Zealand estimate consumption of fresh kiwifruit at $22.9 million less 1.0 million (imports) equals $21.9 million.

D.24.5 Kiwifruit exports

In 2012, kiwifruit was exported at a value of $1,045.7m (Fresh Facts 2013, p2, June year and Statistics New Zealand). However, we have used the March year figure set out in the Zespri Annual Accounts of $1,034.4 million for consistency with other parts of the chain.

A further 878.49 kg[52] of kiwifruit pollen was exported at approximately $2,900 per kg.[53] For the 2012 December year, kiwifruit pollen exports were approximately $2.5 million (1,034.4 m + 2.5m = 1,037.0).

D.24.6 Summary table

The approach used to estimate contribution to GDP assumes that greater profits are more likely to be taken out closer to the consumer. However, the kiwifruit industry is dominated by a grower export monopoly (apart from Australia) to ensure that growers participate in export profits to a greater extent than they otherwise would have.

However, the individual marketing chain estimates that are observed in standard accounting (reported in the Zespri Annual Accounts) do not reflect the contribution to GDP at each stage of the marketing chain set out here. This means that the grower returns are higher (in terms of contribution to the economy) than we have estimated here. The summary below therefore overestimates the returns at the export level and underestimates the returns at the grower level. Although the overall GDP contribution estimate for kiwifruit still represents a good proxy, to better approximate kiwifruit contributions at each stage would require a more in-depth study of this industry.

Table 88 sets out the GDP output share of kiwifruit to the New Zealand economy.

[51] Prices for other kiwifruit are not known. As a proxy, we used an average of green and gold returns ($63,708 per hectare).

[52] Ms Paula Loader, MPI, 2014, pers comm, 24 July 2014. Data from MPI Exports Group June 2014.

[53] Mr Steven Saunders, Pollen Plus, 2014, pers comm, 14 August 2014.

Table 88 Kiwifruit summary

2012, March year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($5 million)	100%	0.37	$1.9 million
Farmgate ($630.3 million)	100%	0.37	$233.2 million
Processing and Wholesale margin ($350.1 million)	100%	0.29	$101.5 million
Domestic ($21.9 million)	100%	0.18	$4.0 million
Export (1,037.0 million)[1]	100%	0.45	$466.6 million
Total GDP output share			**$807.2 million[2]**
Note (1) Includes pollen exports. (2) Numbers rounded.			

Source: Fresh Facts various years, Statistics New Zealand, Fruition and Zespri Annual Reports

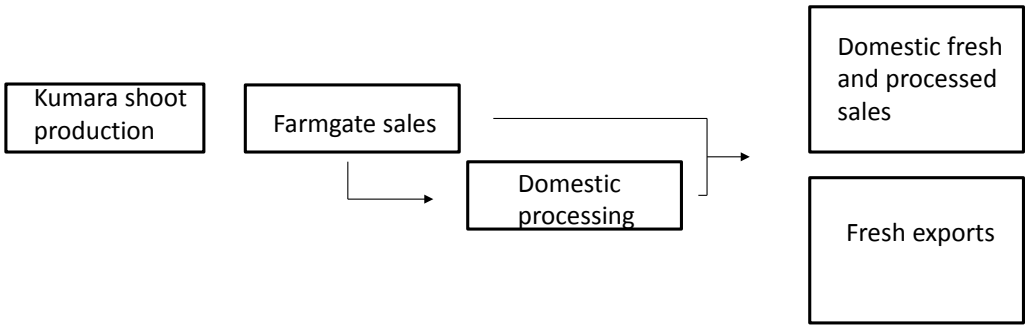
D.25 Kumara (*Ipomoea batatas*)

Approximately 90% of kumara (*Ipomoea batatas*) is grown and processed on the alluvial plains of the Northern Wairoa River, Northland. Kumara is a tropical plant requiring a frost free hot dry summer for best results. Kumara is harvested in February, March and April and stored for supply throughout the year.

Good information is available from the industry on 2012 production and sales.

The value chain is set out in the following diagram.

Figure 29 Kumara value chain



Source: NZIER

D.25.1 Kumara shoots Gross Output value

Kumara shoots sold to growers was approximately $0.7 million in 2012 (personal communication, Anthony Blundell, Kaipara Kumara, 3 March 2015).

D.25.2 Farmgate Gross Output value

Growers' returns at the farmgate were approximately $9.0 million (personal communication, Anthony Blundell, Kaipara Kumara, 3 March 2015).

D.25.3 Processing and Wholesaling margin

The Processing and Wholesaling margin consists of packing, sorting handling, wholesaling, and freight. A small amount further processing also occurs (mainly for kumara chips).

Processing and Wholesaling is estimated at 15% of the farmgate Gross Output value ($9.0m x 0.15 = $1.4m).

Further processing returns are estimated at $1.0 million (personal communication, Anthony Blundell, Kaipara Kumara, 3 March 2015). This has been added to the estimated farmgate Gross Output value to reflect processing Gross Output value.

The total estimated Gross Output value is $2.4 million.

D.25.4 Domestic Gross Output value

Domestic Gross Output value is approximately $28 million for the 2012 period (personal communication, Anthony Blundell, Kaipara Kumara, 3 March 2015).

D.25.5 Export Gross Output value

Export Gross Output value for 2012 was estimated at $5.1 million (Market Access Solutionz 2014a, p83).

D.25.6 Summary

Table 89 sets out the GDP output share of kumara to the New Zealand economy.

Table 89 Kumara summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.7 million)	100%	0.37	$0.2 million
Farmgate ($9.0 million)	100%	0.37	$3.3 million
Processing and Wholesaling margin ($2.4 million)	100%	0.29	$0.7 million
Domestic ($28.0 million)	100%	0.18	$5.0 million
Export ($5.1 million)	100%	0.45	$2.3 million
Total GDP output share			**$11.6 million[1]**
Note (1) Numbers rounded.			

Source: Anthony Blundell, Kaipara Kumara, Fresh Facts, and Horticulture New Zealand 2014

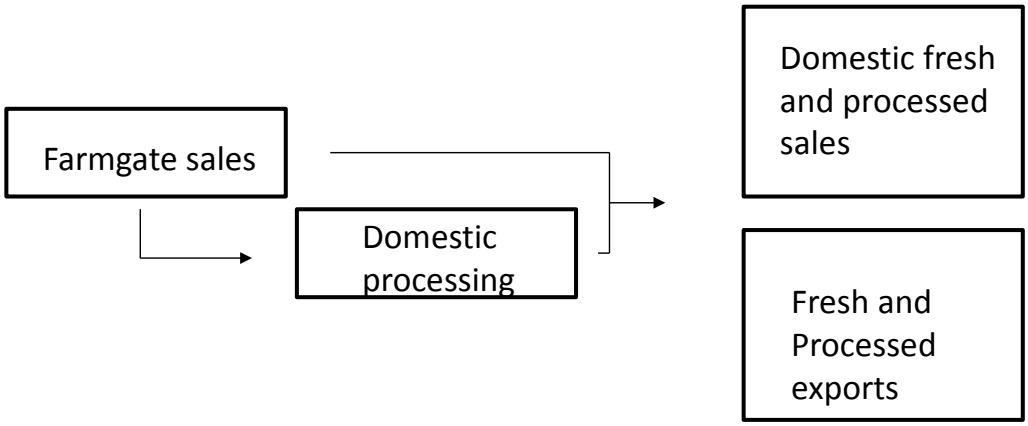
D.26 Lettuce (*Lactuca sativa*)

Lettuce (*Lactuca sativa*) has always been popular as a salad green in New Zealand. The range of varieties has risen dramatically over the past twenty years.

Information is available on domestic and export Gross Output value. Assumptions are made on the processing and farmgate Gross Output values. Seeds are mainly imported.

The value chain for lettuce is set out below.

Figure 30 The lettuce value chain



Source: NZIER

D.26.1 Seed Gross Output value

Very small amounts are grown in New Zealand; however, the vast bulk of lettuce seeds are grown in warm climates such as Australia.

D.26.2 Farmgate Gross Output value

Farmgate value estimates are approximately half of domestic and export Gross Output value (general rule of thumb for vegetable/horticulture industries). Below we set out the estimated farmgate Gross Output value estimates.

Table 90 Lettuce Gross Output value at farmgate

	Domestic + export Gross Output value	Adjustment factor	Farmgate Gross Output value estimate
Lettuce farmgate value	$43.4 million[1]	0.5[2]	$21.7 million
Notes (1) Fresh Facts (2012, p16). (2) Adjustment factor suggested by John Seymour, Horticulture New Zealand.			

Source: NZIER and Horticulture New Zealand

D.26.3 Processing and Wholesaling margin

Processing of lettuce consists of sorting, storage, freight, wholesaling and packaging lettuce and is approximately 15% of the farmgate Gross Output ($3.3 million, personal communication, John Seymour, Horticulture New Zealand, 12 December 2014).

D.26.4 Domestic Gross Output value

Domestic Gross Output value for 2012 was estimated at $41.8 million (Fresh Facts 2012, p16).

D.26.5 Export Gross Output value

Export Gross Output value for 2012 was estimated at $1.6 million (Fresh Facts 2012, p16).

D.26.6 Summary

Table 91 sets out the GDP output share of lettuce to the New Zealand economy.

Table 91 Lettuce summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery	100%	0.37	Mostly imported
Farmgate ($21.7 million)	100%	0.37	$8.0 million
Processing and Wholesaling margin ($3.3 million)	100%	0.29	$0.9 million
Domestic ($41.8 million)	100%	0.18	$7.5 million
Export ($1.6 million)	100%	0.45	$0.7 million
Total GDP output share			**$17.2 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts 2012 and Horticulture New Zealand

D.27 Lilies (*Lilium* species)

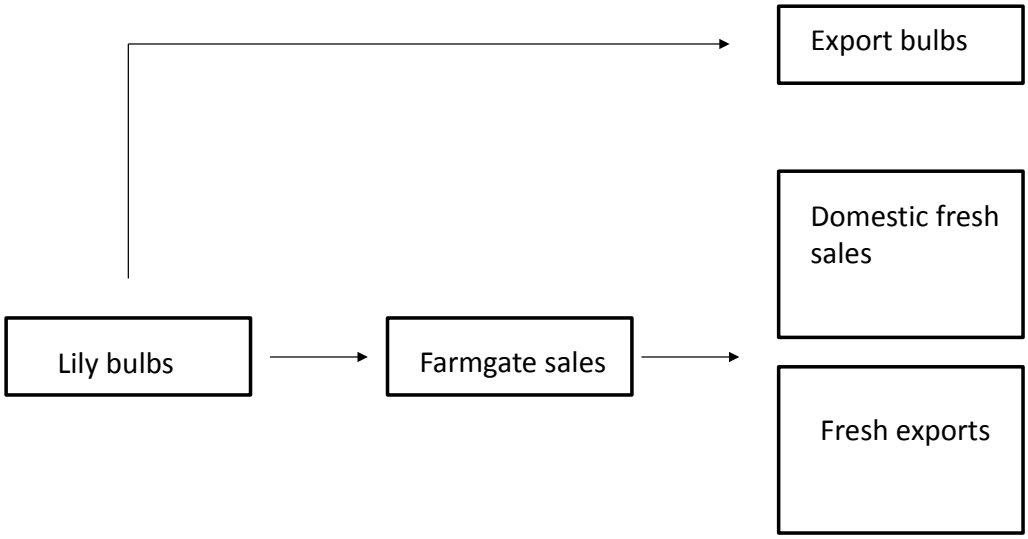
Lilies (*Lilium* species) are big business in New Zealand. The bulbs are exported by a number of companies to fulfil off-season demand in Japan, China, Taiwan and Europe. There is also strong demand in India, Vietnam, Australia, Columbia and Mexico.

Typically, companies lease land off local farmers (mainly in South Canterbury). Land owners plough and roll the paddock and provide irrigation, while contractors plant, fertilise, spray, debud and harvest the bulbs.

Information is difficult to come by on all of the flower businesses. Good information exists on export Gross Output value but we have to rely on industry approximations for other parts of the value chain.

The value chain is set out below.

Figure 31 Lily value chain



Source: NZIER

D.27.1 Bulb Gross Output value

In most cases separating the bulb production from growing bulbs is not possible since it is part of the same vertically integrated production process. Bulbs for the next season are produced at the same time scaled and multiplied up.

The approximate cost or 'best guess' of the value of this process is approximately $0.2 million (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014 and NZIER estimate).

D.27.2 Farmgate Gross Output value

Farmgate Gross Output value estimates are also hard to estimate. The best guess by the industry is approximately $17.7 million (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014). Further the sales channels are numerous with each channel having a different pricing strategy e.g. supermarkets, agents, buyers buying direct etc. This complicates estimating the farmgate returns.

D.27.3 Domestic Gross Output value

Domestic Gross Output value is estimated at $12.0 million. This is a highly approximate figure based on 60 million flowers sold at $0.20 per flower equalling $12.0 million. (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014).

D.27.4 Export Gross Output

Fresh Facts (2012, p20) estimates the exports of lilies as $23.4 million.

D.27.5 Summary

Table 92 sets out the GDP output share of lilies to the New Zealand economy.

Table 92 Lily summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.2 million)	100%	0.37	$0.07
Farmgate ($17.7 million)	100%	0.37	$6.6 million
Domestic ($12.0 million)	100%	0.18	$2.2 million
Exports ($23.4 million)	100%	0.45	$10.5 million
Total GDP output share			**$19.3 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts 2012 and FloraMax

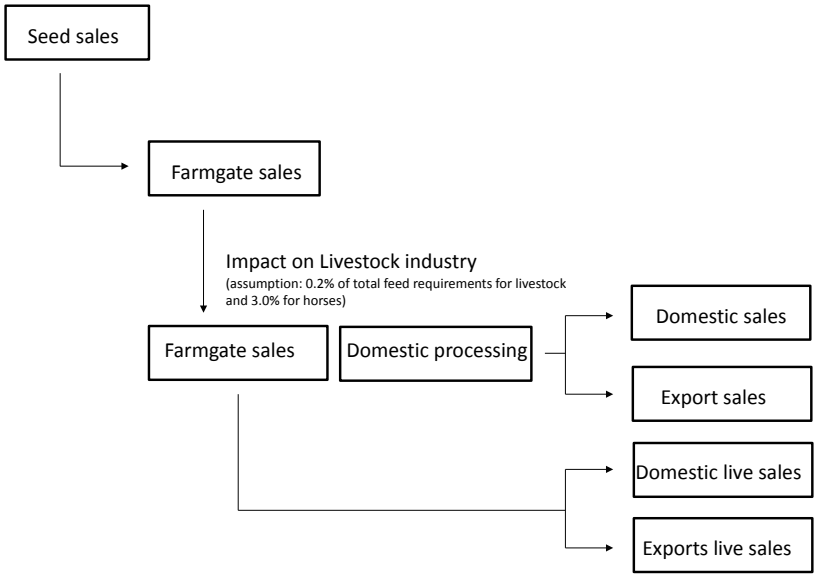
D.28 Lucerne (*Medicago sativa*)

Lucerne (*Medicago sativa*) is grown for livestock industries in New Zealand. With the growth of the dairy industry the demand has increased since it provides forage which allows farmers to extend milk production.

We have little information on the Lucerne production with most information coming from seed merchants and industry experts.

The value chain is set out below.

Figure 32 Lucerne value chain



Note that all livestock industries include live animals (including horses), wool, dairy, meat processing, velvet and other co-products sold.

Source: NZIER

D.28.1 Lucerne Gross Output value

Lucerne seed value is estimated at approximately $1.1 million (personal communication, Stephen Finch, Spec Seed, 5 March 2015).

D.28.2 Farmgate Gross Output value

The crop revenue estimate approximation was $11.9 million in 2012. Number of hectares (4,583) multiplied by the revenue per hectare ($2,600).[54]

D.28.3 Dependent industries

Lucerne is grown by farmers as a forage crop either for their own use or sold on the open market. DairyNZ suggest that lucerne is a minor but valuable addition to livestock feed requirements particularly in the South Island – approximately 0.2% of total livestock requirements (personal communication, Mr Matt Newman, DairyNZ, 18 May 2014).

More lucerne is used in the horse breeding industry, however relative to other forage (e.g. ryegrass and clover) the amount used is relatively small and restricted to the South Island. In the absence of verifiable information on horse intake we have assumed it to be approximately 3% (NZIER estimate).

Table 93 sets out the size of the dependent industries involved.

Table 93 Livestock industries that depend on lucerne

2012, June year, $M per annum

	Farmgate Gross Output value	Processing and Wholesaling margin	Domestic Gross Output estimate	Export Gross Output value
Dairy Gross Output values	$10,828.0 million	$6,552.0 million	$1,045.6 million	$12,573.7 million
Other livestock Gross Output values	$5,958.1 million	$3,033.0 million	$1.432.8 million	$6,882.1 million
Horse Gross Output values	$93.5 million	No processing estimate	$57.0 million	$130.0 million

Source: Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

[54] http://www.landcareresearch.co.nz/__data/assets/pdf_file/0005/77036/1_8_Millner.pdf

D.28.4 Summary

Table 94 sets out the GDP output share of lucerne to the New Zealand economy.

Table 94 Lucerne summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($1.1 million)	100%	0.37	$0.4 million
Farmgate ($11.9 million)	100%	0.37	$4.4 million
Dependent livestock industries (refer to the Table above for livestock industry sales figures for each step in value chain)			
Farmgate Dairy ($10,828.0 million)	0.2%	0.48	$10.6 million
Farmgate Other livestock ($5,958.0 million)	0.2%	0.49	$5.8 million
Farmgate horses value ($93.5 million)	3.0%	0.25	$0.7 million
Dairy: Processing and Wholesaling margin ($6,552.0 million)	0.2%	0.13	$1.7 million
Traditional livestock: Processing and Wholesaling margin ($3,033.0 million)	0.2%	0.15	$0.9 million
Domestic (processing and live) ($2,478.4 million)	0.2%	0.18	$0.9 million
Domestic horses ($57.0 million)	3.0%	0.12	$0.2 million
Export livestock ($19,455.8 million)	0.2%	0.48	$18.7 million
Export horses ($130 million)	3.0%	0.2	$0.8 million
Total GDP output share			**$45.1 million**[1]
Note (1) Numbers rounded.			

Source: BERL 2012, Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.29 Maize and corn (*Zea mays* varieties)

This analysis looks at both maize and corn (*Zea mays* varieties). In New Zealand, maize is used mainly for stock feed while corn is consumed domestically and exported. For maize we have followed Booker (2009, p10) and categorised maize into: maize grain, maize silage, and corn. Maize grain uses only the grain content of the plant while maize silage uses the whole crop: stem, leaf and cob (including the grain). Corn uses the cob only.

Corn has been a staple vegetable in New Zealand for many years. Corn production is centred on the east coast of the North and South Island. Information on the domestic values (seeds, farmgate value and processing) is scarce with much information tightly held.

The maize silage industry is primarily focused on providing food energy for the dairy industry. Extra feed allows for higher stocking rates and production per hectare. Maize silage is harvested in early autumn when yields are maximised and can be fed as dry matter or a greenfield crop. Many dairy farmers grow their own maize silage.

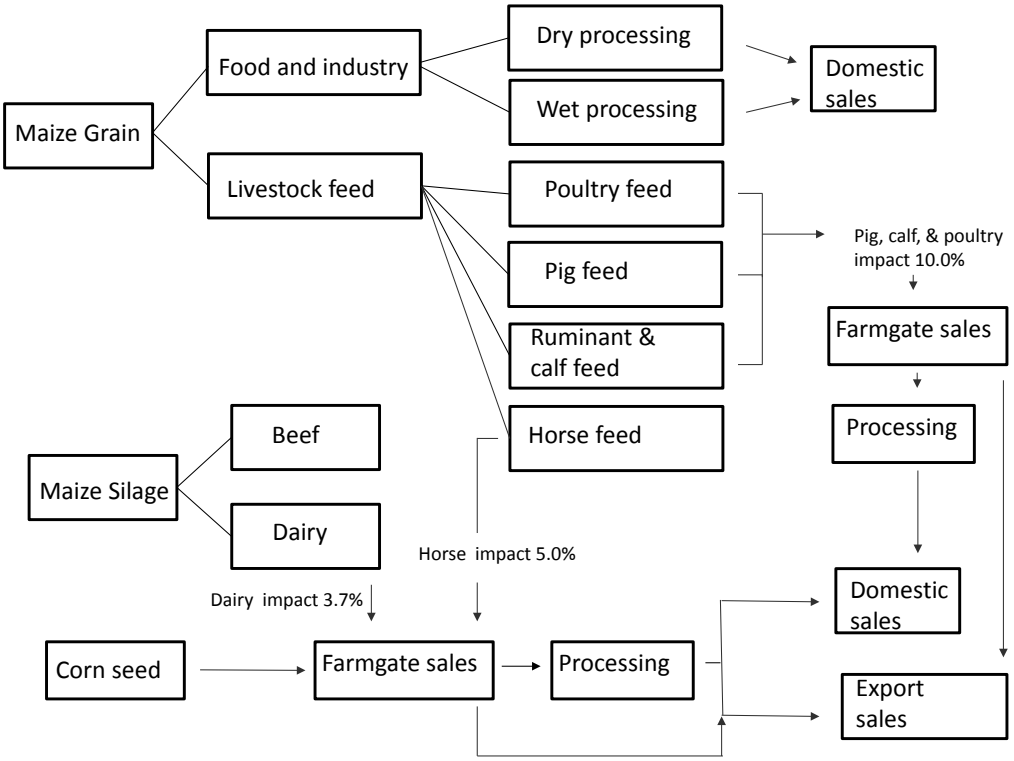
Maize grain is a major feed component for layer birds (eggs), poultry and pig industries. The information for these domestic industries is hard to find. Therefore, estimates for the size of these industries have been taken from various reports and industry associations. While we are unable to verify the exact size of these industries we are confident that the magnitudes are right given that industry associations monitor the industries closely.

Maize grain typically undergoes wet or dry processing. Dry processed maize grain is used in the livestock, poultry, pig and ruminant feed sectors. Also a small amount goes into human consumption and is used as a basis for products such as flaking grits, fine grits, semolina, polenta and maize flour.

Wet processed maize grain is used in products such as starch. Other uses include stock feed, particularly in the dairy industry.

Figure 33 sets out the structure of the maize industry.

Figure 33 Structure of the maize industry



Source: Booker 2009, p10, Fresh Facts 2012 and Lefroy Valley Nurseries

D.29.1 Maize silage

Maize silage is an input into the livestock industry: mainly dairy (95%) and some beef (5%).[55]

Maize silage growth has occurred off the back of the expansion in the dairy industry. It provides supplementary feed so that farmers can maximise milk production at certain times of the year. According to Booker (2009, p35) maize silage is either grown by dairy farmers themselves or bought from other farmers. There are a number of benefits from purchasing or growing maize:

- it can extend lactation through autumn feeding improving profitability
- it can be stored easily reducing the risk of unfavourable weather i.e. a risk management tool to keep stock in good condition
- by growing maize in dairy effluent paddocks it can decrease the nutrient build-up on farms.[56]

D.29.2 Seed Gross Output

Little information is available on seed production. We have used the Arable Food Industry Council's estimates to approximate the seed Gross Output value ($44.8 million, (personal communication, Ivan Lawrie, 3rd February 2016). This is for both silage and grain maize.

[55] We have not included beef in this analysis since it is very difficult to approximate its value and impact to the whole beef sector.

[56] For more explanation, see for example http://www.farmlands.co.nz

D.29.3 Farmgate Gross Output

Table 95 sets out the estimated farmgate Gross Output value of maize silage. The dairy industry uses approximately 922,000 tonnes of maize silage (AIMI 2012). It provides approximately 3.7% (in 2012) of the fodder requirements for the dairy industry (personal communication, Mr Matt Newman, DairyNZ, 18 May 2014). Therefore, the impact of maize on the dairy industry is deemed 3.7%.

For the horse industry, the impact has been estimated at 5% (NZIER estimate based on a qualitative description of horse intake needs in Gee (2012).

At $300 per tonne (Lincoln Financial Budget Manual 2012/2013, pA58; Booker 2009, p68) the approximate size of the industry is $277 million.

Table 95 Gross Output maize silage

2012, June year, $ M

Production	Farmgate prices	Estimated Gross Output value
922,000 tonnes	$300 per tonne	$277m

Source: Lincoln Financial Budget Manual, FAR and Statistics New Zealand

The value chain impacts for the dairy and horse industries are set out in the Table below using Beef + Lamb New Zealand's estimates (personal communication, Mr Rob Davison, 5 June 2014) of farmgate value, processing, domestic and export Gross Output value.

Table 96 Estimated dairy and horse Gross Output value at each stage of the marketing chain

2012, June year, $ M

	Farmgate Gross Output value	Processing and Wholesaling margin estimate	Domestic Gross Output value estimate	Export Gross Output value
Dairy values[1]	$10,828.0 m	$6,552.0 m	$1,045.6 m	$12,573.7 m
Horse values	$93.5 m	No processing estimate	$57.0 m	$130.0 m
Note (1) Dairy values set out in Appendix B.				

Source: Beef + Lamb New Zealand estimates and Statistics New Zealand, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

Table 97 sets out the summary of value for maize silage. In each case the Gross Output value at each stage of value chain is multiplied by the impact on other industries and the GDP output share to obtain a value for maize silage to the economy.

Table 97 Maize silage summary

2012, June year, $ M

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Maize silage production			
Domestic seed value[1] ($44.8 million)	100%	0.37	$16.6 million
Farmgate value ($277 million)	100%	0.37	$102.4 million
Maize silage production as an input into the dairy industry[2]			
Farmgate Dairy estimate ($10,828.0 million)	3.7%	0.49	$196.3 million
Dairy Processing and Wholesaling estimate ($6,552.0 million)	3.7%	0.13	$31.5 million
Dairy domestic estimate ($1,045.6 million)	3.7%	0.18	$7.0 million
Dairy export estimate ($12,573.7 million)	3.7%	0.48	$223.3m
GDP output share (total)			**$577.1**[3]
Notes (1) Values for both maize silage and maize grain. (2) Values set out in Appendix B. (3) Numbers rounded.			

Source: Booker 2009, Beef + Lamb New Zealand, DairyNZ, and Statistics New Zealand, Arable Food Industry Council

D.29.4 Maize Grain

Maize production services a domestic industry that produces animal feed and consumer products.

Seed Gross Output

Information on the seed stage of the value chain has been provided by the Arable Food Industry Council. The estimates are included in the maize silage Gross Output values.

Farmgate Gross Output value

According to FAR,[57] 226,840 tonnes (@ $400 per tonne)[58] was produced in the 2012 June year (see Table 98).

[57] http://www.far.org.nz/mm_uploads/AIMI_Maize_May_1_2012.pdf

[58] Lincoln Financial Budget Manual 2012/2013, pA58.

Table 98 Gross Output for maize grain

2012, June year, $ M

Production	Farmgate prices	Estimated Gross Output value
226, 840 tonnes	$400 per tonne	$90.7m

Source: Lincoln Financial Budget Manual 2012/2013 and Statistics New Zealand

Wet and dry processes

Table 99 sets out what is known about the wet and dry processes used to process maize. A full description of these processes is set out in Booker (2009, p22-34).

Dry processes are focused on feed production for the egg, poultry and ruminant markets. There is also some human consumption of maize in food products. Wet processes remove the starch, fibre and gluten for various food types of human food products.

Table 99 Gross Output values for wet and dry processes

2012, June year, $ M

	Maize consumed estimates (tonnes)[1]	Estimated impact[1]	Farmgate Gross Output value
Dry process			
Layer-hen feed[2]	30,000/35,000	10%	$165 million[3]
Poultry feed	15,000/20,000	10%	$1,000 million[3]
Pig feed	12,000	10%	$185 million[4]
Ruminant feed (bobby calves)	80,000/ 85,000[6]	10%	$120.6 million[5]
Human consumption	20,000		Unknown
Horse feed	5,000/ 10,000	5%	$93.5 million
Wet process			
Human consumption & industrial uses	50,000	Unknown	Unknown
Notes (1) All estimated tonnes and estimated impacts are based on Booker (2009, p22-34) and adjusted for 2012. (2) Layer hens are focused on egg production. (3) pers comm, Mr Steven Kerr, Poultry Industry Association of New Zealand, 24 July 2014. (4) pers comm, Mr Ian Braugh, NZ Pork, 12 August 2014. (5) Double bobby calf export returns ($90m) per annum, Compendium of Farm Facts, 2013 Beef + Lamb New Zealand (6) pers comm, Mr Matt Newman, DairyNZ, 4 August 2014.			

Source: Lincoln Financial Budget Manual 2012/2013, Statistics New Zealand, Communications with New Zealand Pork and the Poultry Industry Association of New Zealand, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

Farmgate Gross Output value

Farmgate value for the pork and poultry industries are estimates taken from industry publications and communications with New Zealand Pork, the Poultry Industry Association of New Zealand and Beef + Lamb New Zealand.

Table 100 Farmgate Gross Output value calculations

2012, June year, $ M

	Estimated farmgate Gross Output value ($m)	Impact of maize[1]	value ($m)
Layer-hen feed[2]	$165.0 million	0.1	$16.5 million
Poultry feed[2]	$1,000.0 million	0.1	$100.0 million
Pig feed[3]	$185.0 million	0.1	$18.5 million
Total pigs and poultry livestock			**$135.0 million**
Ruminant (calf) feed[4]	$120.6 million	0.1	$12.1 million
Horse feed	$93.5 million	0.05	$4.7 million
Notes: (1) Booker 2009, p22-34. (2) pers comm, Mr Steven Kerr, Poultry Industry Association of New Zealand, 24 July 2014. (3) pers comm, Mr Ian Braugh, New Zealand Pork, 12 August 2014. (4) Double bobby calf export returns per annum less a margin of 33%: $180m x33%. It is double the export value because both male and female calves are reared (but only bobby calves are slaughtered). Compendium of Farm Facts, 2013 Beef + Lamb New Zealand and pers comm with Mr Rob Davison, 30 June 2014.			

Source: Beef + Lamb New Zealand, Poultry Industry Association of New Zealand, Booker 2009, New Zealand Pork, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

Processing and Wholesaling Margin

Processing and Wholesaling margins are based on assumptions from other livestock such as beef and lamb (approximately 15% of the farmgate value, personal communication, Mr Rob Davison, Beef + Lamb New Zealand, 30 July 2014) and are set out in the following table. The Processing and Wholesaling margin is an estimate for the value of the processing stage of the value chain. The only exception is pork, where we have been able to obtain accurate processing cost data (an additional 11.7% on top of the farmgate value) from New Zealand Pork (personal communication, Mr Ian Braugh, 12 August 2014).

Table 101 Processing Gross Output value and share value

2012, June year, $ M

	Estimated processing value of each industry[2]	Impact of maize[1]	Share value
Layer-hen feed	$165.0 x 0.15 = $24.8 m	0.10	$2.5 million
Poultry feed	$1,000m x 0.15 = $150 m	0.10	$15.0 million
Pig feed[3]	$185 m x 0.117 = $21.7m	0.10	$2.2 million
Ruminant (bobby calf) processing[2]	$90.6m x 0.15 = $13.6 m	0.10	$1.4 million
Estimated total value	**$210.0 million**		**$21.0 million**[4]
Notes: (1) Booker (2009, p22-34) estimates. (2) Estimates are based on discussions with Mr Rob Davison Beef + Lamb New Zealand, 30 July 2014. $90.6m represents processed exports of bobby calves. (3) Processing costs for pigs is estimated by New Zealand Pork at 11.7% (pers comm, Mr Ian Braugh, 12 August 2014). (4) Numbers rounded.			

Source: Beef + Lamb New Zealand, Poultry Industry Association of New Zealand, New Zealand Pork and Booker 2009

Domestic Gross Output value

The domestic retail margin is estimated at approximately 28% of farmgate value (New Zealand Retail Association 2013, p16). Therefore, the total domestic Gross Output value is farmgate value multiplied by impact of maize, plus an additional 28%. The calculations in are set out in the Table below.

Table 102 Domestic and export Gross Output value and share value

2012, June year, $ M

	Estimated value of retail sales[1]	Impact of maize	Share value
Hen-layer feed	$165 million x 1.28 = $211.2 million	0.1	$20.1 million
Poultry growers	$1,000 million x 1.28 = $1,280 million	0.1	$128.0 million
Pigs	$185.0 million x 1.28 = $236.8 million	0.1	$23.7 million
Domestic Gross Output value livestock total	**$1,728.0 million**		**$172.8 million**
Domestic horses	$57.0 million	0.05	$2.9 million
Bobby calf [2]	$90.6 million	0.1	$9.1 million
Horse exports[3]	$130.0 million	0.05	$6.5 million
Note (1) New Zealand Retailers Association (2013, p16) suggests that retail margins are around 28%. (2) Bobby calf sales are international so don't attract a domestic retail mark-up. (3) IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101.			

Source: Beef + Lamb New Zealand, Poultry Industry Association of New Zealand, New Zealand Pork and Booker 2009

Maize grain summary

Table 103 sets out known values for maize production and value generated from industries that use maize grain as an input.

Table 103 Maize grain summary

2012, $ M

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Maize production			
Domestic seed			See maize silage
Farmgate ($90.7 m)	100%	0.37	$33.6 million
Maize dry production as an input into various industries			
Farmgate (pig and poultry) (($1,350.0 million)	10%	0.25	$33.8 million
Farmgate (calves) ($120.6 million)	10%	0.49	$5.9 million
Farmgate (horses) ($93.5 million)	5%	0.25	$1.2 million
Processing and Wholesaling margin: pigs, poultry) ($196.4 million)[1]	10%	0.15	$3.0 million
Processing and Wholesaling margin (bobby calves) ($13.6m)	10%	0.25	$0.2 million
Domestic pig and poultry ($1,728.0 m)[2]	10%	0.12	$20.7 million
Domestic horses ($57.0 million)	5%	0.12	$0.3 million
International (calves) ($90.6 million)	10%	0.48	$4.4 million
International horses ($130 million)	5%	0.2	$1.3 million
Maize wet production as an input into various industries[3]			
Dry processes	Tonnes		
Human consumption	20,000	Unknown, small inputs into various industries. Value will be less than $3m[2]	
Wet processes			
Human & industrial consumption	50,000	Unknown, small inputs into various industries. Value will be less than $7m[2]	
Total including wet and dry processing impact estimates			**$114.3 million[4]**
Notes (1) The $508.3 is the sum of the poultry layer, poultry and pig industries. (2) The $169.4m is the sum of the poultry layer, poultry and pig industries. (3) The markets for these products are many and varied. A quick calculation illustrates the likely magnitude of the value: 70,000 tonnes (consumed in these markets) divided by total farmgate crop 226,000 tonnes = 31%. 31% of the farmgate figure of $84.5m = $26.1m. Processing is unlikely to cost more than 33% of the farmgate value $26.1m x 0.33 = $8.6m. The output share is likely to be $8.6m x 25% (the processing GDP output share estimated from the Input-output tables) = $2m. A similar calculation could also be made for domestic Gross Output value. This will produce a higher number but be unlikely to be more than $8m. (4) Numbers rounded.			

Source: Booker 2009, Beef + Lamb New Zealand, DairyNZ, Poultry Industry Association of New Zealand, New Zealand Pork, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.29.5 Corn

We had difficulty in obtaining data on the domestic value chain associated with corn. Therefore, we have relied on industry experts and a rule of thumb approach suggested by Horticulture New Zealand. These give approximate values.

Seed Gross Output value

Most seeds are imported. A very small amount of seed is grown in New Zealand (approximately 5%). Approximately $0.01 million worth of corn seed is grown locally (personal communication, Warren Hobson, Lefroy Valley, 13 March 2015).

Farmgate Gross Output value

The estimated farmgate Gross Output value is based on tonnes produced (82,000 tonnes, Fresh Facts 2012 p16) multiplied by a per tonne price ($225 for 2009, Lincoln Financial Budget Manual 2012/13, pA77) equalling $18.5 million.

Processing and Wholesaling margin

Processing and Wholesaling margin values are tightly held by companies. Also they find it difficult to separate out corn processing from the processing of other crops since many of the processing facilities are processing multiple crops. We have estimated the Processing and Wholesaling margin at $4.6 million (Farmgate Gross Output ($18.5m x 0.25).

Processing consists of handling, storage, freight, wholesaling, and some further processing.

Table 104 Corn processing Gross Output value

	Farmgate Gross Output value	Adjustment factor	Processing Gross Output value estimate
Estimated corn processing value	$18.5 million	0.15	$4.6 million

Source: Fresh Facts and Horticulture New Zealand

Domestic Gross Output values

Fresh Facts (2012, p16) estimate domestic production at $20.0 million in 2012.

Export Gross Output values

Fresh Facts (2012, p16) estimates that export values were $42.0 million in 2012.

Summary of corn values

Table 105 sets out the GDP output share of corn to the New Zealand economy.

Table 105 Corn summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.01 million)	100%	0.37	$0.003 million
Farmgate ($18.5 million)	100%	0.37	$6.8 million
Processing and Wholesaling margin ($4.6 million)	100%	0.29	$1.3 million
Domestic ($20.0 million)	100%	0.18	$3.6 million
Export ($42.0 million)	100%	0.45	$18.9 million
Total GDP output share			**$30.7 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012, Lincoln Financial Budget Manual 2012/13, Horticulture New Zealand and Lefroy Valley nurseries

D.29.6 Summary of maize silage and maize grain

Table 106 sets out the GDP output share for the maize silage and maize grain industries. As the project progresses we will also add corn to the estimated value.

Table 106 Summary of corn, maize silage and maize grain

Industries	Estimated value
Corn	$30.7 million
Maize silage	$577.1 million
Maize grain	$114.3 million
Total	**$722.0 million[1]**
Note (1) Numbers rounded.	

Source: NZIER

D.30 Nuts (diverse species)

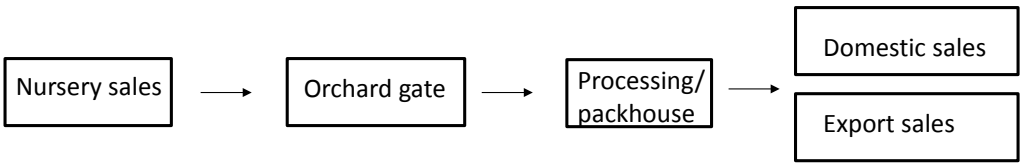
The New Zealand nut industry comprises chestnuts (*Castanea* spp.; Fagaceae family), cashews (*Anacardium occidentale*; Anacardiaceae family), macadamias (*Macadamia* spp.; Protaceae family), walnuts (*Juglans* spp.; Juglandaceae family) and hazelnuts (*Corylus avellana;* Corylaceae family). The domestic nature of the industry means that we have only industry opinion on the size and value of the industry.

Most of the industry is based around hobby farmers in the Waikato and Bay of Plenty. New plantings have been established in Northland, Wairarapa, Horowhenua, and Canterbury.

Information on industry size is scarce with the only reliable information on export data. To estimate orchard gate values, we have taken the hectares planted and applied conservative yields and dollars per tonne to arrive at an approximation of orchard gate values. Other values are generated from these estimates.

The nut industry value chain is set out below.

Figure 34 Nut value chain



Source: NZIER

D.30.1 Trees/root stock Gross Output value

It can take up to 8 years before a tree goes into full production. The numbers of trees being sold to growers is relatively small under $0.1 million per annum.

D.30.2 Orchard gate Gross Output value

Fresh Facts (2012, p25) estimate that the planted area for nuts is 1,484 hectares in 2012. While yields vary between various nut varieties, volumes are expected to be approximately 2,400 tonnes. Multiplying the tonnes by a conservative $3,000 per tonne orchard gate returns are likely to be $7.2 million.

D.30.3 Processing and Wholesaling margin

Most nuts are sold to processors. If we assume that processing is 15% of orchard gate Gross Output values. Total value of processing is $1.1 million ($7.2 multiplied by 0.15).

D.30.4 Domestic Gross Output value

With orchard gate revenues expected to be close to $7.2 million, domestic Gross Output value is estimated to be twice the orchard gate Gross Output value less export Gross Output value equalling $7.3 million.[59]

D.30.5 Export Gross Output value

Fresh Facts (2012, p14-15) estimates nut exports at $1.3 million plus a further $5.8 million in processed exports.

D.30.6 Summary

Table 107 sets out the GDP output share of nuts to the New Zealand economy.

[59] Typically, we expect orchard gate sales to be a half of export plus domestic sales. Therefore, domestic sales are twice orchard gate values less export sales (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014).

Table 107 Nuts summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.1 million)	100%	0.37	$0.04 million
Orchard gate ($7.2 million)	100%	0.37	$2.7 million
Processing and Wholesaling margin ($1.1 million)	100%	0.29	$0.3 million
Domestic ($7.3 million)	100%	0.18	$1.3 million
Export ($7.1 million)	100%	0.45	$3.2 million
Total GDP output share			**$7.5 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012 and NZIER estimates

D.31 Oats (*Avena sativa*)

The market for oats (*Avena sativa*) divides into oats for human consumption and forage oats.

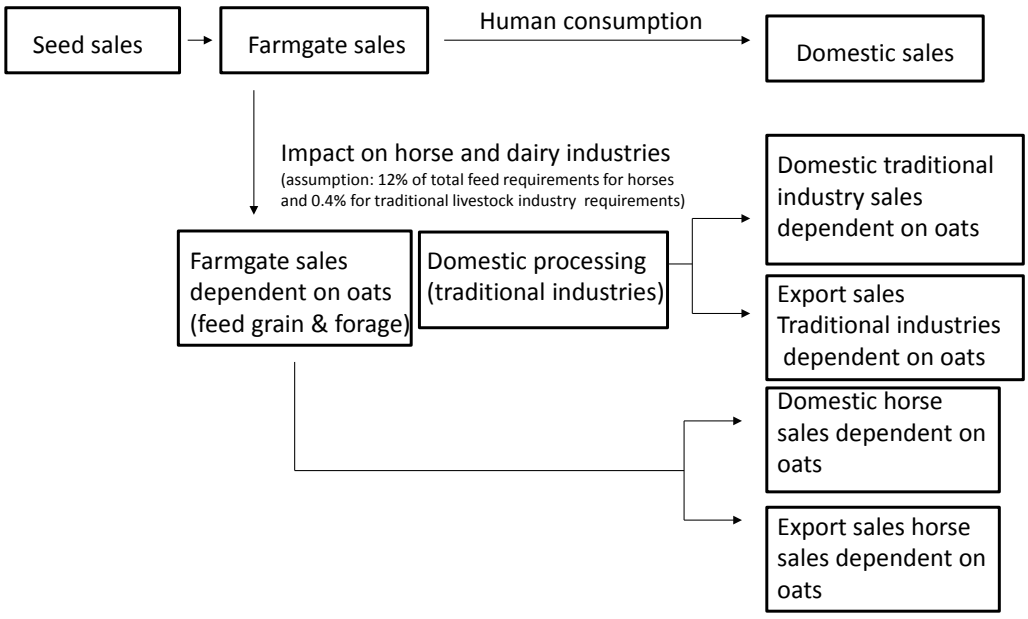
Milled oats are consumed as breakfast cereals and used as cooking ingredients.

Forage oats provide a large amount of feed for a single grazing during winter. They can be planted in February for early-winter grazing, through to April/May in mild climates for late-winter grazing.

Relatively good information is available on oat production and prices therefore good approximations are available on seed and farmgate returns. We have assumed that horse racing is the most important dependent industry.

The value chain is set out below.

Figure 35 Oats value chain



Source: NZIER

D.31.1 Oat seed Gross Output value

Oat seed production is estimated at $0.8 million in 2012. This is based on total production of 1,600 tonnes (Hampton et al 2012, p131) multiplied by $460 per tonne (Lincoln Financial Budget Manual 2012/2013, pA55) plus a premium for seed of $30 per tonne (NZIER estimate).

D.31.2 Farmgate Gross Output value

Farmgate Gross Output values are based on FAR estimates (AIMI 2013) of 15,834 (or $7.3 million) tonnes for milling oats and 2,466 (or $1.1 million) tonnes of feed grain oats in 2012 both at a price per tonne of $460 per tonne ($7.3 million + $1.1 million equals $8.4 million at the farmgate in 2012).

Forage oat farmgate value was approximately $22.0 million in 2012 (Arable Food Industry Council).

D.31.3 Dependent industries

a) Human consumption

Little is known about the value of oat processing for human consumption. There are a variety of channels and processes undertaken with the information on costs being closely guarded by the manufacturers. It is likely that the processing value is at least 25% of the domestic Gross Output value: $14.6 million multiplied by 0.25 equalling $3.6 million (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014).

Domestic sales are estimated at twice the farmgate Gross Output value for milling oats ($7.3 million multiplied by 2 equalling $14.6 million). Note this is the milling oats value from farmgate Gross Output value.

We have little information on the contribution of oats to other manufacturing processes. However, we believe that the contribution to other manufacturing processes is very small. We have assumed a 100% contribution.

b) Feed grain and forage oats

Feed grain oats value stems from their use in the horse and horse racing industries, although in recent years some (an indeterminate amount) has entered the dairy industry. Approximately 15% of the protein consumed in the horse racing industry is in the form of feed grain oats.[60] Oats contribution to the racing industry is calculated in the following way:

- the farmgate value of racing in New Zealand is valued at $93.5 million (IER Pty Ltd 2010, p9)
- domestic Gross Output value for race horses was $57 million in 2010 (IER Pty Ltd 2010, p9)
- the export Gross Output value was estimated at $167 million (IER Pty Ltd 2010, p9).

Forage oats are also used in the sheep and beef industry, although the amount is very small: approximately 0.4% (personal communication, Matthew Newman, DairyNZ, 24 February 2015). The Arable Food Industry Council estimates the value of forage oats produced in 2012 was $22 million.

The livestock industries dependent on oats are set out in Table 108.

Table 108 Gross Output values for livestock industries dependent on oats

2012, June year, $ M per annum

	Farmgate Gross Output value	Processing and Wholesaling value estimate	Domestic Gross Output value estimate	Export Gross Output value
Traditional industry values	$5,958.1 million	$3,033.0 million	$1,432.8 million	$6,882.1 million
Horse values	$93.5 million	No processing estimate	$57.0 million	$130.0 million
Note (1) See Appendix B for value estimates.				

Source: Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

[60] See the following article for a discussion on feeding race horses. http://www.thehorse.com/articles/10331/feeding-racehorses

D.31.4 Summary

Table 109 sets out the GDP output share of oats to the New Zealand economy.

Table 109 Oats summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.784 million)	100%	0.37	$0.3 million
Farmgate ($30.4 million)	100%	0.37	$11.3 million
Dependent industry (human consumption)			
Processing and Wholesaling margin ($3.6 million)	100%	0.13	$0.5 million
Domestic ($14.6 million)	100%	0.18	$ 2.6 million
Dependent industry (horse racing)			
Farmgate ($93.5 million)	12%	0.25	$2.8 million
Domestic ($57.0 million)	12%	0.12	$0.8 million
Exports (130.0 million)	12%	0.20	$3.1 million
Dependent industry (sheep and beef)[1]			
Farmgate ($5,958.1million)	0.4%	0.49	$11.7 million
Processing and Wholesaling margin ($3033.0 million)	0.4%	0.13	$1.6 million
Domestic ($1,432.8 million)	0.4%	0.18	$1.0 million
Export ($6,882.1million)	0.4%	0.48	$13.2 million
Total GDP output share			**$49.0 million[2]**
Note (1) See Appendix B for value estimates (2) Numbers rounded.			

Source: Arable Food Industry Council and NZIER estimates

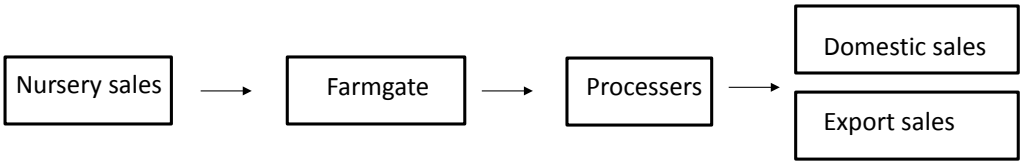
D.32 Olives (*Olea europaea*)

Olive (*Olea europaea*) production in New Zealand began in the 1990s with strong interest particularly in the Marlborough area. While other areas joined in prices received did not meet the expectations of growers and production declined in recent years.

There is little concrete data on domestic production but most olives are pressed into olive oil for the domestic market and a small amount for export.

The value chain is set out below.

Figure 36 Olive value chain



Source: NZIER

D.32.1 Nursery Gross Output value

Nursery production is estimated at $0.03 million in 2012: 3,000 trees multiplied by $10 per tree (personal communication, Kate Marshall, Waimea Nurseries, 13 March 2015).

D.32.2 Orchard gate Gross Output value

We have no estimates available on orchard gate Gross Output values. Therefore, to proxy a Gross Output value for orchard gate we follow Horticulture New Zealand's rule of thumb estimate of dividing domestic Gross Output value for domestic plus export by two.

Table 110 Olive orchard gate value

	Domestic plus export Gross Output value	Adjustment factor	Orchard gate Gross Output value estimate
Estimated olive orchard gate value	$2.8 million	0.5	$1.4 million

Source: Fresh Facts and Horticulture New Zealand

D.32.3 Processing and Wholesaling margin

The companies in the industry tightly hold processing value information. We have estimated that Processing and Wholesaling margin value at approximately 15% of the orchard gate Gross Output value.

Table 111 Estimated olive Processing and Wholesaling margin

	Domestic plus export Gross Output value	Adjustment factor	Processing and Wholesaling margin
Estimated olive processing and wholesaling value	$1.4 million	0.15	$0.2 million

Source: Fresh Facts and Horticulture New Zealand

D.32.4 Domestic Gross Output value

Domestic Gross Output value is estimated at $2.3 million (Fresh Facts 2012, p15).

D.32.5 Export Gross Output value

Export Gross Output value is estimated at $0.5 million (Fresh Facts 2012, p15).

D.32.6 Summary

Table 25 sets out the GDP output share of olives to the New Zealand economy.

Table 112 Olive summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.03 million)	100%	0.37	$0.01 million
Orchard gate ($1.4 million)	100%	0.37	$0.5 million
Processing and Wholesaling margin ($0.2 million)	100%	0.29	$0.06 million
Domestic ($2.3 million)	100%	0.18	$0.4 million
Export ($0.5 million)	100%	0.45	$0.2 million
Total GDP output share			**$1.2 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012 and NZIER estimates

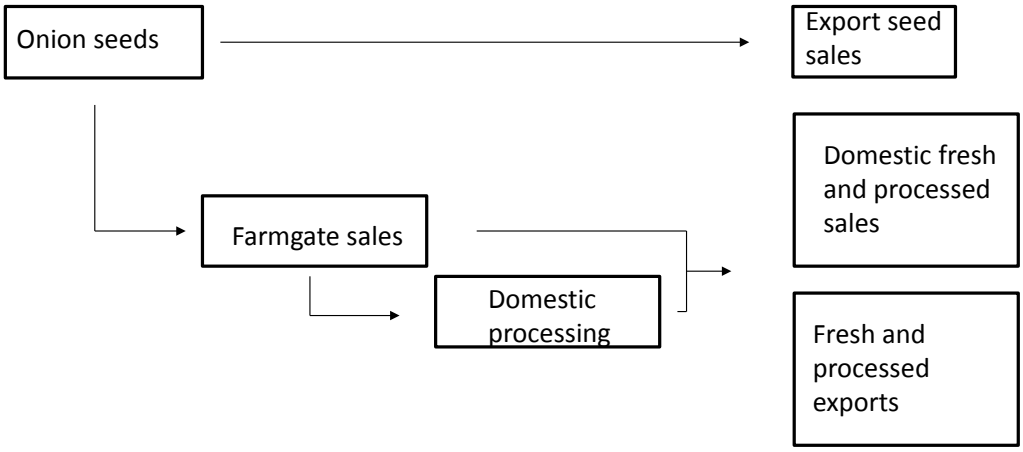
D.33 Onions (*Allium cepa*)

Onions (*Allium cepa*) are mainly grown in the South Auckland region, Hawke's Bay, Manawatu-Horwhenua, and Canterbury. Unlike most horticultural products onions store well; therefore, cheaper sea-freight options are available for the export crop. As a result, European markets are within easy reach of onion growers.

Good information is available on domestic, exports and seed Gross Output value. Also good information is available about the small processing and wholesaling part of the value chain. Farmgate Gross Output value has been approximated since we have no official figures.

Below we set out the value chain for onions.

Figure 37 Onion value chain



Source: NZIER

D.33.1 Seed Gross Output value

Total seed Gross Output value is reported by Hampton et al (2012, p131) to be $2.6 million.

D.33.2 Farmgate Gross Output value

Farmgate Gross Output value is estimated at $61.0 million (Matthew Spence, Onions New Zealand).

D.33.3 Processing and Wholesaling margin

The Processing and Wholesaling margin and further processing are relatively small. It consists of handling, packing, freight, wholesaling and some further processing.

Processing of fresh onions is estimated at an additional 15% (NZIER estimate) of the Gross Output value at the farmgate stage of the value chain ($61.0 m x 0.15 = $9.2m).

The further processing estimates are based on the area planted for processing: domestic plus export Gross Output value multiplied by 1.3% equals $1.1 million (data provided Matthew Spence, Onions New Zealand, 18 December 2015).

Total processing Gross Output value is estimated at $10.3 million.

D.33.4 Domestic Gross Output value

Domestic Gross Output value is estimated at $30.0 million (Matthew Spence, Onions New Zealand).

D.33.5 Export Gross Output value

Export is estimated at $62.2 million (Fresh Facts 2012, p16).

D.33.6 Summary

Table 113 sets out the GDP output share of onions to the New Zealand economy.

Table 113 Onions summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($2.6 million)	100%	0.37	$1.0 million
Farmgate ($61.0 million)	100%	0.37	$22.6 million
Processing and Wholesaling margin ($10.2 million)	100%	0.29	$3.0 million
Domestic ($30.0 million)	100%	0.18	$5.4 million
Export ($62.2 million)	100%	0.45	$28.0 million
Total GDP output share			**$60.0 million**[1]
Note (1) Numbers rounded.			

Source: Onions New Zealand, and NZIER estimates

D.34 Orchids (*Orchidaceae*)

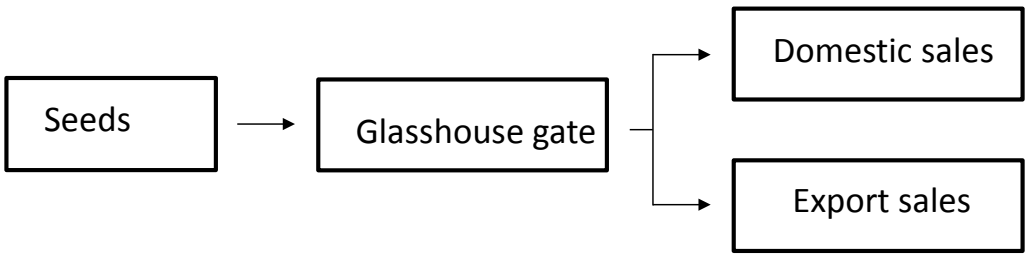
There are a range of different orchids grown commercially in New Zealand; they are species from the family *Orchidaceae*. Orchids are a highly capital intensive glasshouse business with most operations vertically integrated.

The domestic market while important is not the main target market. The aim is to take advantage of the European off-season sending cut flowers and bulbs into Asian and European markets.

Apart from the value of exports, we do not have very good information on other parts of the value chain and rely on industry experts to provide information on the magnitude of these markets.

The value chain is set out below.

Figure 38 Orchid value chain



Source: NZIER

D.34.1 Bulb Gross Output value

We have no official information on orchid bulb production. As with other flower production, businesses are vertically integrated. Bulbs for the next season are produced at the same time as this year's production and scaled and multiplied up.

The approximate cost or "best guess" of the value of this process is approximately $0.1 million (personal communication, Andre der Kwaak, GM FloraMax, 2014, 28 November 2014 and NZIER estimates).

D.34.2 Glasshouse gate Gross Output value

Glasshouse gate estimates are also hard to estimate. The best guess by the industry is approximately $10.8 million (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014). Further the sales channels are numerous with each channel having a different pricing strategy e.g. supermarkets, agents, buyers buying direct etc. This complicates estimating the glasshouse gate returns.

D.34.3 Domestic Gross Output value

Domestic Gross Output is estimated at $3.0 million. This is a highly approximate figure based on 60 million flowers sold at 0.05 cents per flower (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014).

D.34.4 Export Gross Output value

Fresh Facts (2012, p20) estimates the export Gross Output value of orchids as $18.5 million.

D.34.5 Summary

Table 114 sets out the GDP output share of orchids to the New Zealand economy.

Table 114 Orchids summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.1 million)	100%	0.37	$0.04
Glasshouse gate ($10.8 million)	100%	0.37	$4.0 million
Domestic ($3.0 million)	100%	0.18	$0.5 million
Export ($18.5 million)	100%	0.45	$8.3 million
Total GDP output share			**$12.9 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012, FloraMax

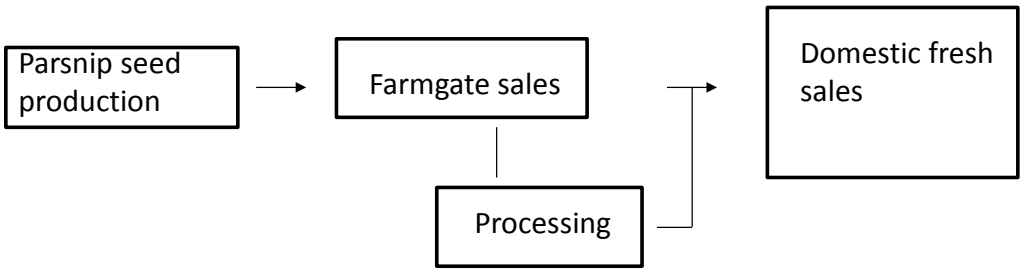
D.35 Parsnips (*Pastinaca sativa*)

Parsnips (*Pastinaca sativa*) are a small domestic industry mainly grown in Pukekohe and Ohakune.

The domestic nature of the business means that information is scarce with consumption data used to calculate the size of the domestic market and other parts of the value chain approximated from domestic market data.

Below we set out the value chain for parsnips.

Figure 39 Parsnip value chain



Source: NZIER

D.35.1 Seed Gross Output value

The parsnip seed industry is very small with most seed imported. However, there are some lines of parsnip grown in New Zealand but no more than 0.02 million (personal communication, Warren Hobson, Lefroy Valley, 4 March 2015).

D.35.2 Farmgate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries that farmgate Gross Output value is approximately a half of domestic Gross Output value. Domestic Gross Output value for parsnips were approximately $4.5 million (unpublished data supporting Fresh Facts 2012, p24 and personal communication, Alastair Aitken, Martech, 13th February 2015).

Table 115 Parsnips Gross Output value at farmgate

	Domestic Gross Output value	Adjustment factor	Farmgate Gross Output value estimate
Parsnips farmgate value	$4.5 million	0.5	$2.3 million

Source: NZIER, and Horticulture New Zealand

D.35.3 Processing and Wholesaling margin

Horticulture New Zealand advise that there was very little processing of parsnips in New Zealand. The Processing and Wholesaling margin consists of packing, storage, transport and wholesaling. We have estimated the Processing and Wholesaling margin at $0.1 million (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014).

D.35.4 Domestic Gross Output value

New Zealand consumers bought approximately $4.5 million worth of parsnips in 2012 (unpublished data supporting Fresh Facts 2012, p24 and personal communication, Alastair Aitken, Martech, 13 February 2015).

D.35.5 Summary

Table 116 sets out the GDP output share of parsnips to the New Zealand economy.

Table 116 Parsnips summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($0.02 million)	100%	0.37	$0.009 million
Farmgate ($2.3 million)	100%	0.37	$0.8 million
Processing and Wholesaling margin ($0.1 million)	100%	0.29	$0.03 million
Domestic ($4.5 million)	100%	0.45	$0.8 million
Total GDP output share			**$1.7 million[1]**
Note (1) numbers rounded.			

Source: Statistics New Zealand and Fresh Facts 2012

D.36 Passionfruit (*Passiflora edulis*)

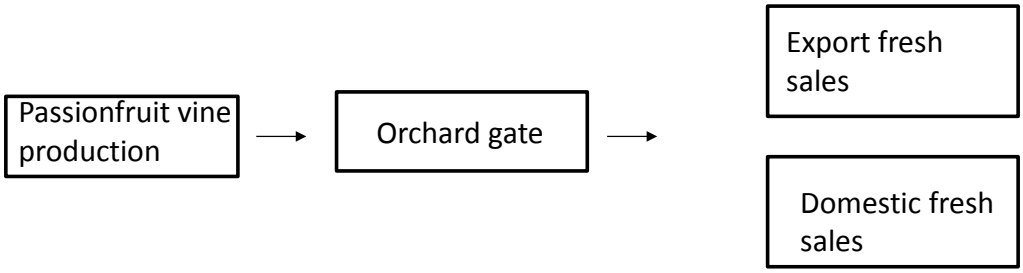
Passionfruit (*Passiflora edulis*) was first grown in Kerikeri in 1927. Only 17 hectares of passionfruit are grown in New Zealand with 65 growers, down from 66 hectares a few years ago. The main reason for this is crown rot which has devastated up to 80% of the crop each year.

Most product is sold into the domestic market, with 25% exported.

Being a small industry we have good data on domestic and export Gross Output value but other parts of the value chain have been estimated by industry experts.

The value chain is set out below.

Figure 40 Passionfruit value chain



Source: NZIER

D.36.1 Vine Gross Output value

It is difficult to estimate the number of vines sold to growers because of the impact of the crown rot disease. The New Zealand Passionfruit Growers Association advise that the number of vines sold to growers are unknown. Their preliminary estimate is that 8,000 vines have been lost due to the crown rot disease. If those vines were replaced (at a cost of $2.70 per vine), this would equate to a value of approximately $0.03 million.

D.36.2 Orchard gate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries that orchard gate prices are approximately half of domestic plus export Gross Output value. Domestic Gross Output value of passionfruit was approximately $1.3 million and export Gross Output value was estimated at $0.3 million (Fresh Facts 2012, p14).

Table 117 Passionfruit Gross Output value at orchard gate

	Domestic + export Gross Output value	Adjustment factor	Orchard gate Gross Output value estimate
Passionfruit orchard gate value	$1.6 million	0.5	$0.8 million

Source: NZIER and Horticulture New Zealand

D.36.3 Processing and Wholesaling margin

Horticulture New Zealand advise that there was very little processing of passionfruit (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014). We have assumed handling, wholesaling and packing is approximately $0.1 million ($0.8 orchard gate multiplied by 15%).

D.36.4 Domestic Gross Output value

New Zealand consumers bought approximately $1.3 million worth of passionfruit in 2012 (Fresh Facts 2012, p14).

D.36.5 Export Gross Output value

Export Gross Output value for passionfruit was $0.3 million in 2012.

D.36.6 Summary

The following table sets out the GDP output share of passionfruit to the New Zealand economy.

Table 118 Passionfruit summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($0.03 million)	100%	0.37	$0.01
Orchard gate ($0.8 million)	100%	0.37	$0.3 million
Processing and Wholesaling margin ($0.1 million)	100%	0.29	$0.04 million
Domestic ($1.3 million)	100%	0.18	$0.2 million
Export ($0.3 million)	100%	0.45	$0.1 million
Total GDP output share			**$0.7 million**[1]
Note (1) numbers rounded.			

Source: Statistics New Zealand and Fresh Facts 2012

D.37 Pears (*Pyrus* species)

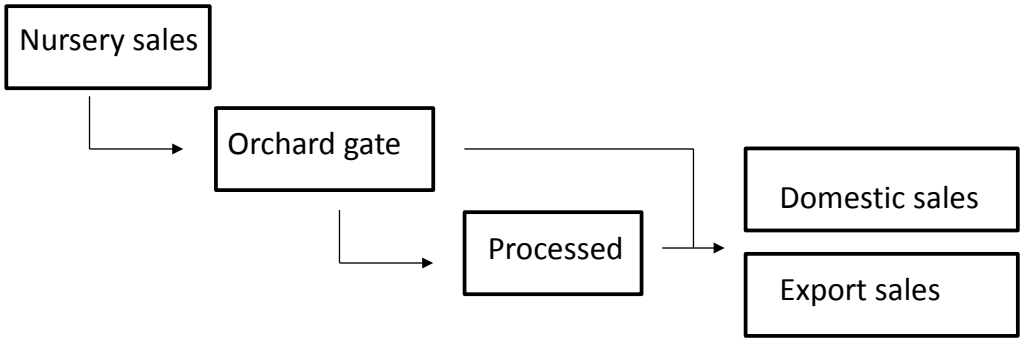
This analysis includes both the common pear (*Pyrus communis*) and Nashi pear (*Pyrus pyrifolia*). The first common pear tree was planted in New Zealand in 1819 by Samuel Marsden. Since that time pear production has been a small but constant.

The traditional areas for growing pears have been Hawke's Bay and Nelson.

Approximately 617 hectares are planted in pears plus 76 hectares of Nashi pears. In the mid-1980s, Nashi pears were introduced into New Zealand and there has been steady growth in volumes.

The value chain for pears is set out below.

Figure 41 Pear value chain



Source: NZIER

D.37.1 Trees/root stock Gross Output value

Pear trees supplied to growers are approximately $0.4 million (personal communication, Kate Marshall, Waimea Nurseries, 12 December 2014).

D.37.2 Orchard gate Gross Output value

Total production is estimated to be 12,000 tonnes. This has been calculated by taking the total export tonnage (2,983 tonnes), adding estimates of domestic consumption (6,271 tonnes) and estimates of the amount removed at the processing stage (2,500 tonnes).

Orchard gate return estimates are calculated at:

- $830 per tonne (June year 2012) for the export crop (MPI estimates derived from 2012 MPI Nelson Budget Model)[61]
- $670 per tonne for the domestic market (MPI estimates derived from 2012 MPI Nelson Budget Model)[62]
- $100 per tonne for the processing market (similar to Apples).

The following Table sets out the orchard gate returns.

Table 119 Orchard gate Gross Output value

2012, December year

	Tonnes	Price per tonne	Gross output value
Exports	2,983	$830	$2.5 million
Domestic	6,271	$670	$4.2 million
Processing	2,500	$100	$0.3 million
Total			**$6.9 million[1]**
Notes (1) numbers rounded			

Source: USDA FAS GAIN Report (2013) and MPI Nelson Budget Model, 2012

[61] Pipfruit Monitoring Report https://www.mpi.govt.nz/document-vault/4191

[62] Pipfruit Monitoring Report https://www.mpi.govt.nz/document-vault/4191

D.37.3 Processing and Wholesaling margin

The Processing and Wholesaling margin equals the Processing Gross Output value minus the Orchard Gate Gross Output.

Processing may occur on-orchard or in a processing facility nearby. Therefore, the distinction between orchard gate Gross Output value and processing Gross Output value can be artificial for a grower (since the packhouse can be on-orchard).

Processing consists of the raw material purchased from the orchard (estimated by the Gross Output value at the orchard gate), packaging, grading, sorting, handling, freight, wholesaling, and further processing (such as juicing).

Table 120 Processing and Wholesaling margin

2012, December year

	Tonnes	Price per tonne	Gross Output value
Packing, packaging and cool storage of export crop	2,983	$1,775	$5.3 million[1]
Packing, packaging and cool storage of domestic crop	6,271	$1,600	$10.0 million[1]
Processing into juice and other products	2,500	$350	$0.9 million[2]
Processing Gross Output (minus)			**$16.2 million**
Orchard gate Gross Output (equals)			**$6.9 million**
Processing and Wholesaling margin			**$9.3 million[3]**
Notes: (1) Annette Carey MPI (2) Fresh Facts (2012) p15 estimate of wholesale gross output value. (3) Numbers rounded.			

Source: MPI and NZIER

D.37.4 Domestic Gross Output value

SNZ estimate that $28.6 million worth of pears were consumed in New Zealand. Our estimate is based on $28.6 million minus $6.1 million (imports) equals $22.5 million.

D.37.5 Export Gross Output value

Pear export Gross Output value, including nashi pears (*Pyrus pyrifolia*)] and processed pears is valued at $5.5 million (Fresh Facts 2012, p14-15).

D.37.6 Summary

Below we set out the contribution of pears to the New Zealand economy.

Table 121 Pear summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.4 million)	100%	0.37	$0.2 million
Orchard gate ($6.9 million)	100%	0.37	$2.6 million
Processing and Wholesaling margin ($9.3 million)	100%	0.29	$2.7 million
Domestic ($22.5 million)	100%	0.18	$4.1 million
Exports ($5.5 million)	100%	0.45	$2.5 million
Total GDP output share			**$12.0 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012, USDA 2013 and MPI Pipfruit Monitoring Report 2012

D.38 Peas (*Pisum sativum*)

Pea (*Pisum sativum*) production in New Zealand began in the 19th century with European settlement.

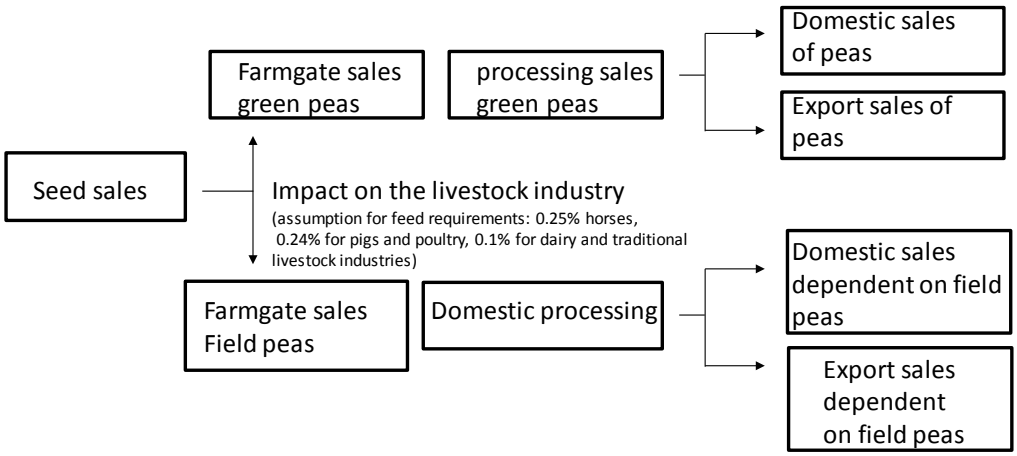
Garden peas are annual cool weather vegetable plants cultivated for their edible green seed or pods. They are harvested at an immature stage to be eaten fresh, canned, and frozen or for processing. Field peas are use as protein supplements in the pig, poultry, dairy and horse industries.

Peas play an important role in horticulture because they have a high protein content, fix nitrogen, control grassy weeds, and disrupt cereal disease life cycles.

Relatively good information exists on seed, farmgate, domestic and export Gross Output values. A Processing and Wholesaling margin value has been estimated.

Below we set out the pea value chain.

Figure 42 Pea value chain



Source: NZIER

D.38.1 Pea seed Gross Output value

Green pea seed Gross Output value is estimated at $23.9 million (BERL 2012, p14).

Field pea seed Gross Output value is unknown; however, an approximate estimate at 1% of farmgate Gross Output value is $0.12 million.

Total seed Gross Output value is approximately $24.0 million.

D.38.2 Farmgate Gross Output value

Farmgate Gross Output values are calculated in Table 122, based on Fresh Facts volume estimates and Lincoln Financial Budget Manual prices.

Table 122 Pea Gross Output value at farmgate

	Volumes	Prices[1]	Farmgate Gross Output value estimate
Green pea farmgate Gross Output value	63,000 tonnes[2]	$1,000 per tonne	$63.0 million
Field pea farmgate Gross Output value	20,148 tonnes[3]	$600	$12.1 million
Notes (1) Lincoln Financial Budget Manual 2012/2013, pA56 and pA75. (2) Fresh Facts 2012, p16. (3) AIMI 2013.			

Source: NZIER and Horticulture New Zealand

D.38.3 Processing and Wholesaling margin

Processing values are tightly held by processing companies.

To give an approximation we have used farmgate Gross Output value multiplied by 15% to estimate the Processing and Wholesaling margin (Statistics New Zealand and NZIER estimate).

Field pea seeds are also processed before being sold to farmers.

Processing consists of storing, handling, freight, wholesaling and further processing (freezing and cool storing).

Table 123 Estimated pea Processing and Wholesaling margin

	Farmgate value	Adjustment factor	Processing and Wholesaling margin
Estimated pea Processing and Wholesaling margin	$75.1 million	0.15	$11.3 million
Field pea Processing and Wholesaling margin	$0.12 million	0.15	$0.002 million

Source: Fresh Facts and Horticulture New Zealand

D.38.4 Domestic Gross Output value

Domestic Gross Output value is made up of domestic pea sales ($50.0 million, Fresh Facts 2012, p16) plus estimates of field pea sales ($24.2 million, twice the farmgate value of field peas).

D.38.5 Export Gross Output value

Export Gross Output value is estimated at $83.5 million (Fresh Facts 2012, p16).

D.38.6 Dependent industries

Field peas contribute to the poultry, horse, and pig industries, dairy and traditional livestock industries.

Pigs and poultry

For pigs and poultry, we have estimated that 2,400 tonnes out a total of 991,027 tonnes consumed by these industries or 0.24% of total protein (New Zealand Feed Manufacturers Association 2015).

Farmgate Gross Output value for the pork and poultry industries are estimates taken from industry publications and communications with the New Zealand Pork, and the Poultry Industry Association of New Zealand.

Table 124 Farmgate Gross Output value

2012, June year, $ M

	Est. farmgate Gross Output value ($m)	Impact of field peas[1]	Share ($m)
Layer-hen feed[2]	$148.0 million	0.24%	$0.4 million
Poultry feed[2]	$1,000.0 million	0.24%	$2.4 million
Pig feed[3]	$176.6 million	0.24%	$0.4 million
Total	**$1,324.6 million**		**$3.2 million**
Notes: (1) NZ Feed Manufacturers Association 2015. (2) pers comm, Mr Steven Kerr, Poultry Industry Association of New Zealand, 24 July 2014. (3) pers comm, Mr Ian Braugh, New Zealand Pork, 12 August 2014.			

Source: Poultry Industry Association of New Zealand, NZ Feed Manufacturers Association and New Zealand Pork

Processing and Wholesaling margin

The processing and wholesaling margins (15%) are based on assumptions from Statistics New Zealand and are set out in Table 125.

The Processing and Wholesaling margin is an estimate for the value of the processing stage of the value chain. The only exception is pork where we have been able to obtain accurate processing cost data (11.7%) from New Zealand Pork (personal communication, Mr Ian Braugh, 12 August 2014).

Table 125 Pea Processing and Wholesaling margin

2012, June year, $ M

	Estimated Gross Output processing value of each industry[2]	Impact of field peas[1]	Industry values
Layer-hen feed	$165.0m x 0.15 =$24.8m	0.24%	$0.06 million
Poultry feed	$1,000.0m x 0.15 = $150m	0.24%	$0.4 million
Pig feed[3]	$176.6m x 0.117 = $21.7m	0.24%	$0.05 million
Estimated total value	**$ 196.4 million**		**$0.5 million**
Notes: (1) NZ Feed Manufacturers Association (2015). (2) Estimates are based on discussions with Mr Rob Davison, Beef + Lamb New Zealand, 30 July 2014 and Statistics New Zealand's national accounts data. (3) Processing costs for pigs is estimated by New Zealand Pork at 11.7% (pers comm, Mr Ian Braugh, 12 August 2014).			

Source: Beef + Lamb New Zealand, Poultry Industry Association of New Zealand and New Zealand Pork

Domestic Gross Output value

The domestic retail margin is estimated at approximately 128% of farmgate value (New Zealand Retailers Association 2013). Therefore, the total domestic Gross Output value is the sum of each stage of the value chain (farmgate value multiplied by impact of peas), plus an additional 28%.

Table 126 Domestic Gross Output value

2012, June year, $ M

	Estimated value of retail sales[1]	Impact of field peas	Value
Hen-layer feed	$165 m x 1.28 = $211.2m	0.24%	$0.5 million
Poultry growers	$1,000m x 1.28 = $1,280m	0.24%	$3.1 million
Pigs	$176.6m x 1.28 = 236.8 m	0.24%	$0.6 million
Total	**$1,728.0 million**		**$4.2 million[2]**
Note (1) New Zealand Retailers Association (2013, p16) suggests that meat retail margins are around 28%. (2) Numbers rounded.			

Horses

Field peas are used as feed for horses to supplement their diet. They are a good source of protein. Small amounts are often combined with other feeds. We have assumed that field peas make up 0.25% of a horses' diet (based on Gee 2012).

Horses contribute at the farmgate, domestic, and live exports of horses. The contributions are set out in the Table below.

Table 127 Dependent industry contribution (horses)

	Value at each stage of the value chain	Dependence
Farmgate	$93.5 million	0.25%
Domestic	$57.0 million	0.25%
Export	$130 million	0.25%

Source: IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

Livestock

Field peas are used as feed for dairy and traditional livestock industries. As a good source of protein they are often combined with other feeds. We have assumed that field peas make up 0.1% of a dairy and traditional livestock diet.

The contributions are set out below.

Table 128 Livestock industries that depend on field peas

2012, June year, $ M per annum

	Farmgate Gross Output value	Processing and Wholesaling margin	Domestic Gross Output value estimate	Export Gross Output value
Dairy values	$10,828.0 million	$6,552.0 million	$1,045.6 million	$12,477.8 million
Livestock values	$5,958.1 million	$3,033.0 million	$1,432.8 million	$6,882.1 million
Note (1) See Appendix B for value estimates.				

Source: Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.38.7 Summary of pea consumption

Table 129 sets out known values for pea production and value generated from industries that use field peas as an input.

Table 129 Pea summary

2012, $ M

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Pea production			
Seed ($24.0 million)	100%	0.37	$8.9 million
Farmgate ($75.1 million)	100%	0.37	$27.8 million
Processing and Wholesaling margin ($11.3 million)	100%	0.29	$3.3 million
Domestic ($74.2 million)	100%	0.18	$13.4 million
Export ($83.5 million)	100%	0.45	$37.6 million
Field Pea production as an input into various dependent industries			
Farmgate (pig and poultry livestock, $1,324.6 million)	0.24%	0.25	$0.8 million
Processing and Wholesaling margin (pig and poultry livestock, $196.4 million)	0.24%	0.15	$0.07 million
Domestic (pig and poultry livestock, $1,728.0 million)	0.24%	0.12	$0.5 million
Farmgate (horses, $93.5 million)	0.25%	0.24	$0.06 million
Domestic (horses, $57 million)	0.25%	0.12	$0.02 million
Export (horses, $130.1 million)	0.25%	0.20	$0.07 million
Farmgate (Dairy $10,828.0 million)	0.1%	0.49	$5.3 million
Processing and Wholesaling margin (Dairy $6,552.0 million)	0.1%	0.13	$0.9 million
Domestic (Dairy $1,045.6 million)	0.1%	0.18	$0.02 million
Export (Dairy $12,573.7 million)	0.1%	0.48	$6.0 million
Traditional livestock industries			
Farmgate traditional industries dependent on peas ($5,958.1 million)	0.1%	0.49	$2.9 million
Processing and Wholesaling margin: traditional industries dependent on peas ($3,033.0 million)	0.1%	0.15	$0.5 million
Domestic: traditional industries dependent on peas ($1,432.8 million	0.1%	0.18	$0.03 million
Export: traditional industries dependent on peas ($6,882.1 million)	0.1%	0.48	$3.3 million
Total			**$111.7 million**[1]
Notes (1) Numbers rounded.			

Source: Beef + Lamb, DairyNZ, Poultry Industry Association of New Zealand and New Zealand Pork

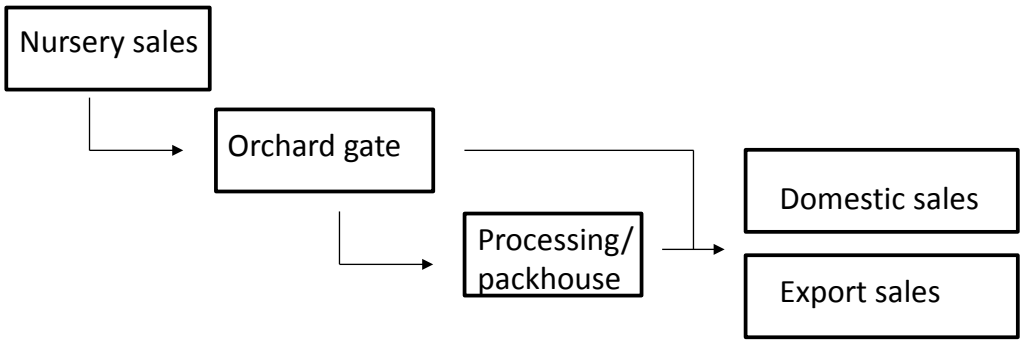
D.39 Persimmons (*Diospyros kaki*)

Persimmons (*Diospyros kaki*) were introduced into New Zealand as a commercial crop in the 1980s. The main growing regions are Northland, Auckland, Waikato and Gisborne.

Good information exists on domestic, export, farmgate and tree sales to orchards. There is little or no processing.

The value chain for persimmons is set out below.

Figure 43 Persimmon value chain



Source: NZIER

D.39.1 Trees/root stock Gross Output value

The number of persimmon trees sold to growers is approximately $0.8 million (personal communications, Kate Marshall, Waimea Nurseries, 16 May 2014 and Athol Campbell, Riversun Nurseries, 16 May 2014).

D.39.2 Orchard gate Gross Output value

The orchard gate estimates are $7.8 million (personal communication, Ian Turk, New Zealand Persimmon Industry Council, 16 May 2014) and the New Zealand Persimmon Industry Council.

D.39.3 Processing and Wholesaling margin

Processing consists of handling, packaging storage, wholesaling, and freight. The Processing and Wholesaling margin is estimated at $1.2 million ($7.8 orchard gate multiplied by 0.15).

D.39.4 Domestic Gross Output value

Domestic Gross Output value is estimated at $4.0 million (Fresh Facts 2012, p14).

D.39.5 Export Gross Output

Export Gross Output value in 2012 were $7.1 million (Fresh Facts 2012, p14).

D.39.6 Summary

Table 130 sets out persimmon's contribution to the economy.

Table 130 Persimmon summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.8 million)	100%	0.37	$0.3 million
Orchard gate ($7.8 million)	100%	0.37	$2.9 million
Processing and Wholesaling margin ($1.2 million)	100%	0.29	$0.3 million
Domestic ($4.0 million)	100%	0.18	$0.7 million
Export ($7.1 million)	100%	0.45	$3.2 million
Total GDP output share			**$7.4 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012, New Zealand Persimmon Industry Council

D.40 Potatoes (*Solanum tuberosum*)

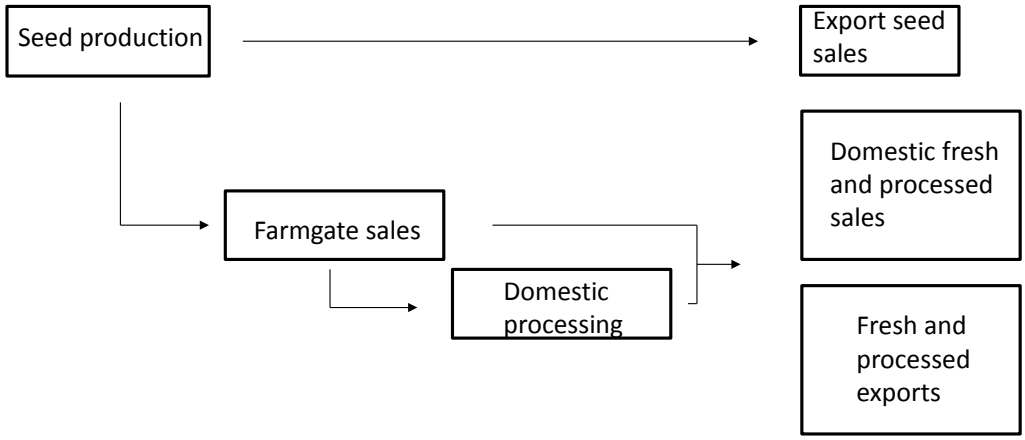
Potato (*Solanum tuberosum*) production has grown over the last ten years benefiting from increased export sales to Australia. However, most production is focused on the domestic market.

South Auckland and Canterbury are the main growing areas.

Good information is available on most aspects of the value chain, although processing data is tightly held by companies.

Below we set out the value chain for potatoes.

Figure 44 Potato value chain



Source: NZIER

D.40.1 Seed potatoes Gross Output value

The value of seed potatoes is approximately $11.4 million (based on tonnes grown or 8% of total value).[63]

D.40.2 Farmgate Gross Output value

Total farmgate Gross Output value is estimated at $142 million.[64]

D.40.3 Processing and Wholesaling margin

Processing values are tightly held by processing companies. We are aware that processing and wholesaling of potatoes is a major activity in the industry (e.g. most potatoes exported are further processed).

To give an approximation we have estimated the processing and wholesaling activity to be 30% of the farmgate Gross Output value (in line with carrots). Processing consists of packing, storage, handling, freight, wholesaling, and further processing (mainly chips). Further processing requires freezing and cool storing.

Table 131 Estimated potato Processing and Wholesaling margin value

	Farmgate Gross Output value	Adjustment factor	Processing Gross Output value estimate
Estimated potatoes processing and wholesaling margin value	$142 million	0.30	$42.6 million

Source: NZIER estimate

D.40.4 Domestic Gross Output value

Domestic Gross Output value is estimated at $451.0 million (Fresh Facts 2012, p16).

D.40.5 Export Gross Output values

Export Gross Output values are estimated at $117.5 million (Fresh Facts 2012, p16).

D.40.6 Summary

Table 132 sets out the contribution of potatoes to the New Zealand economy.

63 http://www.potatoesnz.co.nz/Overview/Our-Industry/Industry-profile.htm

64 ibid.

Table 132 Potato summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed potato ($11.4 million)	100%	0.37	$4.2 million
Farmgate ($142.0 million)	100%	0.37	$52.5 million
Processing and Wholesaling margin ($42.6 million)	100%	0.29	$12.4 million
Domestic ($451.0 million)	100%	0.18	$81.2 million
Export ($117.4 million)	100%	0.45	$52.8 million
Total GDP output share			**$203.1 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012 and Potatoes New Zealand

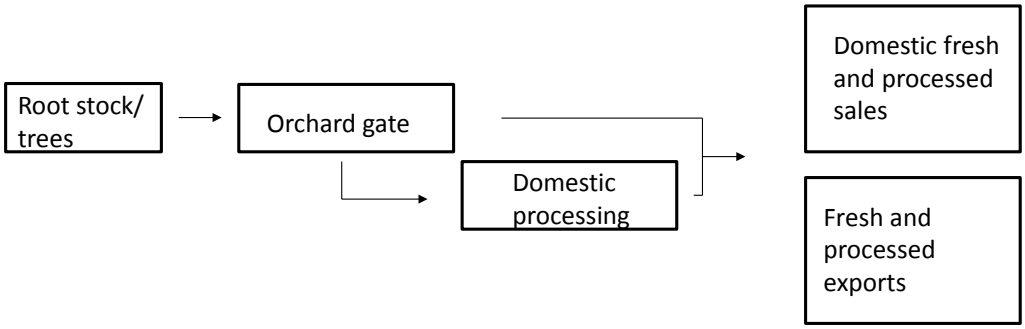
D.41 *Prunus* species

The *Prunus* species valued in this analysis are peaches, plums, nectarines, apricots and cherries. Production of *Prunus* varieties is based in Central Otago and the Hawke's Bay. The industry has a strong export growth focus with approximately just under half of all *Prunus* exported (in value terms). Central Otago grows the main export crop.

Good information exists on exports, domestic, orchard gate Gross Output value and trees supplied to growers. Processing of summerfruit has substantially reduced over the past 10 years.

Below we set out the value chain for summerfruit (Prunus).

Figure 45 Prunus value chain



Source: NZIER

D.41.1 Trees/root stock Gross Output value

Trees supplied to growers are approximately 70,000 multiplied by $10 per tree equalling $0.7 million (personal communication, Julie Green and John Morton, Graham Greene Ltd, 13 March 2015).

D.41.2 Orchard gate Gross Output value

Orchard gate Gross Output value is based on estimated tonnes presented by Fresh Facts and prices from various years collected in the Lincoln Financial Budget Manual.

These calculations are set out in Table 133.

Table 133 Prunus value at orchard gate

	Volumes[1]	Prices[2] per tonne	Orchard gate value estimate
Cherries	2,141 tonnes	$8,390	$18.0 million
Apricots	3,470 tonnes	$2,880	$10.0 million
Peaches	2,692 tonnes	$1,823	$4.9 million
Nectarines	3,684 tonnes	$1,718	$6.3 million
Plums	2,496 tonnes	$2,496	$4.8 million
Total			**$44.0 million[3]**
Notes (1) Fresh Facts 2012, p16. (2) Lincoln Financial Budget Manual 2012/2013 for apricots and cherries, pA72. Peaches, nectarines and plums are NZIER estimates based on domestic Gross Output values. (3) Numbers rounded.			

Source: NZIER and Horticulture New Zealand

D.41.3 Processing and Wholesaling margin

There is now little stone fruit grown for processing, once an important part of the industry. Golden Queen peaches from Hawke's Bay are canned by Wattie's, as are small quantities of Black Doris plums. With the closure of the Roxdale cannery, in Roxburgh, Central Otago, in the early 2000s, apricots are no longer canned in New Zealand. Apricots are dried in Central Otago, with volumes fluctuating yearly.

To reflect the Processing and Wholesaling margin (although many growers have integrated operations) we have estimated the value at 15% of the orchard gate value: $44 million multiplied by 15% equals $6.6 million.

Processing consists of cool storage, sorting, handling, freight, wholesaling, and some further processing.

D.41.4 Domestic and export Gross Output value

Domestic and export Gross Output value is estimated by Fresh Facts 2012, p14.

Table 134 Prunus domestic and Gross Output values

	Domestic consumption	Exports
Cherries	$7.0 million	$21.1 million
Apricots	$6.1 million	$10.2 million
Peaches	$7.4 million	$0.4 million
Nectarines	$10.1 million	Not available
Plums	$7.5 million	$0.2 million
Totals	**$38.1 million**	**$31.9 million**

Source: Fresh Facts 2012, p14

D.41.5 Summary

Table 135 sets out the contribution of Prunus to the New Zealand economy.

Table 135 Prunus summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.7 million)	100%	0.37	$0.3 million
Farmgate ($44.0 million)	100%	0.37	$16.3 million
Processing and Wholesaling margin ($6.6 million)	100%	0.29	$1.9 million
Domestic ($38.1 million)	100%	0.18	$6.9 million
Export $31.9 million)	100%	0.45	$14.4 million
Total GDP output share			**$39.7 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts 2012 and Lincoln Financial Budget Manual 2012/2013

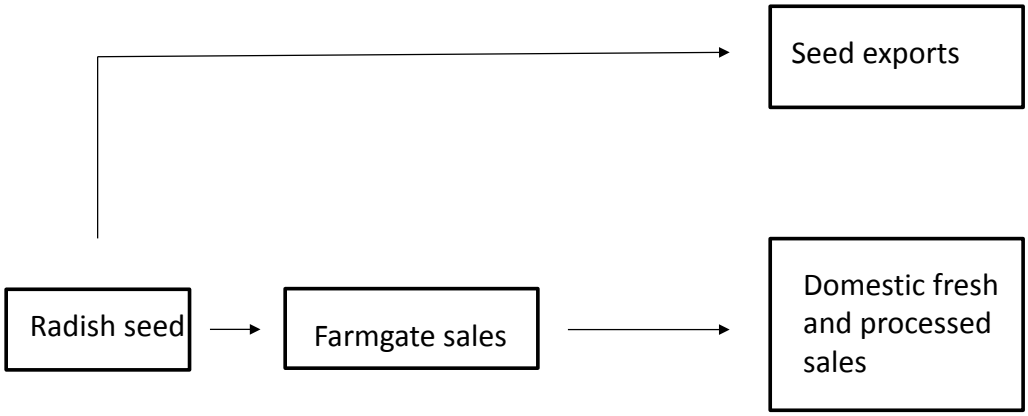
D.42 Radish (*Raphanus sativus*)

Radish (*Raphanus sativus*) seed trade is one of the standout successes in a flourishing international seed trade. Being in the European off-season and having ideal growing conditions the radish seed business is multimillion dollar industry.

We have good information on export seed Gross Output value; however, radish consumption data has been used to estimate the small New Zealand market.

Below we set out the value chain for radish.

Figure 46 Radish value chain



Source: NZIER

D.42.1 Seed production and farmgate Gross Output values

Radish seeds are a major export and its value far exceeds the value of radishes (the vegetable) sold on the domestic market.

To estimate the seed value, we have assumed that it is half the value of:

- domestic radish vegetable sales ($1.4 million) plus
- export sales of radish seeds ($22 million).

This equals $11.7 million (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014).

Domestic Seed + vegetable Gross output at farmgate is estimated at 50% of domestic sales of seeds + vegetable sales $0.7 million.

Table 136 Radish Gross Output value at farmgate

	Export and Domestic Gross Output value/ Domestic seed value	Adjustment factor	Gross Output value estimate
Radish Gross Output seed value	$23.4 million	0.5	$11.7 million
Radish seed farmgate Gross Output value	$1.4 million	0.5[1]	$0.7 million[2]
Note (1) NZIER estimate (2) Numbers rounded.			

Source: NZIER and Horticulture New Zealand

D.42.2 Processing and Wholesaling margin

Processing and wholesaling is valued at $1.9 million (($11.4m + 0.7m or $12.4m) x 15%).

D.42.3 Domestic Gross Output value

Domestic Gross Output value is estimated at $1.4 million (consumption data is unpublished data supporting Fresh Facts 2012, p24 and personal communication, Alastair Aitken, Martech, 13th February 2015).

D.42.4 Export Gross Output value

Radish seed exports are estimated at $22 million (Fresh Facts 2012, p20).

D.42.5 Summary

Table 137 sets out the contribution of radishes to the New Zealand economy.

Table 137 Radish summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seeds ($11.7 million)	100%	0.37	$4.3 million
Farmgate (for domestic seed and vegetable) ($0.7 million)	100%	0.37	$0.3 million
Processing and Wholesaling margin ($1.9 million)	100%	0.29	$0.5 million
Domestic ($1.4 million)	100%	0.18	$0.3 million
Export ($22.0 million)	100%	0.45	$9.9 million
Total GDP output share			**$15.3 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012

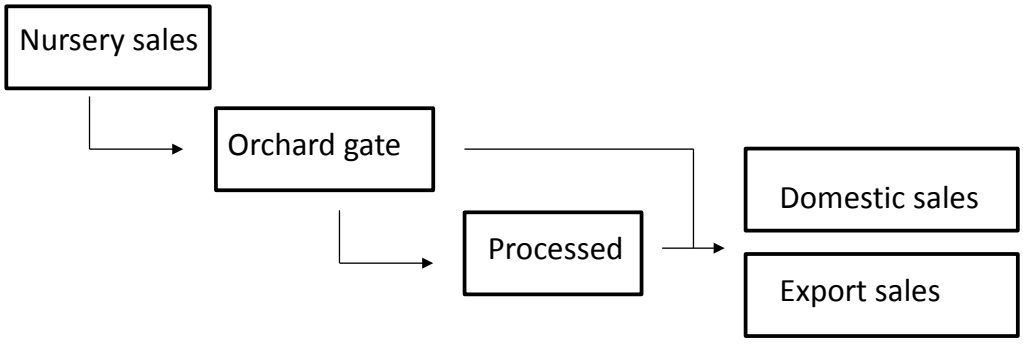
D.43 *Ribes* species

The *Ribes* species valued in this analysis are blackcurrants (*Ribes nigrum*), redcurrants (*Ribes rubrum*) and gooseberries (*Ribes uva-crispa*). Most value (99%) comes from the domestic and exports sales of blackcurrants. Redcurrants and gooseberries are very small crops (5 to 10 hectares each depending on the year).

Good information is available on plant, domestic and exports Gross Output values. Industry assumptions have been made for orchard gate production and processing.

Below we set out the value chain for Ribes.

Figure 47 Ribes value chain



Source: NZIER

D.43.1 Plant Gross Output value

The number of blackcurrant bushes supplied to growers is small. On a per annum basis, it is less than $0.1 million dollars (personal communication, Mike Kearney, Blackcurrants New Zealand Inc, 12 October 2014).

D.43.2 Orchard gate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries orchard gate prices are approximately half of domestic plus export Gross Output value. Domestic plus export Gross Output value of Ribes fruit was approximately $22.6 million (Fresh Facts 2012, p14).

Table 138 Ribes Gross Output value at orchard gate

	Domestic and export Gross Output value	Adjustment factor	Gross Output Orchard gate value estimate
Ribes farmgate value	$22.6 million	0.5	$11.3 million

Source: NZIER and Horticulture New Zealand

D.43.3 Processing and Wholesaling margin

The Processing and Wholesaling margin is tightly held by the companies in the industry. We have proxied the margin at 15% above orchard gate Gross Output value.

Processing consists of cool storage, sorting, handling, freight, wholesaling and some further processing.

Table 139 Estimated Ribes Processing and Wholesaling margin

	Orchard gate Gross Output value	Adjustment factor	Processing and Wholesaling margin estimate
Estimated Ribes processing value	$11.3 million	0.15	$1.7 million

Source: Fresh Facts and Horticulture New Zealand

D.43.4 Domestic Gross Output value

Domestic Gross Output value is approximately $3.7 million. This comprises of $3.6 million (Fresh Facts 2012, p14) in blackcurrant sales with the remainder being redcurrants and gooseberries.

D.43.5 Export Gross Output value

Export Gross Output value in 2012 were $18.8 million.[65]

D.43.6 Summary

Table 140 sets out the contribution of Ribes to the New Zealand economy.

Table 140 Ribes summary

2012, June year, $M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.1 million)	100%	0.37	$0.04 million
Orchard gate ($11.3 million)	100%	0.37	$4.2 million
Processing and Wholesaling margin ($1.7 million)	100%	0.29	$0.5 million
Domestic ($3.7 million)	100%	0.18	$0.7 million
Export ($18.8 million)	100%	0.45	$8.5 million
Total GDP output share			**$13.8 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012 and Blackcurrants New Zealand Inc

D.44 Ribwort plantain (*Plantago lanceolata*)

Narrow leafed plantain (*Plantago lanceolata*) is an upright perennial herb which tolerates many pests and diseases. It has become increasingly popular as a specialist crop or sown in a pasture mix. Approximately 5,000 hectares of plantain was sown in 2011 (New Zealand Forage Systems 2012, p1).

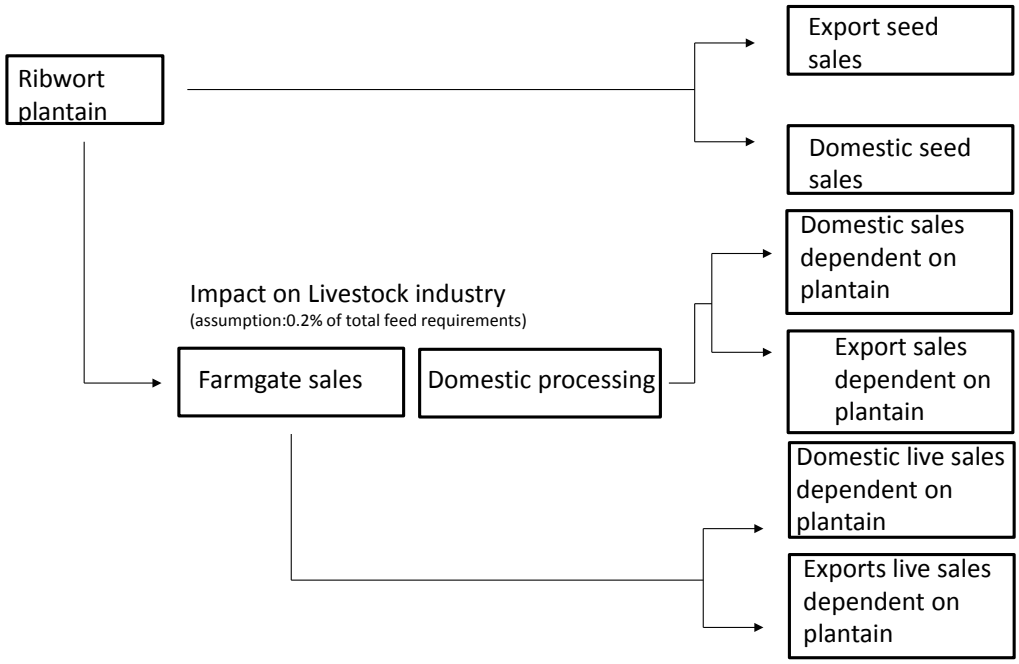
Its coarse root system consists of both a tap root and a fibrous root. The tap root grows to a shallower depth than other tap rooted plants and means that plantain is less tolerant of drought than chicory, red clover and lucerne, though the tap root does provide some degree of drought tolerance.

The small size of the crop means that we had to rely on industry sources for approximations of seed value and domestic Gross Output value. Exports Gross Output value is record by Statistics New Zealand.

[65] http://blackcurrant.co.nz/blackcurrants/the-nz-industry/

Below we have set out the plantain value chain.

Figure 48 Ribwort plantain value chain



Note that all livestock industries include live animals, dairy, wool, dairy, meat processing, velvet and other co-products sold.

Source: NZIER

D.44.1 Seed Gross Output value

Seed Gross Output value is estimate at half the domestic Gross Output value or $1.1 million.

D.44.2 Farmgate Gross Output value

Farmgate Gross Output value of plantain have been calculated from the estimated 5,000 hectares (New Zealand Forage Systems 2012, p1) planted multiplied by $2,600 per hectare revenue (Millner and Roskruge 2013, Table 1 p103 and personal communication, Ivan Lawrie, FAR, 4 March 2015) equalling $13.0 million.

D.44.3 Domestic Gross Output value

Domestic seed Gross Output value is estimated at $2.25 million (BERL 2012, p14).

D.44.4 Dependent industries

Plantain is grown by farmers as a forage crop either for their own use or sold on the open market. DairyNZ suggest that plantain is a minor but valuable addition to livestock feed requirements particularly in the South Island – approximately 0.2% of total livestock requirements (personal communication, Mr Matt Newman, DairyNZ, 18 May 2014).

D.44.5 Summary

Table 141 sets out the GDP output share of plantain to the New Zealand economy.

Table 141 Plantain summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($1.1 million)	100%	0.37	$0.4 million
Farmgate ($13.0 million)	100%	0.37	$4.8 million
Domestic Seed ($2.3 million)	100%	0.18	0.4 million
Dependent livestock industries			
Farmgate Dairy ($10,828.0 million)	0.2%	0.49	$10.6 million
Farmgate Other livestock ($5,958.0 million)	0.2%	0.49	$5.8 million
Dairy Processing and Wholesaling margin ($6,552.0 million)	0.2%	0.13	$1.7 million
Traditional livestock Processing and Wholesaling ($3,033.0 million)	0.2%	0.15	$0.9 million
Domestic (processing and live) ($2,478.4 million)	0.2%	0.18	$0.9 million
Export ($19,455.8 million)	0.2%	0.48	$18.7 million
Total GDP output share			**$44.3 million**[1]
Note (1) Numbers rounded.			

Source: BERL 2012, Beef + Lamb New Zealand estimates, Statistics New Zealand and NZIER estimates

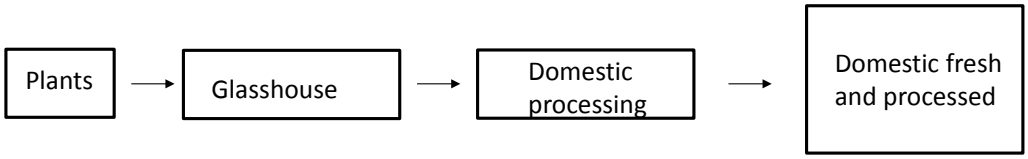
D.45 Roses (*Rosa* species)

Rose (*Rosa* species) production is focused on the domestic market. In recent years, roses have faced stiff competition from imports, particularly from markets such as India.

As with other cut flowers, the ability to estimate value is hampered by the large number of marketing channels used (e.g. supermarkets, agents, direct buying etc.). Therefore, we have relied on industry experts to give a general indication of value at each stage of the value chain.

The following figure sets out the marketing chain for roses.

Figure 49 Rose value chain



Source: NZIER

D.45.1 Rose bush Gross Output value

We have no official information on rose bush production. As with other flower production, businesses are vertically integrated. Bushes and cuttings for the next season are produced at the same time as this year's production and multiplied up.

The approximate cost or 'best guess' of the value of this process for roses is approximately $0.1 million (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014 and NZIER estimate).

D.45.2 Glasshouse gate Gross Output value

Glasshouse gate Gross Output values are hard to estimate. The best guess by the industry is approximately $10.5 million (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014). Imports and the numerous marketing channels with differing pricing structures complicate estimates further.

D.45.3 Domestic Gross Output value

Domestic Gross Output value is estimated at $21.0 million. This is a highly approximate figure based on 60 million domestically produced flowers sold at $0.35 per flower (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014).

D.45.4 Summary

Table 142 sets out the GDP output share of roses to the New Zealand economy.

Table 142 Rose summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.1 million)	100%	0.37	$0.04
Glasshouse gate ($10.5 million)	100%	0.37	$3.9 million
Domestic ($21.0 million)	100%	0.18	$3.8 million
Total GDP output share			**$7.7 million[1]**
Note (1) Numbers rounded.			

Source: FloraMax

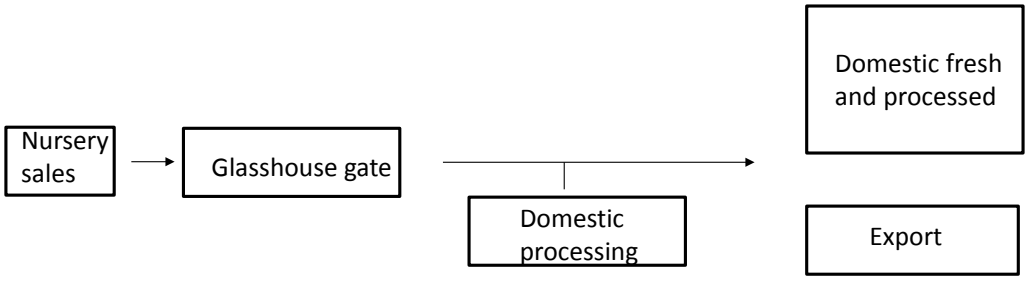
D.46 Rubus species

The *Rubus* species valued in this analysis are boysenberries (*Rubus* hybrid), blackberries (*Rubus fruiticosus*), and raspberries (*Rubus idaeus*). Boysenberries and raspberries dominate *Rubus* production, both of which are exported. Blackberries are focused on the domestic market only.

Most *Rubus* are grown in the Nelson and Hawke's Bay regions and have remained small industries, despite being established for nearly a century.

The figure below sets out the value chain for *Rubus*.

Figure 50 Rubus value chain



Source: NZIER

D.46.1 Plant Gross Output value

The number of *Rubus* bushes supplied to growers is small. Less than $0.05 million dollars on a per annum basis.

D.46.2 Orchard gate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries orchard gate prices are approximately a half of domestic and export Gross Output value. Domestic and export Gross Output value of *Rubus* were approximately $10.7 million (Fresh Facts 2012, p14).

Table 143 Rubus Gross Output value at Orchard gate

	Domestic + export Gross Output value	Adjustment factor	Orchard gate value estimate
Rubus Orchard gate value	$10.7 million	0.5	$5.4 million

Source: Fresh Facts and Horticulture New Zealand

D.46.3 Processing and Wholesaling margin

The Processing and Wholesaling margin is tightly held by the companies in the industry. We have estimated processing at 15% of the orchard gate Gross Output value. Processing consists of packaging, handling, freight, wholesaling, and limited further processing.

Table 144 Estimated Rubus Processing and Wholesaling margin

	Orchard gate	Adjustment factor	Orchard gate value estimate
Estimated rubus processing value	$5.4 million	0.15	$0.8 million

Source: Fresh Facts and Horticulture New Zealand

D.46.4 Domestic Gross Output value

Domestic Gross Output value is approximately $8.2 million in 2012 (Fresh Facts 2012, p14).

D.46.5 Export Gross Output value

Export Gross Output value in 2012 was estimated at $2.5 million (Fresh Facts 2012, p14).

D.46.6 Summary

Below we set out the contribution of Rubus to the New Zealand economy.

Table 145 Rubus summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.05 million)	100%	0.37	$0.02 million
Orchard gate ($5.4 million)	100%	0.37	$2.0 million
Processing and Wholesaling margin ($0.8 million)	100%	0.29	$0.2 million
Domestic ($8.2 million)	100%	0.18	$1.5 million
Export ($2.5 million)	100%	0.45	$1.1 million
Total GDP output share			**$4.8 million**[1]
Note (1) Numbers rounded.			

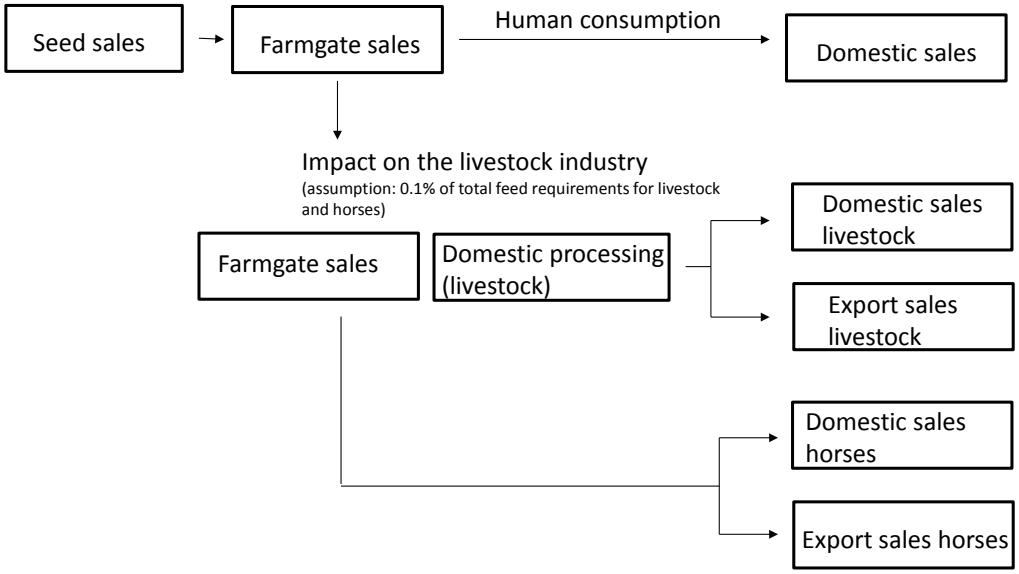
Source: Fresh Facts 2012 and Blackcurrants New Zealand Inc

D.47 Rye (*Secale cereal*)

Rye (*Secale cereal*) is a very small crop and mainly grown in Canterbury as a stock feed, though some production goes to human consumption.

The following figure sets out the value chain.

Figure 51 Rye value chain



Note that all livestock industries include live animals, wool, dairy, meat processing, velvet and other co-products sold. Horses are also included.

Source: NZIER

D.47.1 Rye seed Gross Output value

In 2012, 550 tonnes of rye seed was produced (personal communication, David Green, PGG Wrightsons, 20 March 2015). At $1,000 per tonne, seed value was approximately $0.6 million.

D.47.2 Farmgate Gross Output value

Farmgate Gross Output value of rye was approximately $4.8 million ($480 per tonne[66] multiplied by 10,000 tonnes).[67]

D.47.3 Dependent industries

Human consumption

Little is known about rye production for bread etc. Companies hold this information tightly.

[66] Lincoln Financial Budget Manual 2012/2013, p A58.

[67] Personal communication David Green PGG Wrightsons.

Fodder production

Rye is grown by farmers as a forage crop either for their own use or sold on the open market. DairyNZ suggest that rye is a minor but valuable addition to livestock feed requirements particularly in the South Island – approximately 0.1% of total livestock requirements (personal communication, Mr Matt Newman, DairyNZ, 18 May 2014). Horses are also assumed to be approximately 0.1% of total requirements (NZIER estimate based on Gee (2012)). Table 146 sets out the dependent industries and values.

Table 146 Livestock industries that depend on rye

2012, June year, $ M per annum

	Farmgate Gross Output value	Processing and Wholesaling margin	Domestic Gross Output value estimate	Export Gross Output value
Dairy values	$10,828.0 million	$6,522.0 million	$1,045.6 million	$12,573.7 million
Other livestock values	$5,958.0 million	$3,033.0 million	$1,432.8 million	$6,882.1 million
Horse values	$93.5 million	No processing estimate	$57.0 million	$130.0 million
Note (1) For further information on gross output livestock values see Appendix B.				

Source: Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.47.4 Summary

Table 147 sets out the GDP output share of rye to the New Zealand economy.

Table 147 Rye summary

2012, June year, $M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage of the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($0.6 million)	100%	0.37	$0.2 million
Farmgate ($4.8 million)	100%	0.37	$1.8 million
Human consumption			Unknown but assumed small
Dependent livestock industries			
Farmgate Dairy ($10,828 million)	0.1%	0.48	$5.3 million
Farmgate Other livestock ($5,958.1 million)	0.1%	0.49	$2.9 million
Farmgate horses ($93.5 million)	0.1%	0.25	$0.02 million
Dairy: Processing and Wholesaling margin ($6,552.0 million)	0.1%	0.13	$0.9 million
Traditional livestock processing ($3,033.0 million)	0.1%	0.15	$0.5 million
Domestic (processing and live) ($2,478.4 million)	0.1%	0.18	$0.5 million
Domestic horses ($57.0 million)	0.1%	0.12	$0.006 million

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage of the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Exports livestock ($19,455.8 million)	0.1%	0.48	$9.3 million
Exports horses ($130 million)	0.1%	0.2	$0.03 million
Total GDP output share			**$21.4 million**[1]
Note (1) Numbers rounded.			

Source: BERL 2012, Beef + Lamb New Zealand estimates, Statistics New Zealand and NZIER estimates

D.48 Ryegrass (*Lolium* species)

Ryegrass (*Lolium* species including *Lolium perenne, Lolium multiflorum* and *Lolium x boucheanum*) is the backbone of New Zealand's livestock industry. It is the dominant feed for cattle and sheep. This makes it the most important economic plants grown in New Zealand.

There is good data on ryegrass production in New Zealand. For industries that rely on ryegrass, Beef + Lamb New Zealand have credible estimates of livestock sales at the farmgate, processing and export values (personal communication, Mr Rob Davison, 5 June 2014). The main assumption made is that ryegrass is the dominant feed crop for the livestock industry making up approximately 75% of all livestock nutrient requirements (correspondence with Mr Matthew Newman (DairyNZ) and Mr Nick Pyke (FAR)).[68]

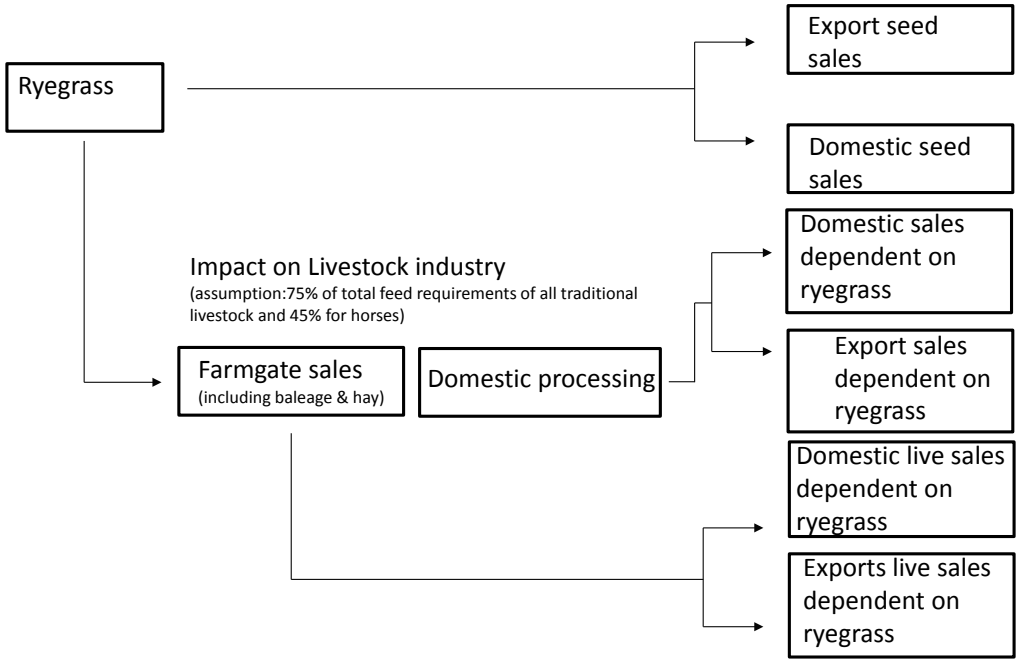
The ryegrass value chain is set out below. Ryegrass seed is sold domestically and exported. However, its main value is as a source of feed for the livestock industry. Other points to note include:

- farmgate Gross Output value is the total value received by farmers from livestock sales
- domestic processing is the value generated by the processing stage of the value chain i.e. the service the processing stage of the value chain performs
- domestic and exports Gross Output value is the total value received from prices multiplied by quantity.[69]

[68] Also see http://www.beeflambnz.com

[69] Export sales are valued in fob terms.

Figure 52 Ryegrass value chain



Source: NZIER

D.48.1 Seed Gross Output value

Most seed production takes place in Canterbury. Total ryegrass seed production in 2011 (December year)[70] was 32,500 tonnes (BERL 2011; Statistics New Zealand; Hampton et al 2012).[71] The total Gross Output value for ryegrass seed sold were approximately $84.5m (BERL 2012, p14). Most ryegrass seed is sold into the export market ($50.22m).

Table 148 Seed Gross Output value at farmgate, domestic and export parts of the value chain

2011 sales

Specific part of the value chain	Calculation	Gross Output value	Source/assumption
Farmgate	50% of export and domestic sales value ($84.5m)	$42.3 million	Horticulture New Zealand assumption
Domestic	Total sales ($84.5) minus export sales	$34.3million	Derived from BERL 2012, p14 and Hampton et al 2012, p133
Export		$50.2 million	Hampton et al 2012, p133

Source: BERL 2012, Hampton et al 2012 and Horticulture New Zealand

[70] The latest year available where exports and domestic production is reported.

[71] Note that we have used 2011 June year to get consistent export and domestic use figures.

D.48.2 Dependent industries value chain

Ryegrass contributes 75% of all nutrition needs for livestock industries. This makes perennial ryegrass New Zealand's preeminent economic plant in value terms.

Table 149 below illustrates ryegrass's importance by setting out the livestock value of farmgate, processing, domestic, and exports stages of the value chain that depend upon ryegrass. Export data comes from Statistics New Zealand through Beef + Lamb New Zealand (personal communication, Mr Rob Davison, 5 June 2014). Beef + Lamb New Zealand have also estimated processing margins and farmgate returns (personal communication, Mr Rob Davison, 30 July 2014) specifically for this project. Livestock (live) sales are based on Statistics New Zealand estimates.

Table 149 Livestock industries that depend on ryegrass

2012, June year, $ M per annum

	Farmgate Gross Output value	Domestic Processing and Wholesaling margin	Domestic Gross Output value (processed and live)	Export Gross Output value
Beef	$2,289 million	$1,706 million	$401 million	$2,469 million
Dairy	$10,828 million	$6,552.0 million	$348 million	$12,477 million
Sheep	$2,820 million	$1,211.1 million	$804 million	$3,125 million
Wool	$675 million	$147.7 million	$43 million	$984 million
Deer	$174 million	$57.5 million	$8 million	$270 million
Goats	-	-	-	$7 million
Export live	-	-	-	$120 million
Domestic live	-	-	$871 million	-
Totals	**$16,786 million**	**$9,584.7 million**	**$2,478 million**	**$19,455 million**

Source: Beef + Lamb New Zealand estimates, Statistics New Zealand and NZIER estimates

Horse industry values are set out in Table 150. Ryegrass is a major contributor to forage consumption in the horse industry. We expect it to be similar to other livestock industries. Given that forage is at least approximately 60% of a horse's diet (Gee 2012) we expect the ryegrass contribution to the horse industry to be approximately 45%.

Table 150 Horse Gross Output values

2012, June year, $ M per annum

	Farmgate Gross Output value	Processing and Wholesaling margin	Domestic Gross Output value	Export Gross Output value
Horse values	$93.5 million	No processing estimate	$57.0 million	$130.0 million

Source: Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.48.3 Ryegrass summary

Table 151 sets out the summary of ryegrass seed production and its dependent livestock industries. Estimates of the Gross Output value at each stage of the value chain have been calculated from Table 149 and multiplied by estimated (livestock) industry impact, and GDP share of output[72] (to avoid double counting). The share of GDP output values are summed to get the total GDP share of output, which demonstrates the importance of ryegrass to the economy.

Table 151 Ryegrass summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage of the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Farmgate seeds ($42.3 million)[1]	100%	0.37	$15.6 million
Domestic seeds ($34.3 million) [1]	100%	0.18	$6.2 million
Export seeds ($50.2 million) [1]	100%	0.45	$22.6 million
Dependent livestock industries[2]			
Farmgate Dairy ($10,828m)	75%	0.48	$3,979.3 million
Farmgate Other livestock ($5,958m)	75%	0.49	$2,189.6 million
Farmgate horses ($93.5 million)	45%	0.25	$10.5 million
Dairy domestic Processing and Wholesaling margin ($6,552.0m)	75%	0.13	$638.8 million
Traditional industry Processing and Wholesaling margin ($3,033.0 million)	75%	0.15	$341.2 million
Domestic (processing and live) ($2,478.4m)	75%	0.18	$334.6 million
Domestic horses ($57.0 million)	45%	0.12	$3.1 million
Export livestock ($19,455.8 million)	75%	0.48	$7,004.1 million
Export horses ($130.0 million)	45%	0.2	$11.7 million
Total GDP output share			**$14,557.3 million[3]**
Note (1) December year 2011 (2) See Appendix B for more detail on gross output values for livestock industries. (3) Numbers rounded.			

Source: BERL 2012, Beef + Lamb New Zealand estimates, Statistics New Zealand and NZIER estimates

[72] The GDP share of output is calculated from estimates made in the Input-Output tables (see Table 1).

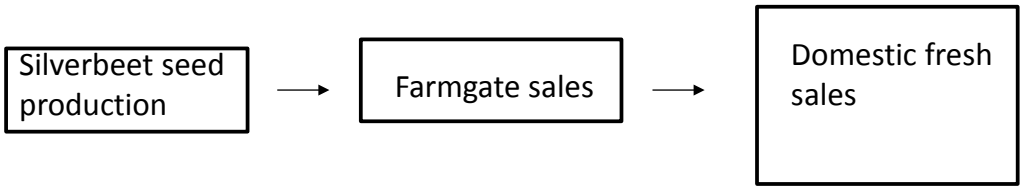
D.49 Silverbeet (*Beta vulgaris* var. *cicla*)

Silverbeet (*Beta vulgaris* var. *cicla*) is grown for the domestic market. It is a small industry based in market gardens around the major cities.

As a small domestic industry we are reliant on industry estimates for industry size.

Below we set out the value chain for silverbeet.

Figure 53 Silverbeet value chain



Source: NZIER

D.49.1 Seed Gross Output value

Silverbeet seeds are imported with a small proportion grown in New Zealand. Seed Gross Output value was approximately $0.02 million in 2012 (silverbeet and spinach industry grower).

D.49.2 Farmgate Gross Output value

Farmgate Gross Output value is approximately $1.1 million in 2012 (silverbeet and spinach industry grower and Horticulture New Zealand).

D.49.3 Processing and Wholesaling margin

The Processing and Wholesaling margin value is estimated at $0.2 million ($1.1 million multiplied by 0.15). Processing consists of packaging, storing, handling, wholesaling, and freight.

D.49.4 Domestic Gross Output value

Domestic Gross Output value is approximately $2.1 million (Fresh Facts 2012 and silverbeet and spinach industry grower).

D.49.5 Summary

Below we set out the contribution of silverbeet to the New Zealand economy.

Table 152 Silverbeet summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.02 million)	100%	0.37	$0.007 million
Farmgate ($1.1 million)	100%	0.37	$0.4 million
Processing and Wholesaling margin ($0.2 million)	100%	0.29	$0.05 million
Domestic ($2.1 million)	100%	0.18	$0.4 million
Total GDP output share			**$0.8 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts 2012

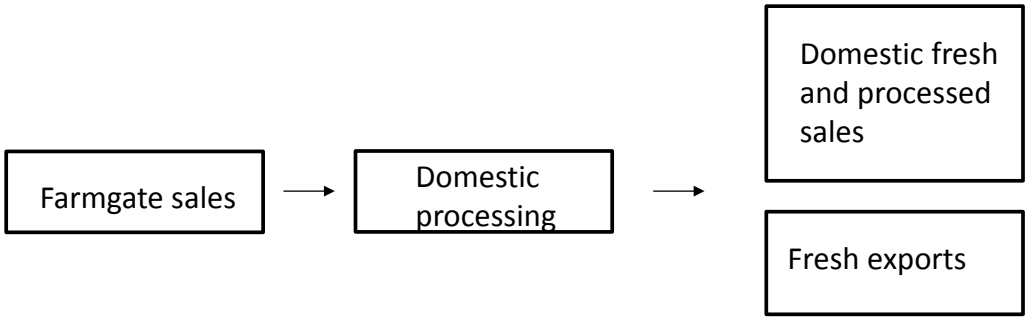
D.50 Sphagnum moss (*Sphagnum cristatum & C. subnitens*)

Sphagnum moss (*Sphagnum cristatum & C. subnitens*) production is harvested from swamps mainly on the West Coast of the South Island.

Information on production is scarce with the only official data focused on exports. Some estimates are available on the domestic market; however, generalised assumptions are applied to farmgate and processing stage of the value chain.

Below we set out the value chain for sphagnum moss.

Figure 54 Sphagnum moss value chain



Source: NZIER

D.50.1 Moss harvesting

Sphagnum moss is a natural resource harvested from Westland wetlands therefore there is no Gross Output value for nursery stock/seed.

D.50.2 Farmgate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries farmgate prices are approximately half of domestic and export Gross Output value. Domestic and export Gross Output value of sphagnum moss was approximately $5.6 million (Fresh Facts 2012, p14 and MAF 2008, p11).

Table 153 Sphagnum moss Gross Output value at farmgate

	Domestic + export Gross Output value	Adjustment factor	Farmgate Gross Output value
Sphagnum moss farmgate value	$5.6 million	0.5	$2.8 million

Source: Fresh Facts 2012 and MAF 2008

D.50.3 Processing and Wholesaling margin

Processing value is tightly held by the companies in the industry. We estimated that at the processing and wholesaling stage of the value chain at 15% above farmgate stage of the value chain.

Processing consists of storage and drying, handling, packing, freight, wholesaling, and some further processing.

Table 154 Estimated sphagnum moss Processing and Wholesaling margin

	Domestic plus export Gross Output value	Adjustment factor	Processing and Wholesaling margin
Estimated sphagnum moss Processing and Wholesaling value	$2.8 million	0.15	$0.4 million

Source: Fresh Facts 2012 and MAF 2008

D.50.4 Domestic Gross Output value

Domestic Gross Output value is approximately 20% of export Gross Output value: $1.1 million (MAF 2008, p11)).

D.50.5 Export Gross Output value

Gross Output value of exports for sphagnum moss was estimated at $4.5 million in 2012 (Fresh Facts 2012, p21).

D.50.6 Summary

Below we set out the contribution of sphagnum moss to the New Zealand economy.

Table 155 Sphagnum moss summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery	100%	0.37	Harvesting a natural resource – no market value
Farmgate ($2.8 million)	100%	0.37	$1.0 million
Processing and Wholesaling margin ($0.4 million)	100%	0.29	$0.1 million
Domestic ($1.1 million)	100%	0.18	$0.2 million
Export ($4.5 million)	100%	0.45	$2.0 million
Total GDP output share			**$3.4 million[1]**
Note (1) Numbers rounded.			

Source: Fresh Facts 2012 and MAF 2008

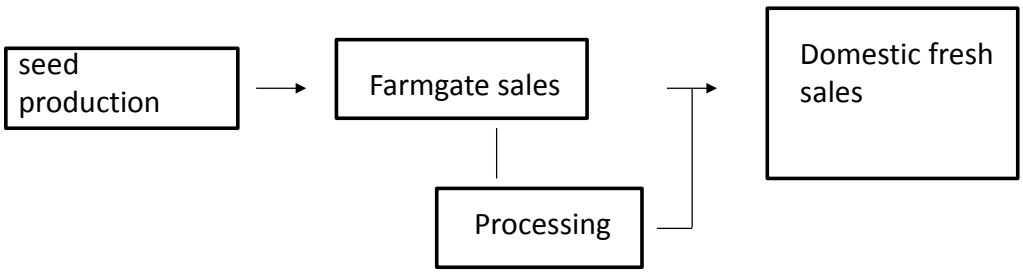
D.51 Spinach (*Spinacia oleracea*)

Spinach (*Spinacia oleracea*) is grown for the domestic market. It is a small industry based in market gardens around major cities.

As a small domestic industry we are reliant on industry estimates for industry size.

Below we set out the value chain for spinach.

Figure 55 Spinach value chain



Source: NZIER

D.51.1 Spinach seed Gross Output value

Spinach seeds are imported, mainly from Australia (personal communication, silverbeet and spinach grower).

D.51.2 Farmgate Gross Output value

Farmgate Gross Output value is approximately $2.0 million in 2012 (personal communication, silverbeet and spinach grower and personal communication, John Seymour, Horticulture New Zealand, 19 March 2015).

D.51.3 Processing and Wholesaling margin

Processing and Wholesaling margin is estimated at $0.3 million ($2.0 million farmgate Gross Output value multiplied by 0.15). Processing consists of handling, storing, packing, wholesaling, and freight.

D.51.4 Domestic Gross Output value

Domestic Gross Output value was approximately $3.9 million (personal communication, silverbeet and spinach grower; and Fresh Facts 2012, p16).

D.51.5 Summary

Table 156 sets out the contribution of spinach to the New Zealand economy.

Table 156 Spinach summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery	100%	0.37	Imported
Farmgate ($2.0 million)	100%	0.37	$0.7 million
Processing and Wholesaling margin ($0.3 million)	100%	0.29	$0.08 million
Domestic ($3.9 million)	100%	0.18	$0.7 million
Total GDP output share			**$1.5 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts 2012

D.52 Strawberries (*Fragaria x ananassa*)

Strawberries (*Fragaria x ananassa*) have been grown in New Zealand for over a century. Originating from crosses of North and South American species, they fruit well for up to four years, but are grown commercially as an annual crop.

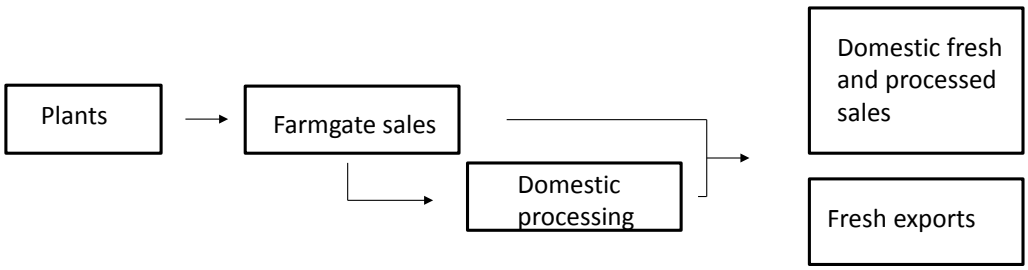
Strawberries are mostly grown for the domestic market. Approximately 6,500 tonnes are produced by 110 growers.

New Zealand's commercial strawberry fields cover a total of 170 hectares, mainly in the Auckland region. The fruit are harvested from spring to the end of summer, depending on the varieties.

Good information exists on domestic and export Gross Output value, however we have relied on industry assumptions and estimates for other parts of the industry.

The value chain for strawberries is set out below.

Figure 56 Strawberry value chain



Source: NZIER

D.52.1 Bush production Gross Output value

Strawberry plant production (i.e. nursery stock) is worth approximately $3.5 million (personal communication, Michael Ahern and Geoff Langford, Strawberry Growers New Zealand Inc, 23 March 2015).

D.52.2 Farmgate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries farmgate prices are approximately a half of domestic and export Gross Output values. Domestic and export Gross Output values for strawberry fruit was approximately $26.1 million (Fresh Facts 2012, p14).

Table 157 Strawberry value at farmgate

	Domestic Gross Output value	Adjustment factor	Farmgate Gross Output value
Strawberry farmgate value	$26.1 million	0.5	$13.1 million

Source: Fresh Facts 2012, and MAF

D.52.3 Processing and Wholesaling margin

The companies in the industry tightly hold processing value information. We have estimated the Processing and Wholesaling margin value at 15% of farmgate values. Strawberry processing consists of handling, packing, sorting, (cool) storing, freight and some further processing.

Table 158 Estimated strawberry Processing and Wholesaling margin

	Farmgate Gross Output value	Adjustment factor	Processing and Wholesaling margin
Estimated strawberry processing and wholesaling value	$13.1 million	0.15	$2.0 million

Source: Fresh Facts and Horticulture New Zealand

D.52.4 Domestic Gross Output value

Domestic Gross Output value is approximately $21.3 million (Fresh Facts 2012, p14).

D.52.5 Export Gross Output value

Export Gross Output value is estimated at $4.8 million (Fresh Facts 2012, p14).

D.52.6 Summary

Table 159 sets out the contribution of strawberries to the New Zealand economy.

Table 159 Strawberry summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($3.5 million)	100%	0.37	$1.3 million
Farmgate ($13.1 million)	100%	0.37	$4.8 million
Processing and Wholesaling margin ($2.0 million)	100%	0.29	$0.6 million
Domestic ($21.3 million)	100%	0.18	$3.8 million
Export ($4.8 million)	100%	0.45	$2.2 million
Total GDP output share			**$12.7 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts 2012

D.53 Tall fescue (*Festuca arundinacea*)

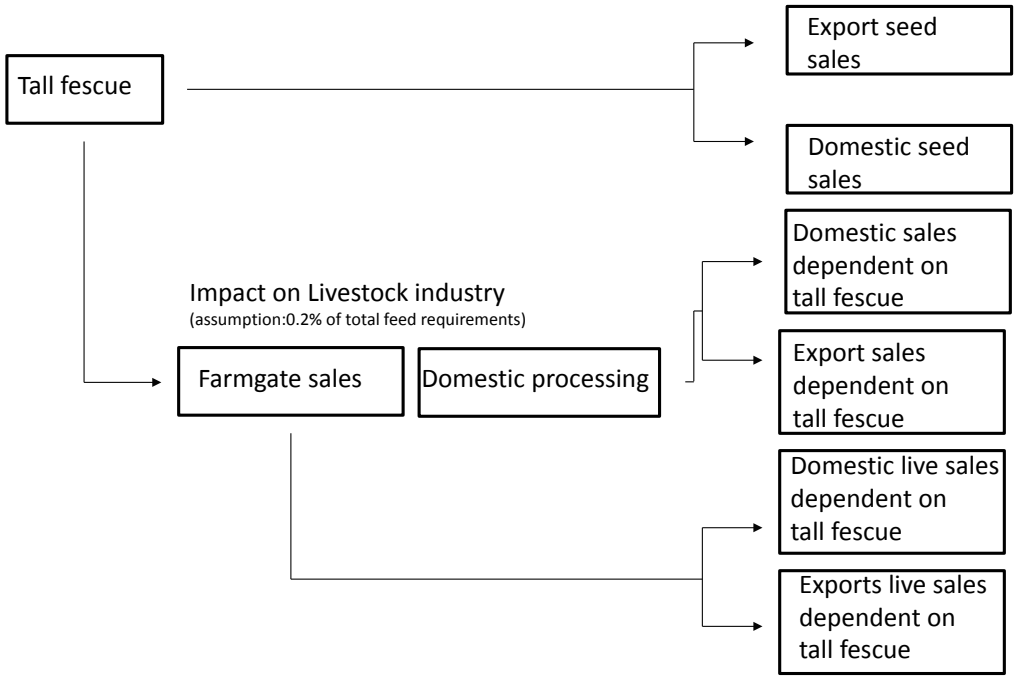
Tall fescue (*Festuca arundinacea*) is a deep rooted perennial grass that is more persistent than perennial ryegrass and can tolerate waterlogging, salinity, grass grub, heat and drought.

Slower to establish than perennial ryegrass, tall fescue is an excellent option where summer moisture stress may limit persistence or yield of perennial ryegrass, therefore it has proven popular in drought prone environments. Sometimes it is mixed with white clover.

We have good information on seed Gross Output value and dependent industries (livestock other than dairy).

Below we set out the value chain for tall fescue.

Figure 57 Tall fescue value chain



Note that other livestock industries include live animals (including horses), wool, meat processing, velvet and other co-products sold.

Source: NZIER

D.53.1 Tall fescue seed Gross Output value

The farmgate value of seed production was approximately a half of domestic plus export Gross Output value: $1.0 million (personal communication, John Seymour, Horticulture New Zealand, 12 December 2014).

Domestic seed Gross Output value is approximately $0.04 million ($2.02 million minus $1.98 million) (BERL 2012, p4 and Hampton et al 2012, p133).

Exports were 1.98 million (Hampton et al 2012, p133).

Table 160 Seed Gross Output value at farmgate, domestic sales and exports

2011 sales

Specific part of the value chain	Calculation	Gross Output value	Source/assumption
Farmgate	50% of export and domestic Gross Output value	$1.0 million	Horticulture New Zealand assumption
Domestic	Total Gross Output value minus export Gross Output value	$0.04 million	Derived from BERL 2012, p14 and Hampton et al (2012, p133)
Export	Statistics NZ	$1.98 million	Hampton et al (2012, p133)

Source: BERL 2012, Hampton et al 2012 and Horticulture New Zealand

D.53.2 Dependent industries

Tall fescue is grown by farmers to support their predominantly sheep and beef operations. It is a niche product approximately 0.2% of total livestock requirements other than dairy particularly in the South Island (personal communication, Mr Matt Newman, DairyNZ, 18 May 2014). We have assumed a similar contribution to the horse industry.

For livestock Gross Output values see Appendix B.

D.53.3 Summary

Table 161 sets out the GDP output share of tall fescue to the New Zealand economy.

Table 161 Tall fescue summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed ($1.0 million)	100%	0.37	$0.4 million
Domestic ($0.04)	100%	0.18	$0.007 million
Export of seeds ($2.0 million)	100%	0.45	$0.9 million
Dependent livestock industries[1]			
Farmgate Other traditional livestock ($5,958.1 million)	0.2%	0.49	$5.8 million
Farmgate horses ($93.5 million)	0.2%	0.25	$0.05 million
Domestic Processing and Wholesaling margin for traditional livestock industries ($3,033.0 million)	0.2%	0.15	$0.9 million
Domestic other traditional livestock ($1,432.8 million)	0.2%	0.18	$0.5 million
Domestic horses ($57 million)	0.2%	0.12	$0.01 million
Exports other traditional livestock ($6,882.1 million)	0.2%	0.48	$6.6 million
Exports horses ($130.0 million)	0.2%	0.2	$0.05 million
Total GDP output share			**$15.3 million[2]**
Note. (1) For Gross Output values see Appendix B. (2) Numbers rounded			

Source: BERL 2012, Beef + Lamb New Zealand estimates, Statistics New Zealand, NZIER estimates, IER Pty Ltd 2010 and Statistics New Zealand HS Code 0101

D.54 Tamarillos (*Solanum betaceum*)

Tamarillos (*Solanum betaceum*) were introduced to New Zealand in 1891 in Auckland. A red-fruited variety was bred at Māngere East in the 1920s, and small-scale commercial production started.

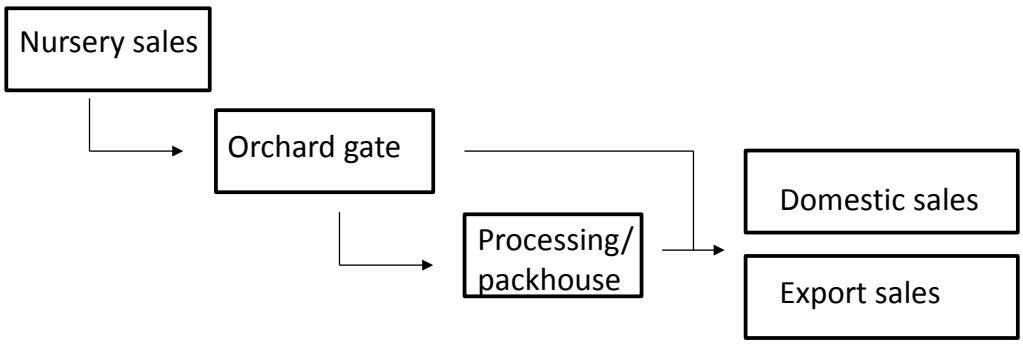
The fruit was strongly promoted in the 1960s and the industry prospered for a few years. The area under cultivation has increased slowly until the arrival of the tomato potato

psyllid which has devastated production. Tamarillos are mainly grown in the Bay of Plenty, Northland and Auckland.

Good information on domestic and export Gross Output values are available. However, the value of other parts of the industry is calculated from industry assumptions and export opinions.

Below we set out the value chain for tamarillos.

Figure 58 Tamarillo value chain



Source: NZIER

D.54.1 Trees/root stock Gross Output value

Tamarillo tree supply has been relatively high in recent years because of the incursion by the Tomato Potato psyllid (TPP). Since 2008 between 60% and 70% of trees have been replaced because of the *Liberibacter* (a bacteria-like organism) carried by the TPP (personal communication, Jim Walker, Plant and Food Research, 16 September 2014). Taking this into account tree replacement will be at least 10% of orchard gate value each year or $0.08 million.

D.54.2 Orchard gate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries orchard gate prices are approximately half of domestic and export orchard gate. Domestic and export Gross Output value for tamarillos was approximately $1.5 million (Fresh Facts 2012, p14).

Table 162 Tamarillo Gross Output value at Orchard gate

	Domestic and export Gross Output value	Adjustment factor	Orchard gate Gross Output value
Tamarillo Orchard gate value	$1.5 million	0.5	$0.8 million

Source: Fresh Facts 2012 and Horticulture New Zealand

D.54.3 Processing and Wholesaling margin

Gross Output value for tamarillos consists of freight, handling, wholesaling, and packing. We have used a margin of 15% the orchard gate Gross Output value (NZIER estimate) of $0.1 million.

D.54.4 Domestic Gross Output value

Domestic Gross Output value is approximately 1.3 million (Fresh Facts 2012, p14).

D.54.5 Export Gross Output value

Exports Gross Output value for tamarillos was approximately $0.2 million (Fresh Facts 2012, p14).

D.54.6 Summary

Below we set out the contribution of tamarillos to the New Zealand economy.

Table 163 Tamarillos summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.08 million)	100%	0.37	$0.03 million
Orchard gate ($0.8 million)	100%	0.37	$0.3 million
Processing and Wholesaling margin $0.1 million)	100%	0.29	$0.03 million
Domestic ($1.3 million)	100%	0.18	$0.2 million
Export ($0.2 million)	100%	0.45	$0.1 million
Total GDP output share			**$0.7 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts 2012

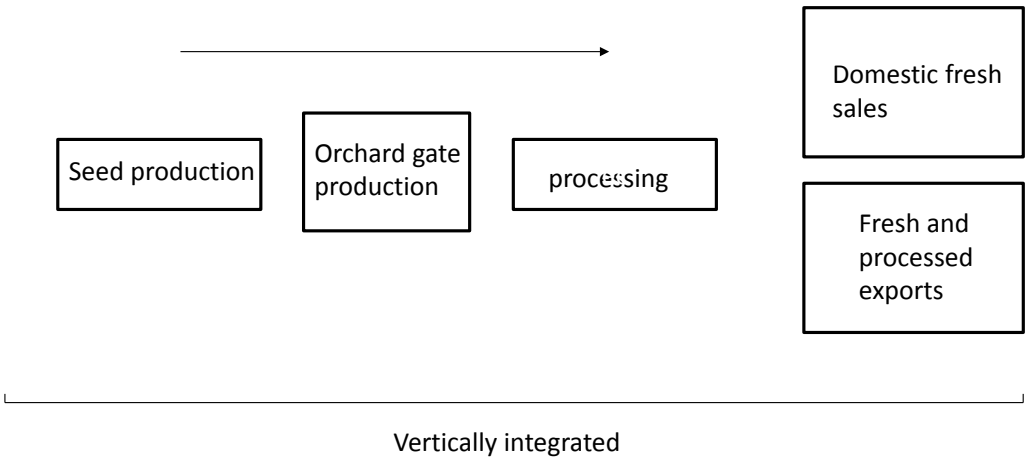
D.55 Tea (*Camellia sinensis*)

Tea (*Camellia sinensis*) is a relatively new venture in New Zealand and is based around one Waikato business growing tea for the Chinese and Asian markets (Zealong).

Export data for 2012 is available but other information on the industry is scarce. We have used industry assumptions to generate information for the industry.

Below we have set out the marketing chain for tea

Figure 59 Tea value chain



Source: NZIER

D.55.1 Trees/root stock Gross Output value

Zealong have established a nursery to supply their operations. We estimate the value of nursery plantings at approximately $0.01 million or 1% of the estimated farmgate returns.

D.55.2 Orchard gate Gross Output value

Horticulture New Zealand estimates that for many horticultural industries orchard gate prices are approximately half of domestic and export Gross Output values. Domestic and export Gross Output values for tea was approximately $2.3 million (Statistics New Zealand HS code 0902 and estimates of domestic Gross Output values).

Table 164 Tea value at Orchard gate Gross Output value

	Domestic + export orchard gate Gross Output values	Adjustment factor	Farmgate Gross Output value estimate
Tea orchard gate value	$2.3 million	0.5	$1.1 million

Source: Statistics New Zealand and NZIER estimates

D.55.3 Processing and Wholesaling margin

The companies in the industry tightly hold the processing value information. We have estimated the value of the Processing and Wholesaling margin at 15% of orchard gate values.

Processing consists of drying, packing, handling, storage, wholesaling and freight.

Table 165 Estimated tea Processing and Wholesaling margin

	Domestic plus export Gross Output value	Adjustment factor	Processing and Wholesaling margin
Estimated tea Processing and Wholesaling margin	$1.1 million	0.15	$0.2 million

Source: Statistics New Zealand and NZIER estimates

D.55.4 Domestic Gross Output value

We have no reliable information on domestic tea Gross Output values. We have looked at other similar sized industries (e.g. sphagnum moss, parsnips, and blackcurrants) to estimate the possible size of the industry. No more than 20% of Gross Output value is expected to be in the domestic market (or $0.5 million).

D.55.5 Export Gross Output value

Statistics New Zealand report that tea exports were $1.8 million in 2012 (HS code 0902).

D.55.6 Summary

Table 166 sets out the contribution of tea to the New Zealand economy.

Table 166 Tea summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.01 million)	100%	0.37	$0.004 million
Orchard gate ($1.1 million)	100%	0.37	$0.4 million
Processing and Wholesaling margin ($0.2 million)	100%	0.29	$0.05 million
Domestic ($0.5 million)	100%	0.18	$0.1 million
Export ($1.8 million)	100%	0.45	$0.8 million
Total GDP output share			**$1.4 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts 2012

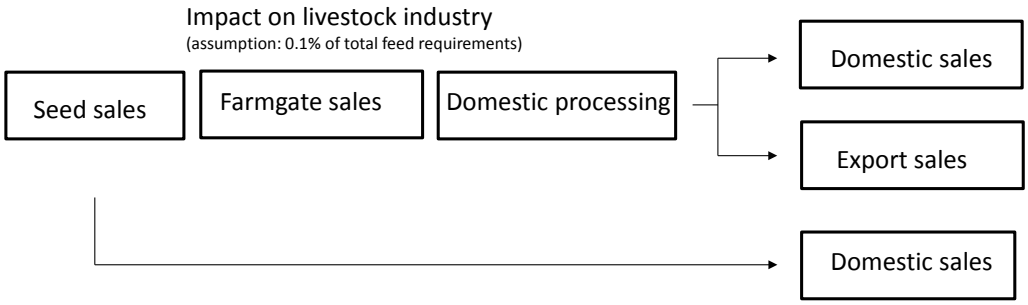
D.56 Timothy (*Phleum pratense*)

Timothy (*Phleum pratense*) is a very minor grass used as part of a grass mix in the colder and wetter regions of the South Island, mainly for beef pastures.

Below we set out the value chain for timothy.

Figure 60 Value chain for timothy

Note that other livestock industries include live animals, wool, dairy, meat processing, velvet and other co-products sold.



Source: NZIER

D.56.1 Seed and domestic Gross Output value

Approximately 20 tonnes of timothy seed is produced in New Zealand with a value of $0.04 million in domestic Gross Output value from seed sales (personal communication, Alan Stuart, PGG Wrightson's, 19th March 2015). Farmgate Gross Output value from seed production is approximately half the domestic Gross Output value ($0.02 million).

D.56.2 Dependent industry

We have assumed that most timothy grass is consumed by the beef industry. We have further assumed that it contributes 0.1% of the protein for the whole beef industry.

The value chain impacts for the beef industry are set out below using Beef + Lamb New Zealand's estimates (personal communication, Mr Rob Davison, 5 June 2014) of farmgate value, processing and wholesaling, domestic, and export Gross Output value.

Table 167 Estimated dairy Gross Output value at each stage of the marketing chain[1]

2012, $M

	Farmgate Gross Output value	Processing and Wholesaling margin	Domestic sales Gross Output value	Export Gross Output Gross Output value
Other traditional livestock values	$5,958.1 million	$3,033.0 million	$1,432.8 million	$6,882.1 million
Note (1) See Appendix B for Gross Output values.				

Source: Beef + Lamb New Zealand estimates and Statistics New Zealand

D.56.3 Summary

Table 168 sets out the contribution of timothy to the economy.

Table 168 Timothy summary

2012, $ M

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Farmgate ($0.02 million)	100%	0.37	$0.007 million
Timothy seed ($0.04 million)	100%	0.18	$0.007 million
Timothy impact on the beef industry[1]			
Farmgate Other livestock ($5,958.1 million)	0.1%	0.48	$2.2 million
Other livestock Processing and Wholesaling margin ($3,033.0 million)	0.1%	0.15	$0.5 million
Other livestock domestic ($1,432.8 million)	0.1%	0.18	$2.6 million
Other livestock export ($6,882.1 million)	0.1%	0.48	$3.3 million
GDP output share (total)			**$8.6 million[2]**
Note (1) See Appendix B for Gross Output values of other traditional livestock. (2) Numbers rounded.			

Source: PGG Wrightsons

D.57 Tomatoes (*Solanum lycopersicum*)

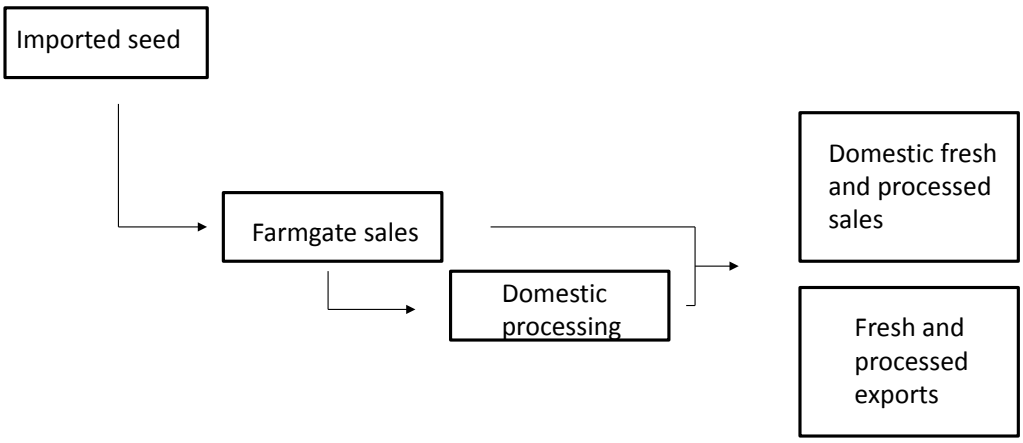
The tomato (*Solanum lycopersicum*) industry is based on covered production for fresh tomatoes (120 hectares in 2012) and outdoor production for processed tomatoes (757 hectares in 2012). Fresh tomato growers raise their plants in greenhouses and are based in Auckland, Pukekohe, Northland, Waikato, Bay of Plenty, Nelson and Canterbury. Processed tomatoes are mainly based in the Gisborne and Hawke's Bay regions.

In 2012 the trend for fresh tomatoes continued towards large tomato-growing enterprises of 20 hectares or more as the smaller players exited the industry. Some 150 growers produced 40,000 tonnes of tomatoes. Most fresh tomatoes are sold on the domestic market with a small export trade.

Good information exists on domestic and export Gross Output values. The amount sold in the processing wholesaling markets is also known. Information on farmgate Gross Output value is based on industry assumptions and most commercial seed is imported.

Below we set out the value chain for tomatoes.

Figure 61 Tomato value chain



Source: NZIER

D.57.1 Seed Gross Output value

Most tomato seeds are imported except for small quantities of heirloom tomato seeds grown for the domestic stage of the value chain (personal communication, Lex Dillon, NZ Hothouse Ltd, 13 March 2015).

D.57.2 Farmgate Gross Output value

Tomatoes levy data indicates that farmgate Gross Output value was $103.5 million (Tomatoes NZ).

D.57.3 Processing and Wholesaling margin

Processing consists of packing, handling, freight, and wholesaling and further processing.

For fresh product we have used an estimate of 15% of farmgate Gross Output value ($103.5 m x 0.15 = $15.5 m). Further processing and wholesaling margin is estimated at

$6.6 million (5m + 3.4m) x 0.79 = $6.6m, NZIER's estimate is based on established retail margins i.e. 21% less than the domestic and export Gross Output value estimates).[73]

The total Processing and Wholesaling margin is estimated at $22.2 million.

D.57.4 Domestic Gross Output value

Domestic Gross Output value of fresh and processed tomatoes were approximately $140.0 million (Tomato levy data, Tomatoes NZ).

D.57.5 Export Gross Output value

Export Gross Output value of fresh and processed tomatoes were approximately $10.3 million (Statistics New Zealand).

D.57.6 Summary

Table 169 sets out the contribution of tomatoes to the New Zealand economy.

Table 169 Tomato summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Seed	100%	0.37	Mainly imported
Farmgate ($103.5 million)	100%	0.37	$38.3 million
Processing and Wholesaling margin ($22.2 million)	100%	0.29	$6.4 million
Domestic ($140.0 million)	100%	0.18	$25.2 million
Export ($10.3 million)	100%	0.45	$4.6 million
Total GDP output share			**$74.6 million[1]**
Note (1) Numbers rounded.			

Source: Tomatoes NZ

D.58 Tulips (*Tulipa* species)

Tulip (*Tulipa* species) production is heavily focused on the export market. In recent years, tulip bulb producers have filled an off-season niche within Europe increasing exports albeit from a low base.

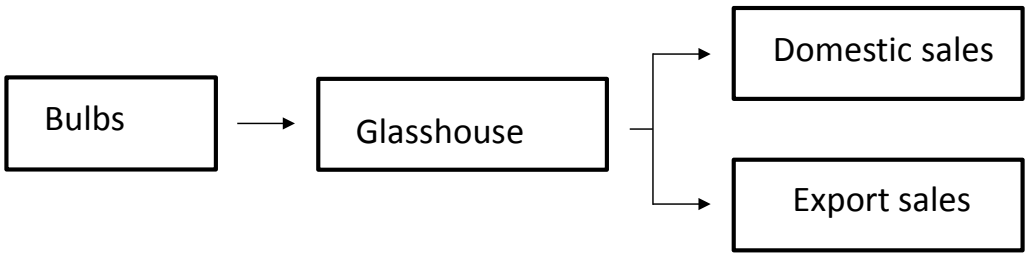
As with other bulb industries, estimating total value is hampered by the large number of differing marketing channels used (e.g. supermarkets, agents, direct buying etc.).

[73] New Zealand Retailers Association 2013, p16.

Therefore, we have relied on industry experts to give a general indication of value at each stage of the process.

The following figure sets out the marketing chain for tulips.

Figure 62 Tulip value chain



Source: NZIER

D.58.1 Bulb Gross Output value

We have no official information on tulip bulb production. As with other flower production, businesses are vertically integrated. Bulbs for the next season are produced at the same time as this year's production and multiplied up or bought from other growers.

The approximate cost or 'best guess' of the value of this process was approximately $0.6 million (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014 and NZIER estimate).

D.58.2 Glasshouse gate Gross Output value

Glasshouse gate Gross Output value estimates are also hard to estimate. The best guess by the industry is approximately $6.2 million (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014). Furthermore, the sales channels are numerous with each channel having a different pricing strategy complicating estimates for Glasshouse gate Gross Output value.

D.58.3 Domestic Gross Output value

Domestic Gross Output value is estimated at $3.0 million. This is a highly approximate figure based on 60 million bulbs sold at $0.05 per bulb (personal communication, Andre der Kwaak, GM FloraMax, 28 November 2014).

D.58.4 Export Gross Output value

Fresh Facts (2012, p20) estimates the export Gross Output value of tulip bulbs as $9.3 million.

D.58.5 Summary

Table 170 sets out the GDP output share of tulip bulbs to the New Zealand economy.

Table 170 Tulip bulbs summary

2012, June year, $ M per annum

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Nursery ($0.6 million)	100%	0.37	$0.02
Glasshouse gate ($6.2 million)	100%	0.37	$2.3 million
Domestic ($3.0 million)	100%	0.18	$0.5 million
Export ($9.3 million)	100%	0.45	$4.2 million
Total GDP output share			**$7.0 million**[1]
Note (1) Numbers rounded.			

Source: Fresh Facts 2012, FloraMax

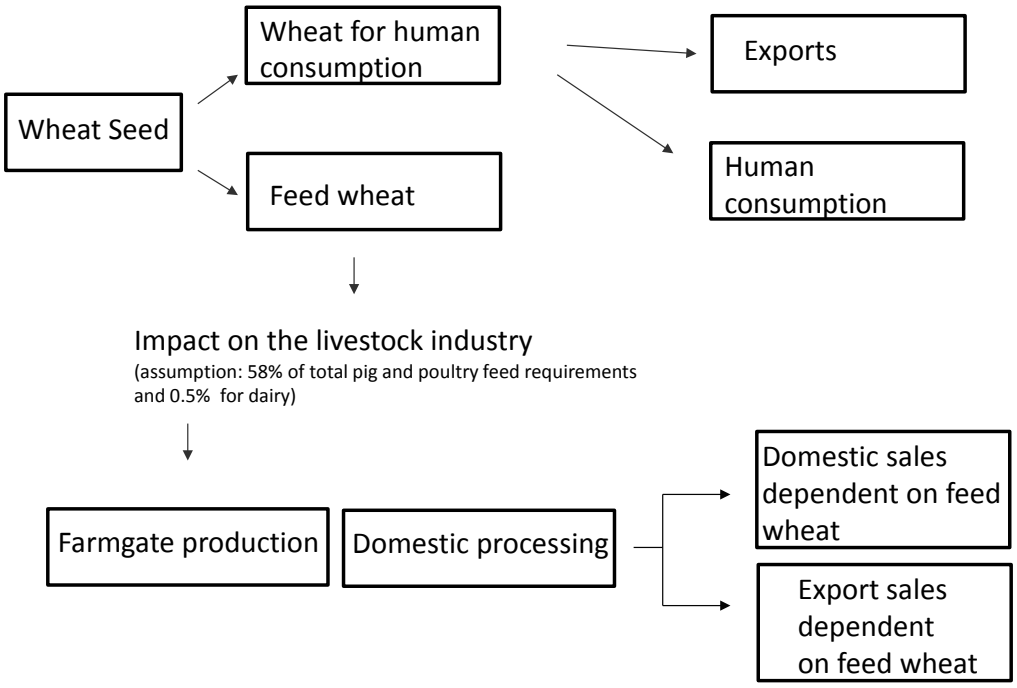
D.59 Wheat (*Triticum*)

This analysis of wheat includes both *Triticum aestivum* and *T. durum*. Wheat arrived with European settlement. In the 19th century, wheat was the major crop in New Zealand. Its long decline began with refrigeration as other land uses became more competitive. Deregulation in the late 1980s has reduced the wheat crop further as it now has to compete with imported Australian wheat.

Good information is available on wheat seed and farmgate value from the Arable Food Industry Council. This has been driven by a FAR initiative to improve the quality of data at the farmgate through the AIMI survey. Information on human consumption is not well documented because of the large number of uses of wheat and information on processing costs is closely guarded. Information on the impact on livestock industries is well documented.

Below we set out the value chain for wheat and its dependent industries.

Figure 63 Wheat value chain



Source: NZIER

D.59.1 Wheat seed Gross Output value

Estimates for feed wheat and milling wheat are based on tonnes grown for each market and are set out in the following Table.

Table 171 Wheat seed Gross Output value

	Tonnes of wheat seed (percentage of wheat seed sold for each market)[1]	Price[2]	Gross Output value
Milling wheat	2,088 (32%)	$480 per tonne	$1.0 million
Feed wheat	4,418 (68%)	$430 per tonne	$1.9 million
Total			**$2.9 million[3]**
Notes (1) Wheat seed sold in 2011: 6,500 tonnes, Hampton et al 2012, p131. (2) Lincoln Financial Budget Manual 2012/2013 pA49 to A51. (3) Numbers rounded.			

Source: Hampton et al 2012 and Lincoln Financial Budget Manual 2012/13

D.59.2 Farmgate Gross Output value

Farmgate Gross Output value is estimated as $138.1 million in the 2012 year. The calculations are set out in Table 172.

Table 172 Wheat farmgate Gross Output values

	Tonnes of wheat sold[1]	Price[2]	Gross Output value
Milling wheat	90,000	$450 per tonne	$40.5 million
Feed wheat	244,000	$400 per tonne	$97.6 million
Total			**$138.1 million[3]**
Notes (1) Arable Food Industry Council (2) Lincoln Financial Budget Manual 2012/2013 pA49 to A51. (3) Numbers rounded.			

Source: Hampton et al 2012 and Lincoln Financial Budget Manual 2012/13

D.59.3 Dependent industries

Human consumption

Gross Output value estimates for processing and wholesaling, domestic, and export are set out in Table 173.

Table 173 Wheat Gross Output values for human consumption

	Farmgate Gross Output value	Conversation factor	Gross Output value
Processing and Wholesaling margin	$40.5 million[1]	0.15[2]	$6.1 million
Domestic	$40.5 million[3]	2[4]	$81.0 million
Export[5]			$1.1 million[6]
Notes (1) Domestic plus export Gross Output value. (2) NZIER estimate of mark up between farmgate and processing parts of the value chain (1.15 above farmgate Gross Output value). (3) Milling wheat sold at farmgate. (4) Horticulture New Zealand's general assumption that domestic Gross Output value are twice farmgate values. (5) Statistics New Zealand. (6) Numbers rounded.			

Source: Statistics New Zealand, NZIER

Feed wheat

We have assumed that most feed wheat enters the poultry and pig industries. From the New Zealand Feed Manufacturers Association[74] we know that nearly 59% of all protein used in these industries is sourced from the wheat industry.

Farmgate value for the pork and poultry industries are estimates taken from industry publications and communications with New Zealand Pork and the Poultry Industry Association of New Zealand.

Feed wheat is also consumed by the dairy industry. We have estimated that feed wheat provides 0.5% of dairy industry feed requirements at the farmgate.

[74] http://nzfma.org.nz/media/reference/feed-manufacture/2013-annual-nzfma-feed-overview

Table 174 Farmgate Gross Output value

2012, June year $ M

	Estimated farmgate Gross Output value ($m)	Impact of wheat[1]
Layer-hen feed[2]	$165.0 million	0.588
Poultry feed[2]	$1,000.0 million	0.588
Pig feed[3]	$185.0 million	0.588
Pig and poultry total	**$1,350.0 million**	
Dairy	$10,828.0 million[4 5]	0.05
Notes: (1) http://nzfma.org.nz/media/reference/feed-manufacture/2013-annual-nzfma-feed-overview (2) pers comm, Mr Steven Kerr, Poultry Industry Association of New Zealand, 24 July 2014. (3) pers comm, Mr Ian Braugh, New Zealand Pork, 12 August 2014. (4) Also see Appendix B. (5) Numbers rounded.		

Source: Poultry Industry Association of New Zealand, NZ Feed Manufacturers Association and New Zealand Pork

Processing and Wholesaling margin

Processing and Wholesaling margin values are based on assumptions from other livestock industries such as Beef + Lamb New Zealand and Horticulture New Zealand (personal communications, Mr Rob Davison, Beef + Lamb New Zealand, 30 July 2014, John Seymour, Horticulture New Zealand, 12 December 2014 and Statistics New Zealand) and are set out in Table 175. The Processing and Wholesaling margin value is an estimate for the value of the poultry processing stage of the value chain (15%). Pork processing cost data (11.7%) was obtained from New Zealand Pork (personal communication, Mr Ian Braugh, 12 August 2014).

Feed wheat is also used in the dairy industry providing an estimated 0.5% of feed requirements.

Table 175 Wheat processing and Wholesaling margin calculations

2012, June year, $ M

	Estimated Processing and Wholesaling margin value of each industry[2]	Impact of wheat[1]
Layer hen feed	$165 m x 0.15 = $24.8m	0.588
Poultry feed	$1,000 m x 0.15 = $150.0m	0.588
Pig feed[3]	$185.0 m x 0.117 = $21.7m	0.588
Pig and poultry estimated total value	**$196.4 million**	**0.588**
Dairy Processing and Wholesaling margin	$6,552.0m [4]	0.05
Notes: (1) NZ Feed Manufacturers Association (2015). (2) Estimates are based on pers comm with Mr Rob Davison Beef + Lamb New Zealand, 30 July 2014. (3) Processing costs for pigs are estimated by New Zealand Pork at 11.7% (pers comm, Mr Ian Braugh, 12 August 2014). (4) Numbers rounded.		

Source: Beef + Lamb New Zealand, Poultry Industry Association of New Zealand and New Zealand Pork

Domestic consumption

The domestic retail margin is estimated at approximately 128% of farmgate value (New Zealand Retailers Association 2013). Therefore, the total domestic Gross Output value is the sum of each stage of the value chain (farmgate value multiplied by impact of barley), plus an additional 28%.

Table 176 Domestic Gross Output value

2012, June year, $ M

	Estimated value of domestic Gross Output value[1]	Impact of wheat
Hen-layer feed	$165m x 1.28 = $211.2m	0.588
Poultry growers	$1,000m x 1.28 = $1,280m	0.588
Pigs	$185m x 1.28 =$236.8m	0.588
Pigs and poultry estimated total value	**$1,728.0 million**	**0.588**
Dairy	$1,045.6 million	0.005
Note (1) New Zealand Retailers Association (2013, p16) suggests that meat retail margins are around 28% for meat. (2) Numbers rounded. (3) Also see Appendix B, Table 7.		

Source: Beef + Lamb New Zealand, Poultry Industry Association of New Zealand and New Zealand Pork

D.59.4 Export Gross Output value

Feed wheat also contributes to the export stage of the value chain through dairy export Gross Output value.

Table 177 Export Gross Output value

$ M, June 2012

	Estimated Gross Output value for export	Impact of wheat	Share
Dairy sales	$12,573.7 million	0.05	$62.9 million

Source: NZIER estimates based on Dairy NZ information

D.59.5 Summary

Table 178 sets out the contribution of wheat to the New Zealand economy.

Table 178 Wheat summary

2012, $ M

Gross Output value (price multiplied by quantity at each stage of the value chain)	Impact of plant species at each stage in the value chain	Share of output value (attributable to stage in the value chain) that contributes to GDP	Impact of the plant species on GDP
Wheat production			
Domestic seed ($2.9 million)	100%	0.37	$1.1 million
Farmgate ($138.1 million)	100%	0.37	$51.1 million
Wheat production for human consumption			
Processing and Wholesaling margin ($6.1 million)	100%	0.29	$1.8 million
Domestic ($81.0 million)	100%	0.18	$14.6 million
Export ($1.1 million)	100%	0.45	$0.5 million
Wheat production as an input into various industries (feed wheat)[1]			
Farmgate (pig and poultry livestock, $1,350.0 million)	58.8%	0.24	$198.5 million
Processing and Wholesaling margin (pig and poultry livestock, $196.4 million)	58.8%	0.68	$17.3 million
Domestic (pig and poultry livestock, $1,728.0 million)	58.8%	0.12	$121.9 million
Farmgate (Dairy $10,828.0 million)	0.5%	0.49	$26.5 million
Processing and Wholesaling margin (Dairy $6,552.0 million)	0.5%	0.13	$4.3 million
Domestic (Dairy $1,045.6 million)	0.5%	0.18	$0.9 million
Export (Dairy $12,573.7 million)	0.5%	0.48	$30.2 million
Total			**$468.6 million[2]**
Note (1) See Appendix B for Gross Output values of pigs and poultry and the various stages of the production chain. (2) Numbers rounded.			

Source: Beef + Lamb New Zealand, DairyNZ, Poultry Industry Association of New Zealand, New Zealand Pork and Arable Food Industry Council

Appendix E References

E.1 Appendix A, B & C references

AGRICOM (), Cocksfoot, other grasses, http://www.agricom.co.nz/products/cocksfoot

Ahern Michael & Geoff Langford, Strawberry Growers New Zealand Inc, personal communications, 23 March 2015.

AIMI (2012), *Summary of Maize Areas and Volume – 1 May 2012* http://www.far.org.nz/mm_uploads/AIMI_Maize_May_1_2012.pdf

AIMI (2013), *Summary of Cereal Areas and Volume – 1 July 2013.* http://www.far.org.nz/mm_uploads/3963_AIMI_Survey_July_1_2013_Summary_Report_FINAL.pdf

Aitken A, Martech, unpublished data and personal communication, 13 February, 2015.

Beef + Lamb New Zealand (various years), *Farm Facts*.

Beef + Lamb New Zealand [Meat New Zealand] (2001), Perennial grasses - what you need to know, *More Profit from Pastures*, issue 2, November. http://www.beeflambnz.com/Documents/Farm/Perennial%20grasses%20-%20Profit%20from%20Pastures%20series.pdf.

BERL (2011), *2011 Analysis of the Value of Pasture to the New Zealand Economy*. Report to the Pasture Renewal Charitable Trust.

BERL (2012), *Economic Impact Assessment of Arable Production*. Report to the Arable Food Industry Council.

Blackcurrants New Zealand Inc., Website http://blackcurrant.co.nz/blackcurrants/the-nz-industry/

Blueberries New Zealand (2015), Website http://www.blueberriesnz.co.nz/

Blundell Anthony, Kaipara Kumera, personal communication, 3 March 2015.

Booker J W (2009), *Production, distribution and utilisation of maize in New Zealand*. Lincoln University, A dissertation submitted in partial fulfilment of the requirements for the Degree of Masters of Applied Science.

Braugh I, New Zealand Pork, personal communication, 12 August 2014.

Briggs K (1999) Feeding racehorses, *The Horse* 1 August 1999.

Campbell Athol, Riversun Nurseries, personal communication, 16 May 2014.

Clough P (2013), The value of ecosystem services for recreation. In Dymond J (Ed), *Ecosystem services in New Zealand: conditions and trends*. Lincoln: Manaaki Whenua Press.

Davison R, Beef + Lamb New Zealand, personal communications: 5 June 2014, 30 June and 30 July 2015.

Deloitte (2012), Vintage 2012. http://www2.deloitte.com/content/dam/Deloitte/nz/Documents/consumer-business/vintage2012winesurvey.pdf

Der Kwaak A, FloraMax, personal communications: 28 November 2014 and 10 December 2014.

Dillon Lex, NZ Hothouse Ltd, personal communication, 13 March 2015.

Dymond J (Ed) (2013), *Ecosystem services in New Zealand: conditions and trends*. Lincoln: Manaaki Whenua Press.

Finch Stephen, Spec Seed, personal communication 5 March 2015.

Fallon Peter, Aspara Pacific Ltd, personal communication, 10 March 2015.

Forbes Rod, Ministry for Primary Industries, personal communication, 15 May 2014.

Gee E (2012), *Feeding Horses in New Zealand*. Publication of the New Zealand Equine Research Foundation.

Green D, PGG Wrightson, personal communication, 20 March 2015.

Green J and J Morton, Graham Greene Ltd, personal communications, 13 March 2015

GRIN (2015) United States Department of Agriculture Germplasm Resources Information Network. http://www.ars-grin.gov/cgi-bin/npgs/html/tax_search.pl

Hampton J, Rolston M, Pyke N, and Green W (2012), Ensuring the long term viability of the New Zealand seed industry. *Agronomy New Zealand, 42, 2012*.

Hobson W, Lefroy Valley, personal communications: 4 March 2015, 12 March 2015 and 13 March 2015.

Honsis D, RD2 International, personal communication, 6 May 2014.

Horticulture New Zealand and Plant and Food Research (various years), *Fresh Facts: New Zealand Horticulture*.

Horticulture New Zealand, unpublished data supporting Fresh Facts 2012.

Horticulture New Zealand (2014), Barriers to our Export Trade.

IER Pty. Ltd (2010), *Size and Scope of the New Zealand Racing Industry*. New Zealand Racing Board. http://www.nzracingboard.co.nz/wp-content/uploads/2013/11/NZRB_Size_and_Scope_Final.pdf.

Kearney Mike, Blackcurrants New Zealand Inc, personal communication, 12 October 2014.

Kerr S, Poultry Industry Association of New Zealand, personal communication, 24 July 2014.

Lawrie Ivan, FAR, personal communication, 4 March 2015.

Lee-Jones D, US Embassy, personal communication, 16 October 2014.

Lincoln University (2012/13), *Lincoln Financial Budget Manual.* ed Jane Pangborn.

Loader Paula, Ministry for Primary Industry, personal communication, 24 July 2014.

Market Access Solutionz Ltd (2014), APP202097 – Dichlorvos and its formulations: submission from the Horticulture Industries. Prepared for Horticulture Product Groups. http://www.epa.govt.nz/search-databases/HSNO%20Application%20Register%20Documents/APP202097_SUBMISSION110662_Market_Access_Solutionz.pdf.

Market Access Solutionz (2014a), *Barriers to our Export Trade*. New Zealand Horticulture Export Authority and Horticulture New Zealand.

Marshall K, Waimea Nurseries, personal communications: 13 March 2014, 16 May 2014, 12 December and 13 March 2015.

Milner J P & N R Roskruge (2013), The New Zealand Arable Industry. In Dymond J (Ed), *Ecosystem services in New Zealand: conditions and trends*. Lincoln: Manaaki Whenua Press.

Ministry for the Environment (2014a) Historic updates of Kyoto Protocol financial information . http://www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/nzs-net-position-under-kyoto-protocol/historic

Ministry for the Environment (2014b) Greenhouse Gas Inventory and Net Position Report http://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/ghg-inventory-2014-snapshot.pdf

Ministry for Primary Industries (2012), *Horticulture monitoring 2012: pipfruit*. Wellington: MPI. https://www.mpi.govt.nz/document-vault/4191.

Ministry for Primary Industries (2013) National Exotic Forest Description (NEFD) as at 1 April 2013, Wellington. https://www.mpi.govt.nz/document-vault/809

Ministry of Agriculture & Forestry (2008), Criterion 6 in *Sustainable management of New Zealand's forests*. http://maxa.maf.govt.nz/mafnet/publications/2008-nz-report-montreal-process/criterion6a.pdf

Ministry of Agriculture & Forestry (2010) *New Zealand wood availability forecasts 2007-2040.* Wellington: MAF.

Ministry of Forestry and the New Zealand Forest Research Institute Ltd (1995), *Special purpose timber species*. Wellington: Ministry of Forestry. http://maxa.maf.govt.nz/forestry/publications/SpecialPurposefinal.pdf.

Ministry for Primary Industry Exports Group, data received, June 2014.

New Zealand Feed Manufacturers Association (2015), *Annual Feed Production Statistics for the Year Ending December 2014*. http://www.nzfma.org.nz/media/reference/feed-manufacture/2013-annual-nzfma-feed-overview.

New Zealand Forage Systems (2012) *Plantain – A brief literature review, http://www.nzforagesystems.co.nz/uploads/library/Muir/Plantain_-_A_brief_Literature_Review_-_December_2012.pdf*

New Zealand Forest Owners Association (FOA) (various years), *Facts and Figures* (annual publication) http://www.nzfoa.org.nz/resources/publications/facts-and-figures.

New Zealand Forest Owners Association *Facts and Figures 2012*, Exports by product.

New Zealand Persimmon Industry Council, Website http://www.nzpersimmons.org.nz/

New Zealand Retailers Association (2013), *The Retail Market in New Zealand: An Analysis 2013*. New Zealand Retailers Association.

New Zealand Wine Growers (2013) *Annual report*.

Newman M, DairyNZ, personal communications: 18 May 2014, 24 February 2015 and 20 March 2015.

Nicholas I and Hall P (2010), *Promising resources and systems for producing bioenergy feedstocks: Eucalypts New Zealand*. IEA Bioenergy. http://ieabioenergytask43.org/wp-content/uploads/2013/09/IEA_Bioenergy_Task43_PR2011-01.pdf.

Palmer J (2012), 'Apples and pears - Pipfruit in New Zealand', *Te Ara - the Encyclopedia of New Zealand*, updated 13-Jul-12. http://www.teara.govt.nz/en/apples-and-pears/page-1.

Partridge C, Southern Produce Ltd, personal communication, 19 March 2015.

Peach D, Oakberry Farm, personal communication, 11 March 2015.

PGG Wrightson Seeds (), Cocksfoot. http://www.pggwrightsonseeds.com/products/grassses/cocksfoot/

Plant & Food Research, Case studies. http://www.plantandfood.co.nz/

Potatoes New Zealand, Website http://www.potatoesnz.co.nz/

Pyke N, FAR, personal correspondence, July 15th 2014.

Saunders Steven, Pollen Plus, personal communication, 14 August 2014.

Seymour J, Horticulture New Zealand, personal communications: 12 December 2014 and 19 March 2015.

Simmonds D (2013), Tourism and ecosystem services in New Zealand. In Dymond J (Ed), *Ecosystem services in New Zealand: conditions and trends*. Lincoln: Manaaki Whenua Press.

Spence Matthew, Horticulture New Zealand, personal communication, 12 December 2014.

Statistics New Zealand (2013), *Gross Domestic Product: December 2012 quarter*. http://www.stats.govt.nz/browse_for_stats/economic_indicators/GDP/GrossDomesticProduct_HOTPDec12qtr/Tables.aspx.

Statistics New Zealand (2007). *National Accounts Input-Output tables: year ended 2007*. http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts/input-output%20tables.aspx

Statistics New Zealand (2011). HSC Codes 0101, 0902 from *New Zealand Harmonised System Classification 201*2. Available from www.stats.govt.nz

Stuart Alan, PGG Wrightsons, personal communication, 19 March 2015.

Treasury (2015), New Zealand Economic and Financial Overview 2015. http://purl.oclc.org/nzt/o-1732

Turk Ian, Persimmons Industry Council, 16 May 2014.

Underwood Ruth, Fruition, personal communication, 15 May 2014.

USDA (2013), New Zealand fresh deciduous fruit annual, New Zealand Apple and Pear Sector report, November. USDA Foreign Agricultural Service. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Fresh%20Deciduous%20Fruit%20Annual_Wellington_New%20Zealand_11-27-2013.pdf.

USDA (2013a), New Zealand Kiwifruit – A sector report. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/New%20Zealand%20Kiwifruit%20-%20A%20Sector%20Report_Wellington_New%20Zealand_1-23-2013.pdf

Walker Jim, Plant and Food Research, personal communication 16 September 2014.

Wickham Ben, New Zealand Wine Growers, 19 August 2014.

Yao R, L Barry, D Harrison, S Wakelin, Magnard & T Payn (2013), Planted Forests. In Dymond J (Ed), *Ecosystem services in New Zealand: conditions and trends*. Lincoln: Manaaki Whenua Press.