LOCKYER VALLEY HORTICULTURE RESEARCH PROJECT

STAFFORD STRATEGY

Lockyer Valley REGIONAL COUNCIL

Australian Government
BUILDING OUR FUTURE

Prepared For Lockyer Valley Regional Council | April 2018

SYDNEY OFFICE

3.02 POST 46a MacLeay Street
Potts Point NSW 2011, Australia

E admin@thestaffordgroup.com.au

O +61 29331 6222

BRISBANE OFFICE

PO BOX 265
Sandgate QLD 4017, Australia

E admin@thestaffordgroup.com.au

MELBOURNE OFFICE

Level 19, 567 Collins Street
Melbourne VIC 3000, Australia

E admin@thestaffordgroup.com.au

STAFFORD STRATEGY

www.staffordstrategy.com.au

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1. Executive Summary

1.1. Introduction

Stafford Strategy[1] (Stafford) was commissioned by the Lockyer Valley Regional Council (Council) to develop a report on horticultural production within the Lockyer Valley Region (region). The purpose of the project is to:

- Offer a greater understanding of the horticultural production industry; and
- provide a guide to Council and industry to assist with future planning and decision making.

A key outcome of the project has been to identify the capacity to increase food production, as well as levels of 'waste'[2] that could potentially be used as an input[3] commodity for bio-energy.[4] Council has requested that Stafford investigate the estimated volume of *useable* waste that could justify the development of a bio-processing facility, that could harness potential bio-energy for the region

Stafford is aware that access to accurate and relevant horticultural data is a vital tool for Council, governments and industry to help determine the allocation of resources and to help grow the economy. Therefore, there is a need to ensure that data for horticultural production provides an accurate representation of the industry in its current form, to help inform future development opportunities and, ultimately, benefit the Lockyer Valley.

1.2. What We Know

Figure 1 provides an overview of all available published data relevant to the agricultural industry, particularly horticultural commodities, as published by the Australian Bureau of Statistics (ABS). This excludes large scale crop production and includes the following categories (as defined by the ABS):

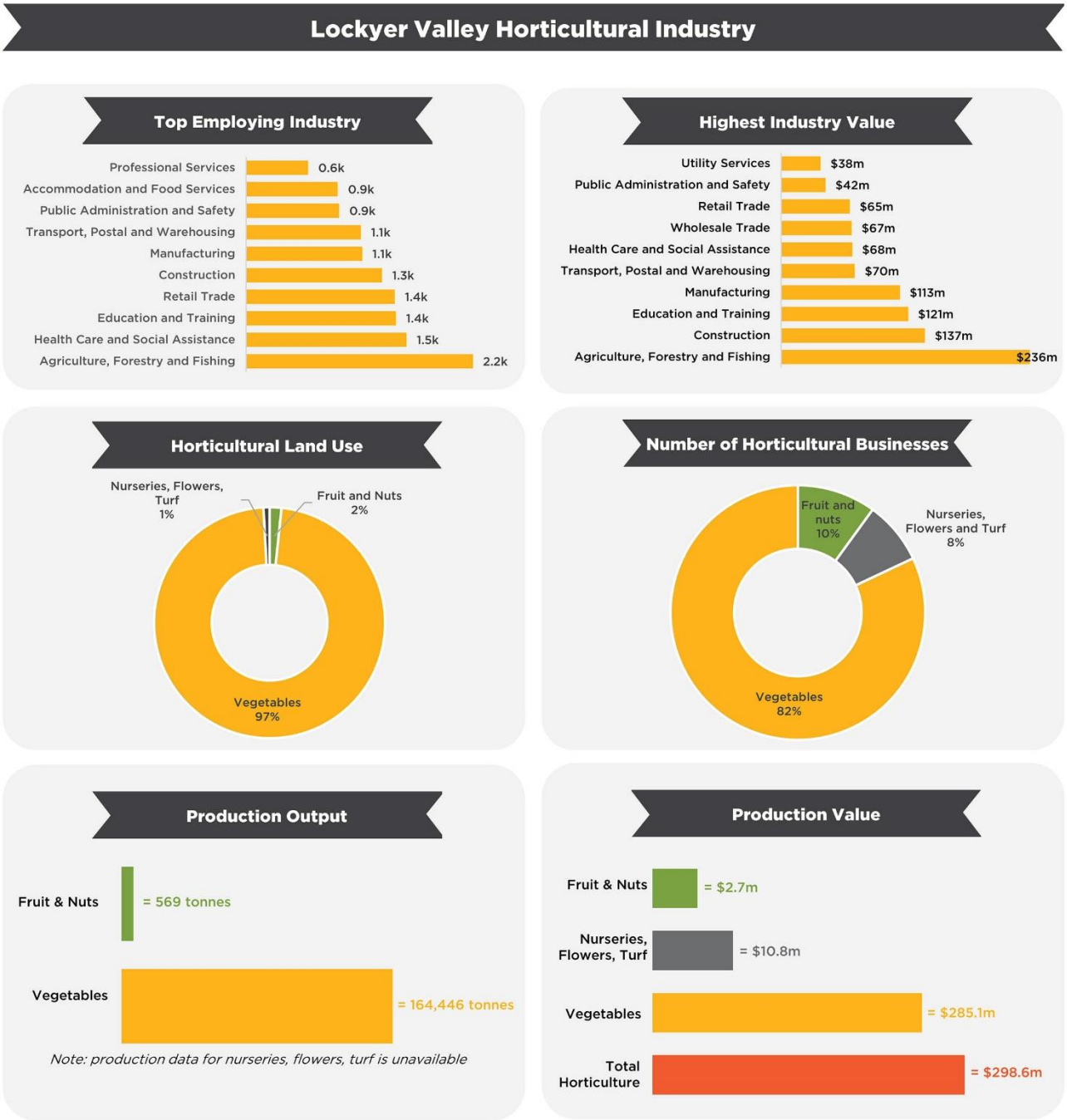
- fruit and nuts;
- nurseries, flowers and turf; and
- vegetables (for human consumption).

As shown below, horticulture is a significant part of the Lockyer Valley economy and vital to the region's growth. The top regional employing industry, as well as the highest value[5] industry, is 'agriculture, forestry and fishing' (inclusive of the horticultural sector).[6]

In addition, horticultural production in the region is substantial, generating a total estimated output[7] of 165k tonnes per annum, at a total gross value of around $300m. This is primarily driven by vegetable production, which comprises over 95% of total horticultural output and value.

[1] Formerly The Stafford Group (pre-November 2017)
[2] For the purpose of this report, 'waste' refers to damaged crops or crops unable to be harvested for its original use
[3] Input describes any product, resource or material used to grow, harvest and produce crops, including labour, machinery, seeds, fertilizer, etc
[4] Bioenergy describes any renewable energy source based on biological matter. We have distinguished this term from bio fuel, which is more commonly used to describe liquid bio energy fuels.
[5] The dollar value generated by crops produced in the Lockyer Valley, which contributes to the local economy
[6] As 'forestry' and 'fishing' are very minor industries in the region, the vast majority of employment is in agriculture/horticulture.
[7] The level/volume of crops produced in the region, measured in terms of weight

Figure 1: Lockyer Valley Horticultural Industry



Importantly, one of the major advantages of the Lockyer Valley, compared to other agricultural regions across Australia, is its ability to produce different commodities on a consistent (i.e. year-round) basis. This maximises the level of output and increases the demand for labour, providing significant benefit to the local economy.

In addition, the Lockyer Valley horticultural industry provides a significant contribution to nation-wide production. The region comprises around 5% of Australia's total vegetable production (and around 20% of total Queensland production).[8] As such, the region plays an important role in overall food production, including the ability to act as a market leader in generating output to meet future increases in demand across Australia.

[8] Horticulture Innovation Australian Limited, Australian Horticulture Statistics Handbook (vegetables), 2018; Excludes 'other vegetables'

1.3. What We Don't Yet Know

Table 1 summarises the gaps in horticultural data that are not yet available from any available data sources or are unable to be provided by growers (who are reluctant to release data, even to independent third parties).

Table 1: Gaps in Horticultural Data

Gaps	
▪ Full range of commodities not listed ▪ ABS data not consistent with growers' data ▪ Some relevant data not publicly available ▪ Commodity supply chain unknown ▪ Lack of labour force statistics	▪ Lack of input data (e.g. labour costs) ▪ Lack of waste data ▪ ABS data request not user friendly ▪ Growers often unable/unwilling to provide accurate data

1.4. What We Need to Know

The following outlines the data benchmarks and data categories that need to be provided in order to improve data accuracy and increase understanding of the horticultural industry:[9]

- employment figures – both size and cost of labour for each commodity;
- the land use required (by area), as well as the location of production;
- the costs of all other inputs, such as water, seeds, etc;
- packing and harvesting costs;
- the gross value of production;
- the volume and type of exports (i.e. processed vs fresh produce);
- the volume and type of imports (i.e. processed vs fresh produce);
- the financial performance of the region's farms, in terms of total income;
- identification of any challenges in production, such as water supply, soil quality, etc; and
- the need for external support from the growers' group or Council to support production and potential expansion.

1.5. Industry Potential

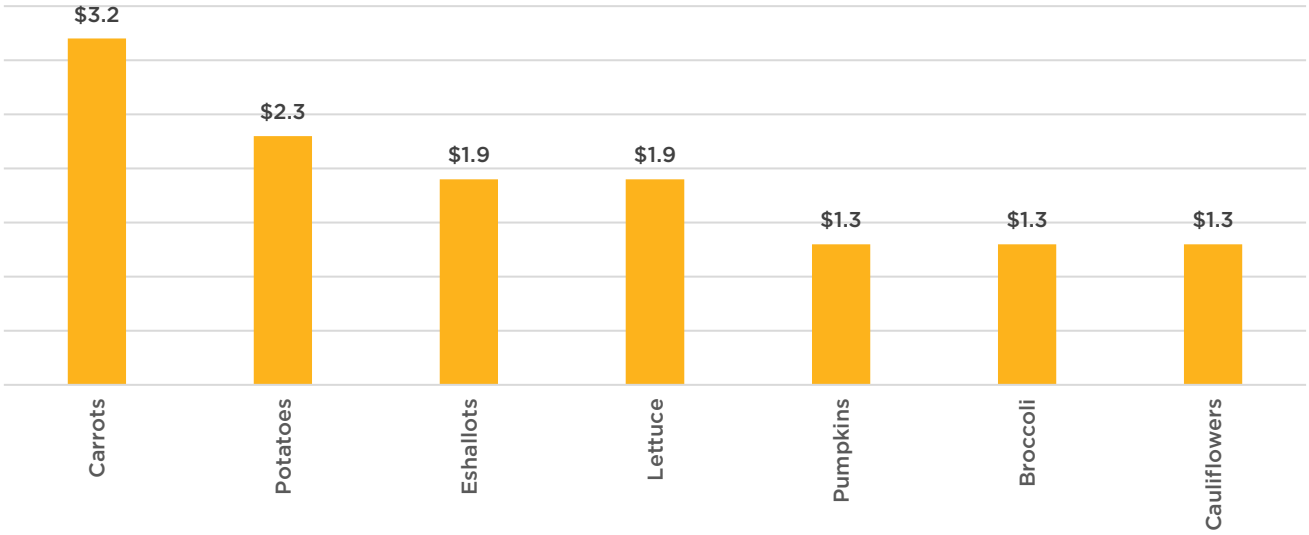
To examine industry potential, including the capacity to increase horticultural output and value, an assessment was made of survey data provided by the growers' group. This provides a snapshot of 7 crops grown in the region, based on survey responses from 10 different growers (out of 42). To provide a complete dataset and offer higher levels of sectoral accuracy, would, however, necessitate a higher response from growers in the region.

The input data provided by the growers only included labour costs; while the output data only covered production value. Ideally, one would use the full range of inputs (such as labour, machinery, seeds, pesticides, etc) and calculate production output in terms of volume and value. However, due to the limited data available, labour costs were applied as the proxy for inputs and production value as a proxy for outputs. Figure 2 shows the subsequent input-output ratio for selected crops by dividing the total value of production by the value of inputs. This demonstrates the additional value of output for every additional dollar of input. By product, carrots (ratio of $3.2) are the most

[9] These benchmarks were adapted from a variety of sources, including: Department of Economic Development Jobs, Transport and Resources (Victoria), Vegetable Industry Profile, 2014; National Horticultural Research Network, National Research, Development & Industry Development Framework for Horticulture, 2010

cost-effective crop, followed by potatoes ($2.3). In effect, the ratio reflects the value of outputs for every additional dollar of inputs. As such, we note the following key points:

Figure 2: Input-Output Ratio, Growers' Group Survey Data[10]



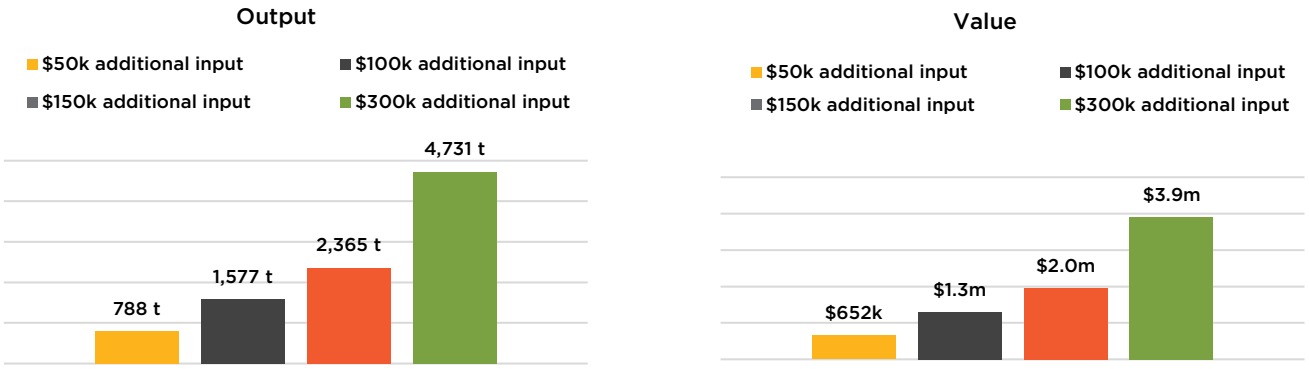
1.5.1. Capacity for Industry Growth

The capacity for generating additional output and value was estimated for the surveyed crops, using the above ratios, assuming a range of different increases in total input (by $50k, $100k, $150k and $300k). These input levels are deliberately conservative to reflect, for illustrative purposes, what a small percentage of additional input can have on output able to be generated.

The overall result of this analysis is shown in Figure 3, which demonstrates:

- the total cumulative output for the crops could increase by a range of 788 tonnes ($50k additional input) to 4,700 tonnes ($300k additional input); and
- the total cumulative value of output has the capacity to increase by up to a further $3.9m (from $300k of additional input).

Figure 3: Capacity for Additional Output and Value



[10] Eshallots are used as a proxy for onions

These results merely provide a snapshot of the capacity for industry growth, as it is based on the input-output ratios for 7 crops only. A complete dataset, with information for all horticultural crops, would provide a more holistic representation of the capacity for increases in output and value noting there are many crops grown in the Lockyer.

In addition, increasing production is predicated on growers in the region being able to fully utilise agricultural land and, importantly, having access to additional water for irrigation, which is currently noted as a major limitation.

1.5.2. Economic Impact of Additional Input

Additional input into horticultural production will also generate additional economic benefit to the region, primarily through additional employment and subsequent increases in employee/worker spend. As shown in Table 2, the key results from this analysis are as follows:

- total additional employment days ranging from 286 days ($50k input) to 1,716 days ($300k input); and
- total additional employee spend in the region, ranging from of $11k ($50k input) up to $65k ($300k input).

Table 2: Economic Benefit from Additional Input

	$50k additional input	$100k additional input	$150k additional input	$300k additional input
Additional Employment Days	286 additional employment days, including potentially: ▪ 86 full time workers ▪ 57 transient workers ▪ 143 international workers	572 additional employment days, including potentially: ▪ 172 full time workers ▪ 114 transient workers ▪ 286 international workers	858 additional employment days, including potentially: ▪ 257 full time workers ▪ 172 transient workers ▪ 429 international workers	1,716 additional employment days, including potentially: ▪ 515 full time workers ▪ 343 transient workers ▪ 858 international workers
Additional Employee Spend	$11k additional employee spend, including: ▪ $1.9k full time workers ▪ $626 transient workers ▪ $8.4k international workers	$22k additional employee spend, including: ▪ $3.8k full time workers ▪ $1.3k transient workers ▪ $17k international workers	$33k additional employee spend, including: ▪ $5.6k full time workers ▪ $1.9k transient workers ▪ $25k international workers	$65k additional employee spend, including: ▪ $11k full time workers ▪ $3.8k transient workers ▪ $50k international workers

The full list of assumptions and data used to generate these results are detailed in Section 5.3 of the report.

1.6. Maximising the Use of Waste

The potential value that can be generated by waste is important to consider, as it represents the level of additional value that could be realised if a bio-processing facility was developed (that could harness bio-energy).

Using an estimated range of average waste levels for each crop (of 5%, 10% and 15%), based on approximate figures provided by the Lockyer Valley Growers' Group (growers' group), the potential volume of horticultural waste has been calculated. As shown in Table 3, this could range from 8,251 tonnes (5% waste level) to 24,752 tonnes (15% waste level). Converting this output into gross value results in increases in total value of up to $34.7m.

Table 3: Estimated Volume and Value of Waste

	5% Waste Levels	10% Waste Levels	15% Waste Levels
Volume	8,250.8 tonnes	16,501.5 tonnes	24,752.3 tonnes
Value	$11.6m	$23.1m	$34.7m

It is important to note that these results are based on assumptions to the survey data. Therefore, we recommend greater investigation is undertaken into the actual levels of waste and the ability for this waste to be processed as an input commodity for another use (e.g. bio-processing facility).

Once this data is understood, it will be important to demonstrate the potential value of waste to growers and the ability to transform this into a valuable commodity that generates growth and additional profits.

1.7. Recommendations

Based on the research and analysis to-date, we recommend the following next steps are explored to help realise future growth in the horticultural industry[11]:

- there is a pressing need for more timely and accurate datasets, including a revision of the ABS data requests and an annual survey of growers in the region;
- identify how to incentivise growers to provide more accurate data to the ABS, as well as provide specific data to independent third parties;
- the data gaps need to be filled in before considering the feasibility of a bio-processing facility (that could harness potential bio-energy;
- undertake a national and global study of best practice bio-energy plants (of a comparable scale) to determine optimum wastage requirements to make it a viable project as comparative analysis is vital for viability testing;
- assess the potential for additional crop wastage to be transported to the Lockyer Valley (from other growing regions) and examine the cost effectiveness of using this waste as an input in a bio-energy plant;
- determine the economic value of employment from increases in input, leading to greater production output and associated value;
- determine the direct and indirect economic value and benefits of increased employment and higher production levels;
- determine the broader economic value generated from production gains and employment, including wages/salary growth, spend patterns, etc;
- examine how increases in horticultural production and value would position the region in comparison with other major growth areas across Australia (e.g. percentage of total output, contribution to GDP, etc);
- through this, identifying the comparative advantages that the Lockyer Valley has over other regions; and
- identify the net effect of growth potential in horticultural production on the region.

[11] Whilst initial results have been generated above, through use of assumptions and estimations, more robust and complete data sets would strengthen these conclusions and help reduce the reliance on assumptions which have had to be made


Organic Farm

2. Context

2.1. Overview

This section provides a summary of the background to the research project, including the key strategic and economic issues that help inform the development of this project.

2.2. Methodology

The methodology adopted for this report has included the following:

- consultation with key personnel, including Councillors, Council staff and industry stakeholders (including local growers and the grower's group);
- a site visit to the Lockyer Valley, including growers, farms and urban centres;
- a review of relevant strategies and policies to build the context for the report;
- a review of relevant ABS, ABARES and Grower's Group data providing information about the horticultural industry;
- identification of data gaps, as well as opportunities for growth potential;
- discussion of preliminary findings with Council;
- preparation of the draft report and presenting interim recommendations to Council for feedback; and
- finalisation of the Horticultural Research Project.

It is important to note that there is a general lack of accurate horticultural statistical data at a regional level. The commercially sensitive nature of data also makes growers reluctant to release data, even to independent third parties.

Where possible, any data gaps have had to be filled by a mix of assumptions based on stakeholder feedback and data sources offered by existing ABS statistical material.

2.3. The Lockyer Valley

The Lockyer Valley is a Local Government Area (LGA) located in South-East Queensland, situated around one hour's drive – or 70km – to the west of Brisbane and borders Toowoomba to the east.

The region, covering approximately 2,200 square kilometres, is primarily an agricultural area and recognised as one of the "top ten most fertile farming areas in the world."[12] Most of the land is rich agricultural farmland, which is heavily cultivated to produce "the most diverse commercial range of vegetables and fruit of any area in Australia." As such, the area is often referred to as "Australia's salad bowl" and comprises 12-14% of the Queensland agricultural economy.[13]

The region also comprises a wide mix of major farming corporations, large to medium sized growers and a few smaller, boutique growers.

[12] http://lockyervalleygrowers.com.au/
[13] http://lockyervalleygrowers.com.au/

2.4. Strategic Context

Council has requested in-depth examination of horticultural production in order to assist decision-making, including the planning and allocation of resources. As such, Stafford was requested to identify the following:

- the capacity to increase food production;
- the capacity for production growth; and
- the volume of waste and potential to utilise this as an input commodity for another purpose.

It is also worth noting that Council is currently undertaking a suite of interlinked strategies and plans (being developed with the assistance of Stafford) designed to improve understanding of the region and identify opportunities for growth, including:

- an Economic Development Plan (incl. Regional Food Sector Strategy) 2018-2022; and
- a Tourism Destination Plan 2018-2022.

2.5. Economic Context

Council is focusing on this project is because the horticultural sector, as part of the broader agricultural industry, is a significant part of the Lockyer Valley's economy and vital to the region's ongoing growth.

As highlighted in the Lockyer Economic Development Plan, the agricultural industry – which is identified as a proxy for the horticultural sector[14] – is the top employing industry and generates the highest levels of economic output. The Lockyer Valley wishes to retain its dominant national position in this sector.

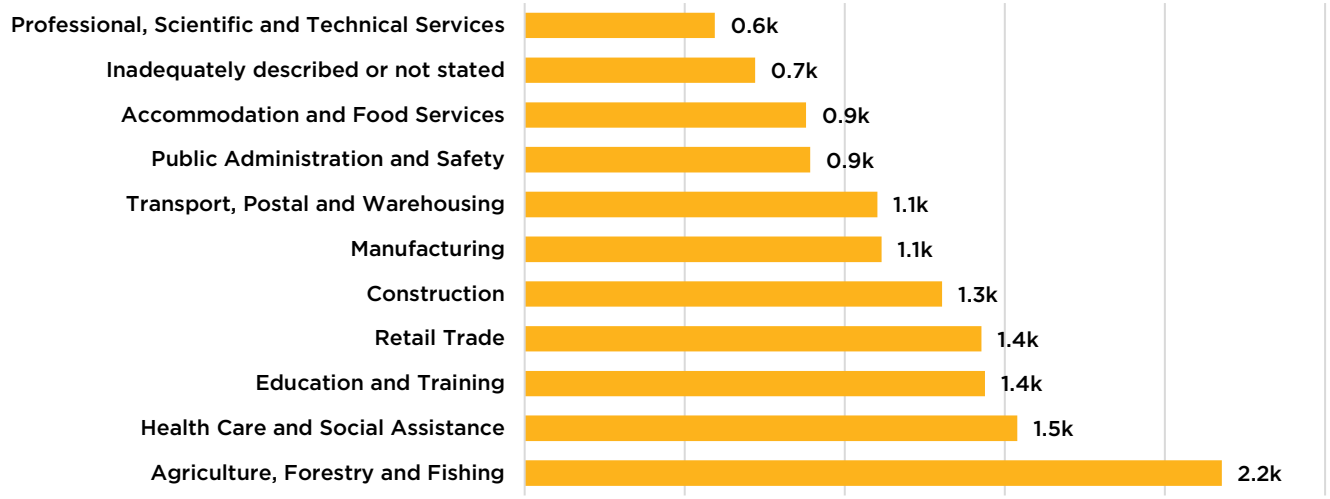
2.5.1. Industry Employment

Figure 4 details the top 10 employing industries in the Lockyer Valley for 2016. As expected, the top employing industry is 'agriculture, forestry and fishing' (inclusive of the horticultural sector), which employs around 2.2k people. This is at least 40% greater than the next highest employing industry, 'health care & social assistance' (1.5k), followed by 'education & training' (1.4k), 'retail trade' (1.4k), 'construction' (1.3k) and 'manufacturing' (1.1k).

As 'forestry' and 'fishing' are very minor industries in the region, the vast majority of employment is in agriculture/horticulture.

[14] As all available data on a macro level relates to the agricultural industry, we have assumed

Figure 4: Employment by Industry (2016)[15]

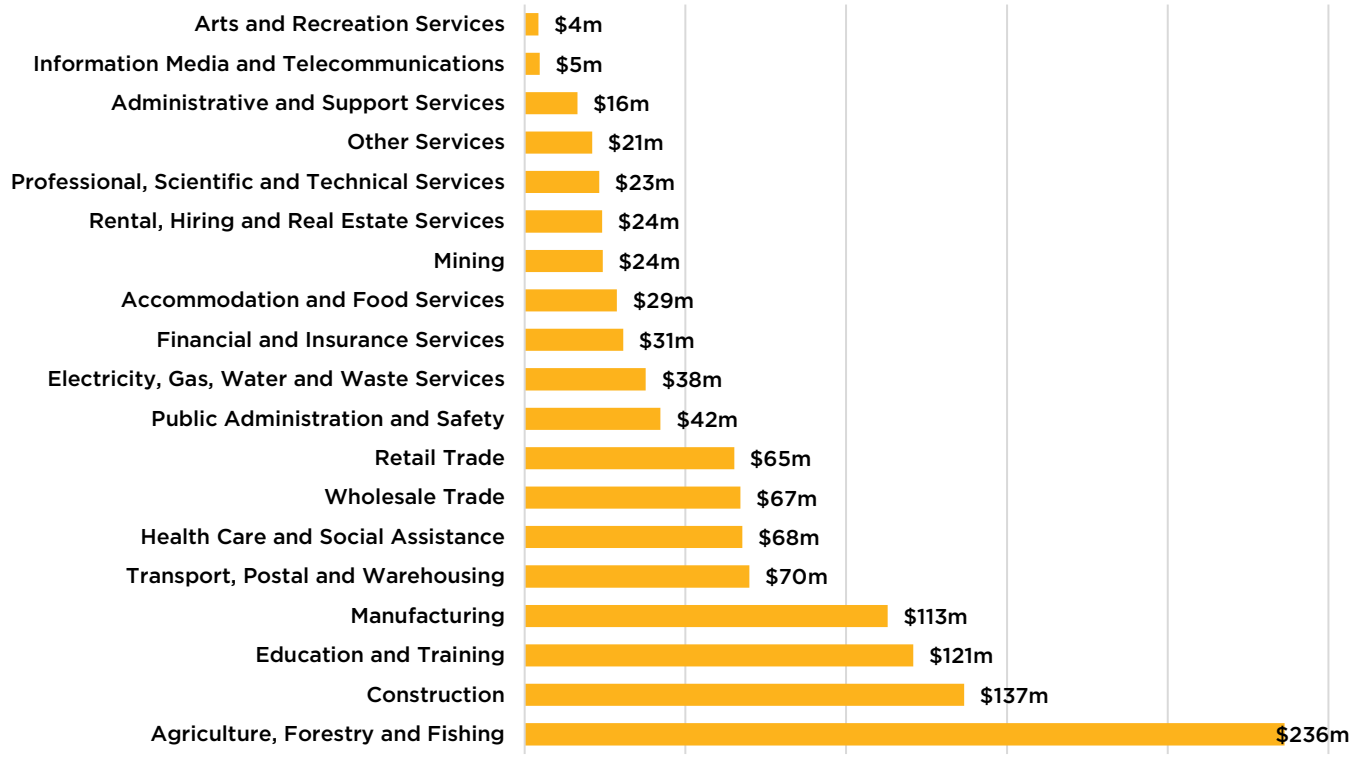


2.5.2. Industry Value

As shown in Figure 5, the 'value add' by industry is dominated by agriculture, forestry and fishing, which generated $236m in economic value, or 21% of the total. This is almost double the value of the next closest industry, construction, which generated $137m, or 12%.

This demonstrates the primacy of the agricultural industry, including horticultural production, and its importance to the Lockyer Valley economy. The bulk of this value is again attributed to agriculture/horticulture.

Figure 5: Value Add by Industry (2015-16)[16]



[15] https://profile.id.com.au/lockyer-valley/industries
[16] http://economy.id.com.au/lockyer-valley/value-add-by-industry

2.6. Demand Analysis

In addition to the economic and strategic importance of agriculture to the Lockyer Valley economy, forecast demand for agricultural products (particularly produce) is expected to increase nation-wide. Figure 6 demonstrates the projected increase in demand for fresh vegetables – a core horticultural commodity – based on data from the 2013 *Sustainable Food Bowl Strategy*.

According to this data, demand in South-East Queensland (inclusive of the Lockyer Valley) is expected to grow by 74k tonnes (or 27%) by 2031, which equates to annual average growth of 2% per annum; while across Australia, demand is expected to increase by some 147k tonnes (or 10%) by 2031.

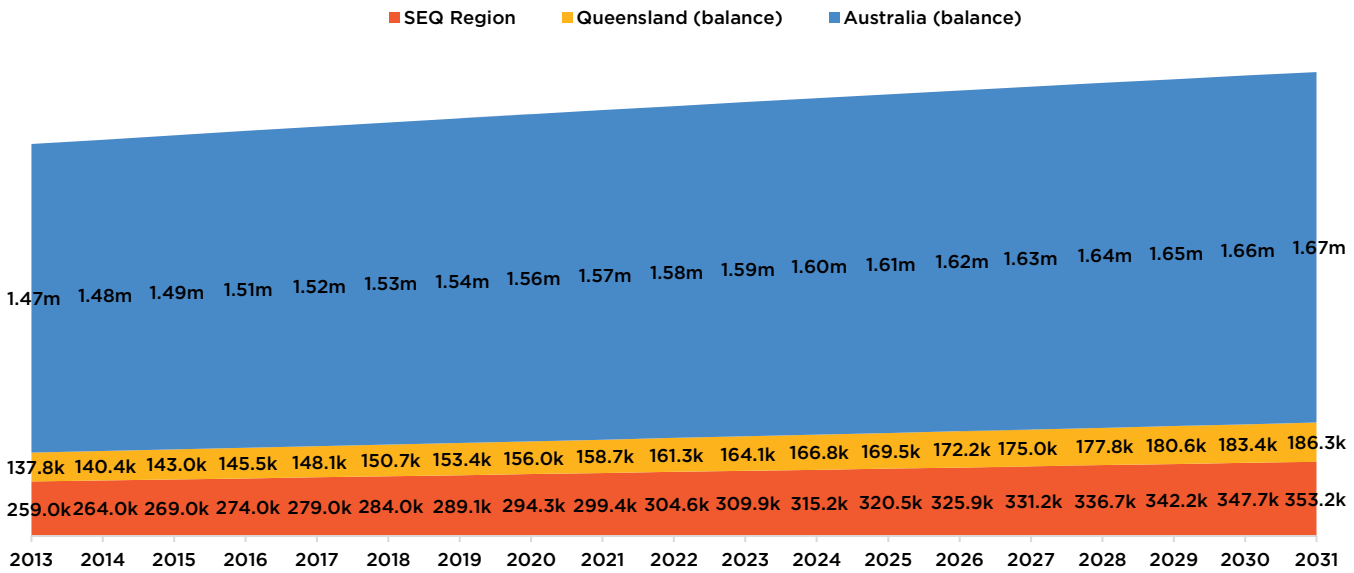
Therefore, undertaking research into the horticultural industry and obtaining more information (data and statistics) is critical to understanding the region's capacity to increase food production in line with growing consumer and export demand.

The significance needs to be viewed on a national scale, noting that the Lockyer Valley is one of the most fertile, high-quality growing regions in Australia, along with, for example, the Goulburn Valley (Victoria), the Murrumbidgee Irrigation Area (NSW), the Sunraysia district (Victoria and NSW) and the Riverland region (SA).[17] The ability to meet national demand for fresh produce, let alone expand export potential, is predicated on higher production flows from the region to meet national demand levels.

As detailed in Section 3.10., the Lockyer Valley plays an important national role in overall food production, including the ability act as a market leader in generating output to meet any increases in consumer demand across Australia.

The scale and sophistication of farming operations in the region are also an important factor in maintaining appropriate bio security levels. The ability to set, monitor and check for bio security and to avoid breaches, necessitates having major farm producers with sophisticated technology to monitor and maintain quality standards.

Figure 6: Forecast Demand for Fresh Vegetables (Tonnes per Annum)[18]



[17] Department of Agriculture and Water Resources, Horticulture Fact Sheet
[18] Information Report – Lockyer Valley Sustainable Food Bowl Strategy (2013)

2.7. Project Relevance

In addition to its contribution to the Lockyer Valley economy, the graphs in Section 2.5 also highlight the region's reliance on agriculture in terms of economic output, jobs as well as the visitor economy. Such a reliance, whilst being an obvious strength for the Lockyer Valley, is also an area of potential risk should a downturn in agriculture occur.

As such, this project plays an important role in helping to future proof the industry by identifying the capacity for growth, through estimating increases in the volume of inputs, as well as maximising the commercial uses of food production, and by looking at the potential of converting waste material into an input commodity for other uses.

In addition, Stafford is aware that access to accurate and relevant horticultural data is a vital tool for Council, governments and industry to allocate resources and grow the economy. Therefore, there is a need to ensure that the available data for agricultural production provides an accurate representation of the industry in its current form, which could help inform future development opportunities and, ultimately, benefit the Lockyer Valley.

3. Situation Analysis

3.1. Overview

This section provides an assessment of the Lockyer Valley horticultural industry, including production output and value of commodities grown in the region. This analysis aims to summarise available data, evaluate the industry and identify future commercial opportunities as well as growth potential in food production.

The data used to populate this section has been sourced from a combination of:

- ABS[19];
- the growers' group, via a survey sent out to all 42 growers in the region, of which 10 provided a response; and
- confidential discussions with Council and industry stakeholders.

3.2. Horticultural Commodities

For the purposes of this report, the horticultural industry consists of the following commodity categories grown in the Lockyer Valley (note: as defined by the ABS): fruit and nuts; nurseries, flowers and turf; and vegetables (for human consumption).

Stafford notes that this industry differs from the broader agricultural industry as it excludes large-scale crop production (e.g. wheat, cereal crops, etc.) or livestock (e.g. cattle). These other crops and major production items for the region, noting that a major strength of the Lockyer Valley is the ability to rotate commodities and cultivate numerous times per annum.

3.3. Land Use

3.3.1. Agricultural Land Use

Table 4 provides an overview of agricultural land use within the Lockyer Valley, with total holdings of around 52k hectares. Of this, horticultural commodities comprise just over 23% of total land holdings (12k hectares), which is driven by vegetable production areas (11.8k hectares). Overall, vegetable production comprises the highest area for all listed agricultural commodities.

Table 4: Agricultural Land Use (2015-16)[20]

Category	Area (ha)	% of total
Vegetables	11,750	22.6%
Broadacre crops	3,098	6.0%
Hay and Silage	242	0.5%
Fruit and Nuts	200	0.4%
Nurseries, Flowers and Turf	102	0.2%
Total holdings	**51,878**	**100%**

[19] Note: Lockyer Valley agricultural data was calculated by aggregating 'Statistical Area 2' level data (i.e. areas within the LGA), as defined by the ABS.
[20] ABS, Agricultural Commodities, Australia–2015-16; Excludes area for livestock as data is unavailable, therefore, totals do not add up.

3.3.2. Horticultural Land Use

This section expands on the horticultural categories to provide a clearer picture of land use by commodity.

3.3.2.1. Vegetables

As shown in Table 5, there is approx. 11.8k hectares dedicated to vegetable production. This is driven by large areas required for sweet corn (3.5k hectares, or 30% of total), beans (1.8k hectares or 16%) and broccoli (1.7k hectares or 15%).

Table 5: Vegetable Land Use (2015-16)[21]

Commodity	Area (ha)	% of total
Beans	1,829	15.6%
Broccoli	1,740	14.8%
Cabbages	404	3.4%
Capsicums	21	0.2%
Carrots	163	1.4%
Cauliflowers	369	3.1%
Lettuces	909	7.7%
Melons	91	0.8%
Mushrooms[22]	0.02	0.0%
Onions	295	2.5%
Potatoes	634	5.4%
Pumpkins	624	5.3%
Sweet Corn	3,536	30.1%
Tomatoes	79	0.7%
Other	1,054	9.0%
Total	**11,750**	**100%**

3.3.2.2. Fruit and Nuts

The data for fruit and nuts land use is only available for broader categories, not for individual commodities. As such, Table 6 demonstrates that of the 200 hectares used for fruit and nuts production, 97% of this is comprised of orchard fruits.

Table 6: Fruit and Nuts Land Use (2015-16)[23]

Commodity	Area (ha)	% of total
Grapes	0.6	0.3%
Orchard Fruit and Nuts	194	96.9%
Plantation	6	2.8%
Total	**200**	**100%**

[21] ABS, Agricultural Commodities, Australia–2015-16
[22] Converted from square metres
[23] ABS, Agricultural Commodities, Australia–2015-16

3.3.2.3. Nurseries, Flowers and Turf

Finally, around 100 hectares are used to cultivate turf (64 hectares), flowers (25 hectares) and nurseries (13 hectares), making this the smallest category – by land size – for the horticultural industry.

Table 7: Nurseries, Flowers and Turf Land Use (2015-16)[24]

Commodity	Area (ha)	% of total
Turf	64	63%
Flowers	25	24%
Nurseries	13	13%
Total	**102**	**100%**

3.4. Number of Local Businesses

The number of businesses undertaking agricultural activity, within the horticultural sector, is shown in Table 8. Throughout the region, there are 143 horticultural businesses, with the vast majority (82%) involved in vegetable commodities. Importantly, the size of the large farming corporations/companies means they have a disproportionate share of land and through economies of scale, are able to generate far higher productions output.

Table 8: Number of Horticultural Businesses (2015-16)[25]

Category	Number of businesses[26]	% of total
Fruit and nuts	14	10%
Nurseries, Flowers and Turf	12	8%
Vegetables	117	82%
Total	**143**	**100%**

3.5. Production Output

The following provides an overview of the level of production output (in tonnes) for each horticultural commodity. As shown in Table 9, in 2015-16 total production output was 165k tonnes, comprised of sweet corn (over 22% of total), lettuce (15%), potatoes (over 11%) and cabbages (10%).

Table 9: Horticultural Industry, Production Output (2015-16)[27]

Commodity	Production (tonnes)	% of total
Sweet Corn	37,180	22.53%
Lettuce	24,818	15.04%
Potatoes	19,573	11.86%
Cabbages	16,812	10.19%
Broccoli	13,177	7.99%
Pumpkins	12,178	7.38%
Onions	12,108	7.34%
Beans	9,226	5.59%
Cauliflower	8,214	4.98%
Carrots	5,058	3.07%
Tomatoes	3,129	1.90%

[24] ABS, Agricultural Commodities, Australia–2015-16; Excludes area for livestock as data is unavailable.
[25] ABS, Agricultural Commodities, Australia–2015-16
[26] Refers to all businesses undertaking agricultural activity with an estimated value of agricultural operations (EVAO) of $40,000 or greater
[27] ABS, Agricultural Commodities, Australia–2015-16; Note: excludes nurseries

Commodity	Production (tonnes)	% of total
Melons	2,909	1.76%
Avocados	196	0.12%
Nectarines	123	0.07%
Peaches	112	0.07%
Mangoes	79	0.05%
Limes	57	0.03%
Capsicum	45	0.03%
Mushrooms	22	0.01%
Grapes	2	0.002%
Total	165,015	100%

Other key points to note include:

- When categorised, almost all horticultural production (164k, or over 99%) is generated by vegetables.
- The remainder (i.e. less than 1%) of horticultural output is generated by fruit and nuts. However, there is no data publicly available for the production output of nurseries, flowers and turf.

3.6. Yield

The yield for each commodity is an important variable as it demonstrates the relative efficiency of production, by comparing production output against land use.

The commodity with the greatest level of yield, detailed in Table 10, is mushrooms (at 1.2k tonnes per hectare), followed by cabbages (41.6 tonnes per hectare), onions (41.1 tonnes per hectare) and tomatoes (39.4 tonnes per hectare)

However, it is important to note that yield does not necessarily equate to high output, only efficient output in terms of the level of production by area. For example, despite the significantly high yield of mushrooms, it is a relatively insignificant crop in terms of total output (22 tonnes produced per annum). Therefore, the key is to find the right balance between total output and use of available land.

When categorised, the aggregate yield for vegetables is approx. 15.4 tonnes per hectare; while the aggregate yield for fruit and nuts is 2.8 tonnes per hectare (noting this is based on output per tree).

Table 10: Horticultural Industry, Yield (2015-16)[28]

Commodity	Yield (tonne/hectare)
Mushrooms	1,167
Cabbages	41.59
Onions	41.09
Tomatoes	39.38
Melons	32.01
Carrots	30.94
Potatoes	30.86
Lettuces	27.29
Cauliflowers	22.25

[28] ABS, Agricultural Commodities, Australia–2015-16; Note: excludes nurseries

Commodity	Yield (tonne/hectare)
Pumpkins	19.52
Sweet Corn	10.52
Broccoli	7.57
Beans	5.04
Grapes	4.0
Capsicums	2.12
Avocados*	0.05
Limes*	0.02
Mangoes*	0.02
Nectarines*	0.01
Peaches*	0.01

*Note: The yield for these fruits are measured by production tonne per tree.

3.7. Production Value

3.7.1. Value of Agriculture

The total value of agricultural production in the Lockyer Valley, for 2015-16, is estimated at $365.7m. This is primarily driven by horticultural commodities – vegetables, nurseries, flowers and turf, fruit and nuts – which generate around $300m in output (82% of total), followed by livestock ($50m or 14%), hay and silage ($12.9m or 4%) and broadacre crops ($4.6m or 1%).

Although the broader agricultural industry contributes to the Lockyer Valley economy, the key contributor to industry value is generated from horticultural crops, particularly vegetables (78% of total).

Table 11: Gross Value of Agriculture (2015-16)[29]

Category	Gross Value ($m)	% of total
Vegetables	$285.1m	78%
Livestock	$50.0m	14%
Hay and Silage	$12.9m	4%
Nurseries, Flowers and Turf	$10.8m	3%
Broadacre crops	$4.6m	1%
Fruit and Nuts	$2.3m	1%
Total agriculture	**$365.7m**	**100%**

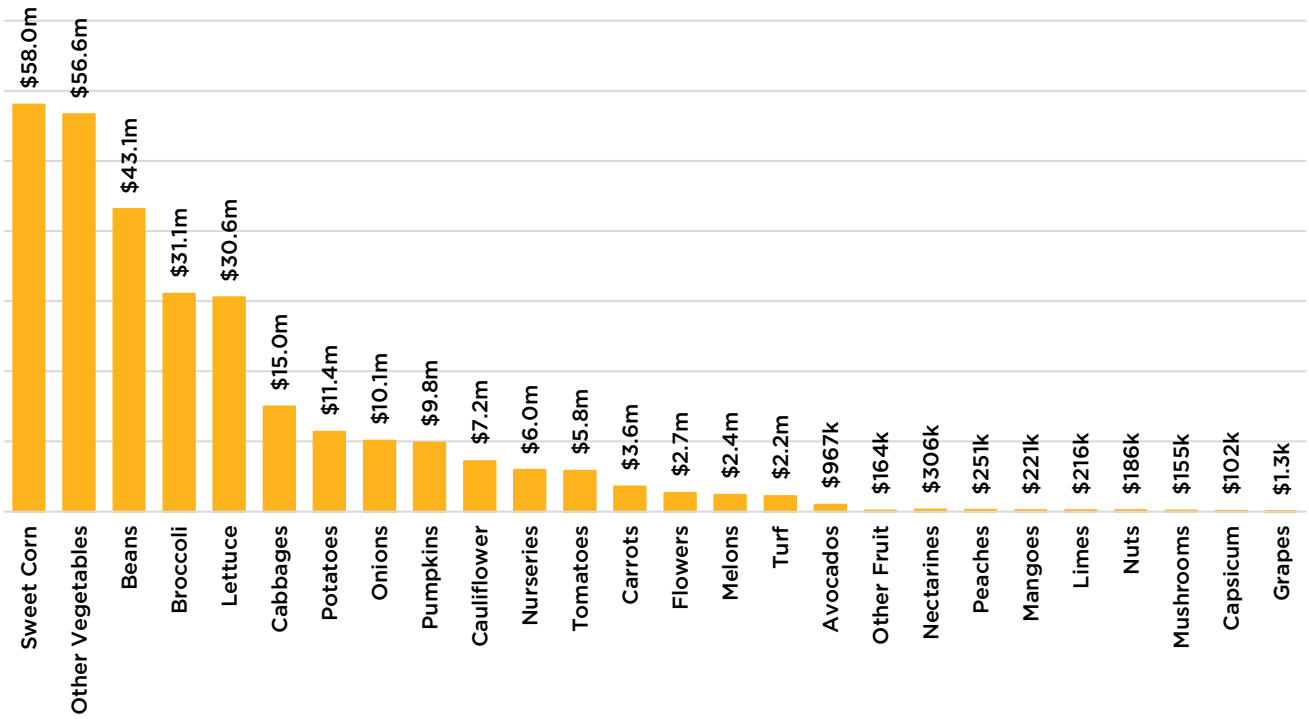
[29] ABS, Value of Agricultural Commodities Produced, Australia–2015-16

3.7.2. Value of Horticulture

Figure 7 expands on the horticultural categories above and illustrates the gross value for each horticultural crop. Key findings can be synthesised as follows:

- The top 10 commodities with the greatest value are all vegetable crops.
- The total gross value of the horticultural industry is $298.3m.
- Of the individual crops, the greatest value is generated by sweet corn ($58m), followed by beans ($43.1m), broccoli ($31.1m) and lettuce ($30.6m).
- The higher value of vegetable crops can be directly attributed to the greater levels of production output, particularly in comparison to the other horticultural categories (Section 3.5).
- The specific crops included in 'other vegetables', 'other nuts' and 'other fruit' is not specified in the data. As such, the level of output and land use is unknown.

Figure 7: Gross Value of Horticultural Commodity Outputs (2015-16)[30]



As outlined later in section 3.9, Lockyer Valley is able to produce output on a consistent (i.e. year-round) basis, with some crops able to be grown and harvested in multiple cycles per annum (see Table 12). The ability to maximise output through multiple growth cycles is a significant factor contributing to the gross value of horticultural commodities.

[30] ABS, Value of Agricultural Commodities Produced, Australia–2015-16

3.8. Production Value Analysis

This section demonstrates the relative value of the horticultural commodities, measured against the level of output as well as land use. This data was calculated by dividing the gross value of each commodity against the production output and/or land use. It is important to note, however, that this data does not necessarily reflect the overall value or output produced by each commodity.

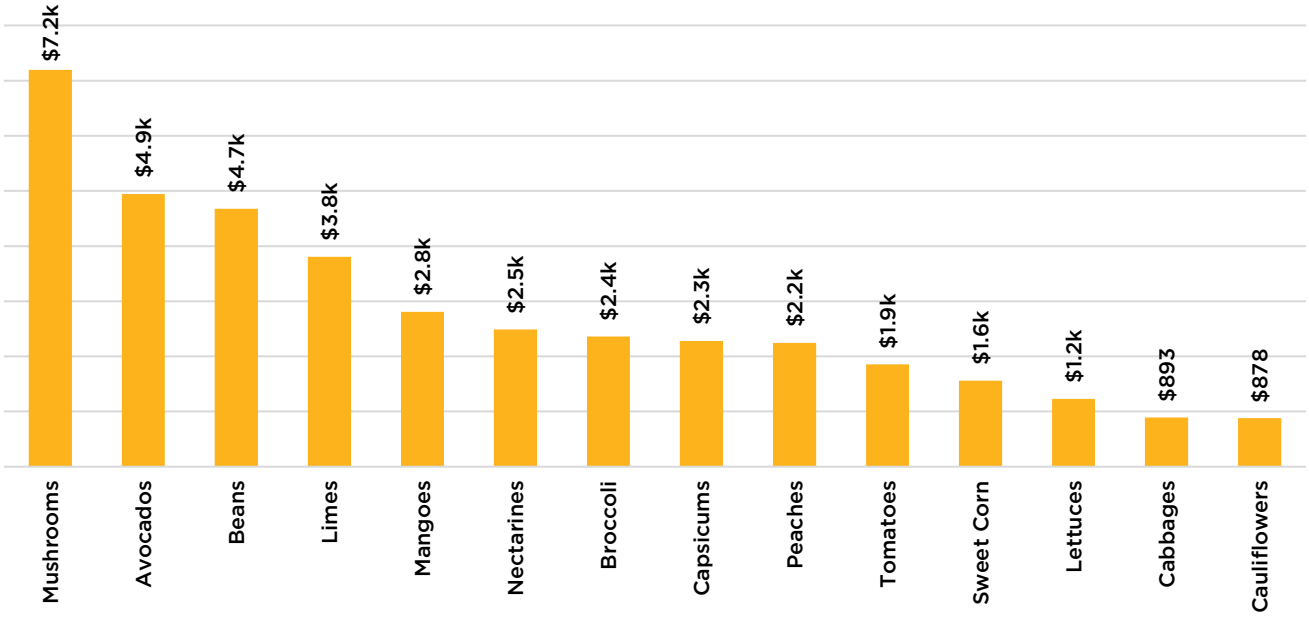
We have also excluded commodities where the data, in terms of output or land use, isn't publicly available.

3.8.1. Gross Value per Tonne (Output)

Figure 8 demonstrates the gross value generated by each crop for every tonne in production output. Key points to note include:

- The greatest value, by output, is generated by mushrooms ($7.2k per tonne), followed by avocadoes ($4.9k), beans ($4.7k) and limes ($3.8k).
- Generally, the 'lighter' produce, such as small vegetables and fruit tend to have a higher value to output ratio. Therefore, the data is less favourable to bulkier produce.
- When the horticultural crops are categorised, fruit and nuts generate $4.7k in gross value per tonne; while vegetables generate $1.4k per tonne, reflecting the higher value of most fruit and nuts.
- No data is available for the nurseries, flowers and turf category, as there is no production data provided.

Figure 8: Gross Value per Tonne (2015-16)

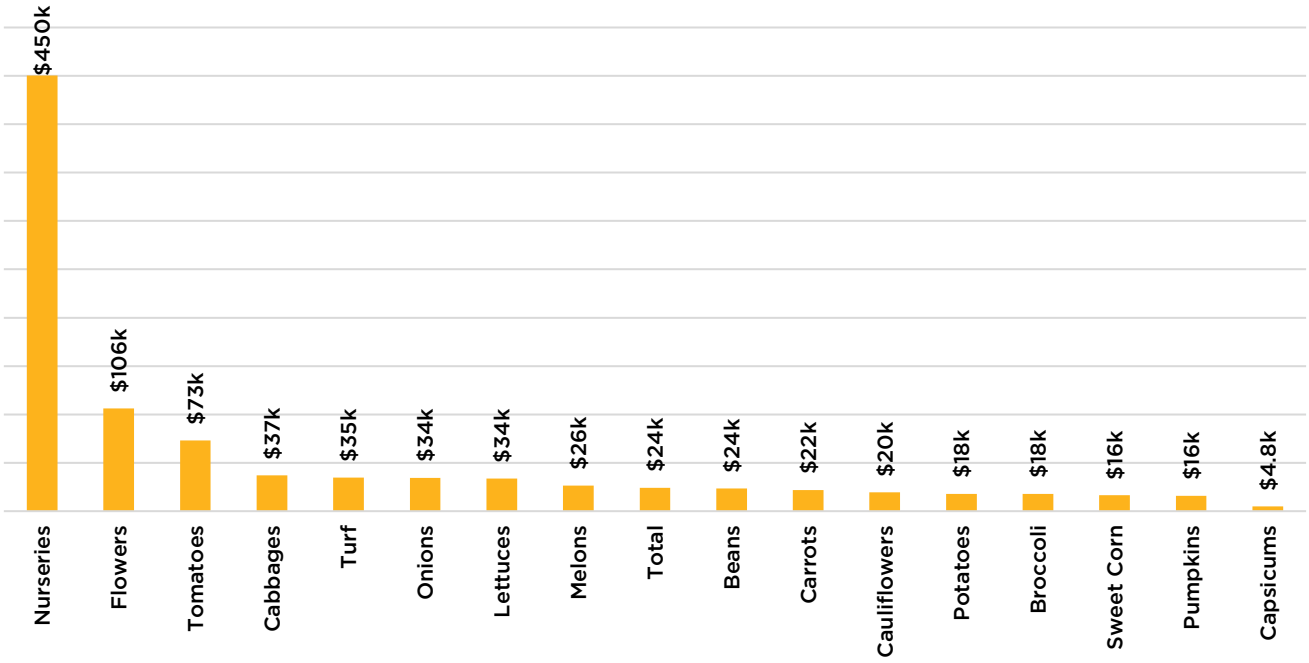


3.8.2. Gross Value per Hectare (Land Use)

As detailed in Figure 9, the gross value generated by horticulture crops, per hectare of land use, can be summarised as follows:

- Excluding mushrooms, nurseries generate the greatest value ($450k per hectare), followed by flowers ($106k), tomatoes ($73k) and cabbages ($37k).
- The data tends to be more favourable to crops that require a smaller area.
- All individual fruit and nuts crops are excluded from this analysis, as land use data for this category is not publicly available.
- When categorised, nurseries, flowers and turf generate the greatest value ($106k per hectare), followed by vegetables ($24k)[31] and fruit and nuts ($13k).

Figure 9: Gross Value per Hectare (2015-16)[32]



3.9. Year-Round Supply

As highlighted in Table 12, a comparative advantage of the Lockyer Valley (and major strength) is the ability to produce different commodities on a consistent (i.e. year-round) basis. The benefits of this include:

- a continual supply of horticultural products to meet increases in demand, with some crops able to be grown and harvested multiple times per annum;
- maximising the level of output and increasing the gross value of the horticultural industry;
- activation of downstream supply-chain companies, for packing, distribution and transport of crops; and
- increasing the overall demand for labour.

Table 12 shows planting windows (in green) and harvest windows (in grey) for some of the popular crops in the region.[33]

[31] Includes 'other' vegetables
[32] Excludes mushrooms, which, at $8.4m per hectare, is an extreme outlier
[33] This provides a snapshot only and does not include the full range of horticultural commodities or crops grown in the Lockyer Valley

Table 12: Horticultural Production, Planting and Harvesting Timeframes[34]

Crop/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beans												
Beetroot												
Broccoli												
Cabbage												
Capsicum												
Carrot												
Cauliflower												
Celery												
Chinese Cabbage												
Garlic												
Lettuce												
Onion												
Potato												
Pumpkin (Jarrahdale)												
Pumpkin (Jap)												
Sweet Corn												
Tomato												
Sweet Potato												
Watermelon												

3.10. Comparative Analysis

This section details the Australian horticultural industry, in terms of its production, to help illustrate the scale of the Lockyer Valleys contribution. This demonstrates the market share of the Lockyer Valley and the important role it plays in ensuring food production in Australia is able to meet increases in demand (Section 2.6).

For the purposes of this analysis, we have focused on vegetable production only, as:

- it is the dominant horticultural category in the Lockyer Valley and across Australia; and
- it enables a better like-for-like analysis with other locations.

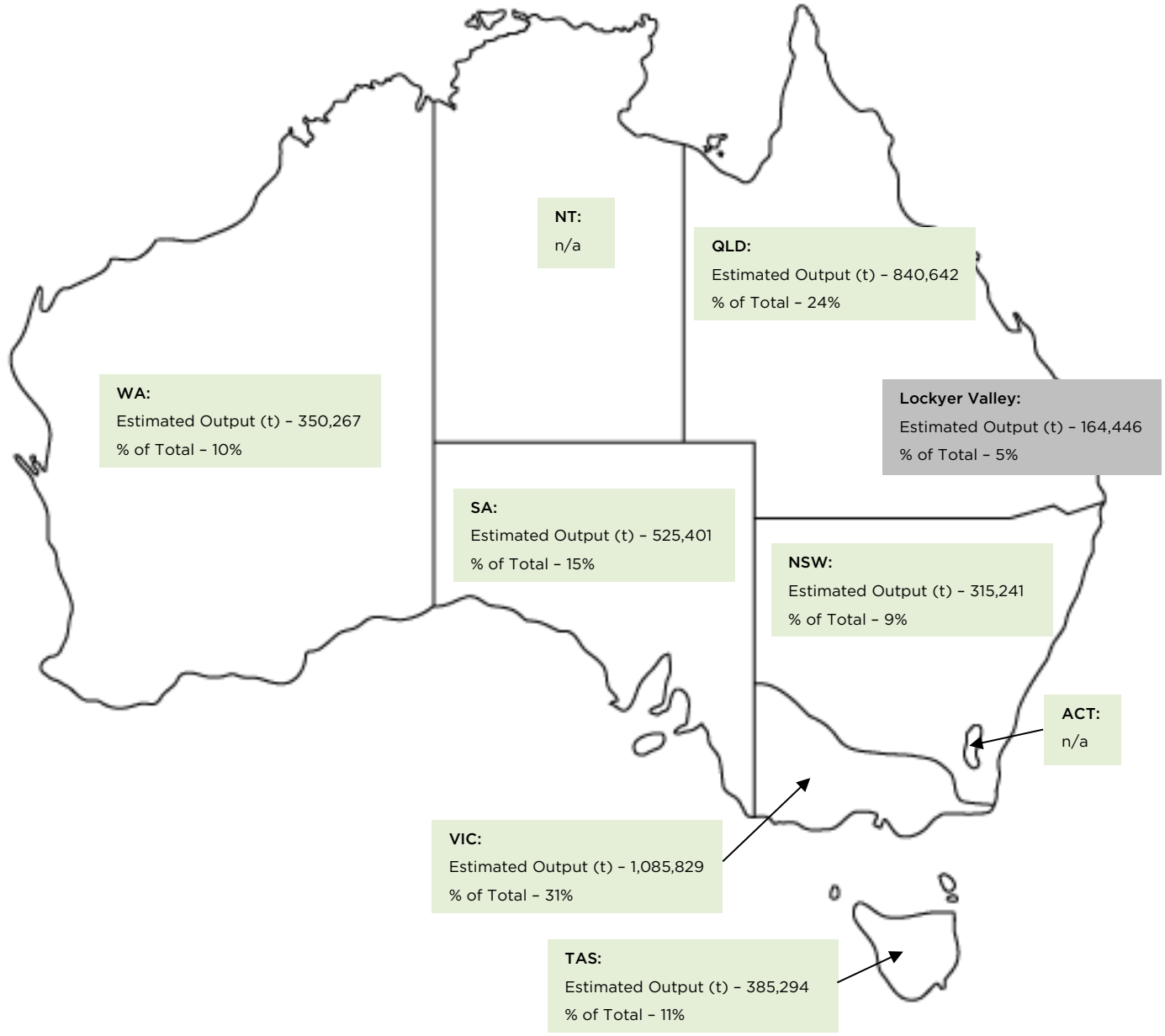
Figure 10 demonstrates the total vegetable production for select jurisdictions across Australia, as published by the 2017 Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) Australian vegetable-

[34] DAFF website. Table sourced from Information Report – Lockyer Valley Sustainable Food Bowl Strategy

growing farms survey (note: the survey excludes NT and the ACT). State-wide data, rather than regional data has been applied for horticulturally significant areas across Australia, because of the limited published information and subsequent analysis on a region by region basis. Ideally, it would be preferable to compare the Lockyer Valley against other horticultural regions, but this is not possible on a statistical level without comparable data and noting this data is not yet publicly available.

As shown, below, Victoria (31%) comprises the largest share of vegetable production in Australia, followed by Queensland (24%) and South Australia (15%). The Lockyer Valley, by comparison, generates 5% of total production, demonstrating a high-level of contribution to the industry (representing approximately 20% of total Queensland production).

Figure 10: Map of State/Territory Vegetable Production[35]



[35] ABARES Australian vegetable-growing farms survey

Stafford also measured the output of major vegetable crops grown in the Lockyer Valley, in comparison to Australia-wide output. As shown in Table 13 below, the total output of several of these crops comprises a significant proportion of total production in Australia.

For example, the Lockyer Valley comprises 61% of total sweet corn, followed by beans (32%) and cabbages (24%). Overall, the region generates 6% of the selected crops.

Table 13: Comparison of Vegetable Crop Production[36]

Crop	Lockyer Valley (t)	Australia (t)	% of total
Sweet Corn	37,180	61,333	61%
Lettuces	24,818	128,225	19%
Potatoes	19,573	1,333,418	1%
Cabbages	16,812	71,126	24%
Broccoli	13,177	75,231	18%
Pumpkins	12,178	120,981	10%
Onions	12,108	237,635	5%
Beans	9,226	29,039	32%
Cauliflowers	8,214	67,704	12%
Carrots	5,058	318,198	2%
Tomatoes	3,129	426,398	1%
Total	**164,446**	**2,869,288**	**6%**

This data demonstrates the significance of the Lockyer Valley horticultural industry, compared to state-wide and national vegetable production. As such, the region plays a significant role in the overall domestic supply of food and has the ability to remain an ongoing market leader in meeting projected increases in demand.

[36] Horticulture Innovation Australian Limited, Australian Horticulture Statistics Handbook (vegetables), 2018; Excludes 'other vegetables'

4. Gap Analysis

4.1. Gap Analysis

The following gap analysis was identified from a combination of a review of the available horticultural data, the situation analysis (Section 3) and stakeholder feedback. A summary of this analysis is detailed in Table 14, which highlights the gaps in horticultural data, key issues and a potential solution for moving forward.

Table 14: Gap Analysis

Gap in Horticultural Data	Issue	Potential Solution
Full range of commodities not listed	▪ Data provided by the ABS does not cover all crops grown in the region (e.g. broccolini, herbs) ▪ ABS list broad vegetable categories that apply nation-wide ▪ All crops not listed are included in a high-level category labelled 'other', making it impossible to disaggregate	▪ The ABS could update its agricultural categories and broaden the published list of crops, which are currently outdated ▪ The growers' group could collect crop information for the region and publish this online (or in separate publications)
ABS data not consistent with growers' data	▪ Production data published by ABS is measured by weight; while output by growers is measured by unit count (e.g. number of boxes, crates, etc) ▪ To comply with ABS requirements, growers will estimate the weight of the output (by converting from unit numbers), which impacts on data accuracy	▪ The ABS could amend data collection techniques to allow for easy conversion of output into weight (e.g. provide an online tool, etc) ▪ Growers require online programs and tools to help calculate the average weight of each unit, which would generate more accurate data
Some relevant data not publicly available	▪ Some commodities listed in ABS publications do not provide data in terms of production output or land area used ▪ In some cases, the data for different commodities is not consistent (e.g. size of land vs number of trees)	▪ ABS data should include consistent information ▪ When responding to an ABS data request, growers should provide all data for commodities grown
Commodity supply chain unknown	▪ The ABS does not specify the distribution of crops or supply chain process, including: o destination of produce (e.g. local, regional, international) o distribution of produce (e.g. retail chains, processing, fresh markets, etc)	▪ The ABS could broaden its categorisation of crop data to include this additional information ▪ The growers' group could collect this specific information from individual farms
Lack of labour force statistics	▪ ABS provides data on the number of agricultural businesses, although this is limited to businesses with an EVAO of $40,000 or greater ▪ There is no published data on the size of the labour force that contributes to horticultural production	▪ The ABS could revise its criteria for inclusion of agricultural businesses to provide a more accurate picture (noting this was implemented to avoid burdening small businesses) ▪ The ABS or the growers' group could collect data on the number of employees required to grow each crop, possibly disaggregated between the planting and harvesting workforce
Lack of input data in general	▪ The level of input required to grow each commodity is unknown ▪ This includes: size of the workforce, cost of labour, water usage, cost of other inputs (e.g. seeds, machinery, etc) ▪ Understanding the inputs required helps identify the total cost of output, the efficiency of production and the capacity for future increases in production	▪ The ABS could commence collection of input data (e.g. employee size, costs, etc) as part of the data request ▪ The growers' group could also collect input data from individual farms, published using a standard template to ensure data consistency

Gap in Horticultural Data	Issue	Potential Solution
Lack of waste data	▪ The definition of wastage is not universal amongst growers – for some, it includes damaged crops that are processed for further use; for others, all damaged crops are excluded ▪ There is no accurate data on the proportion of crops that are classified as waste – growers tend to provide an estimate or a range. ▪ The uses of crop waste (e.g. processing, canning, unused, etc) is unknown ▪ Growers are also unwilling to provide exact waste data due to privacy concerns	▪ The growers' group, on behalf of farmers in the region, could establish a universal definition of wastage that is endorsed by individual farms ▪ The growers' group could also collect waste data from individual farms, confidentially, to provide an accurate picture of total waste volume (and value) that could be used as inputs for other commodities
ABS data request not user friendly	▪ Growers are concerned that ABS data requests were a burden to complete and not user friendly. As a result, forms are often completed last minute and inaccurately, leading to inaccuracies in data	▪ The ABS should consider developing more user-friendly data requests, particularly through the use of online tools and programs that allow efficient and accurate data collection ▪ This could, for example, allow growers to accurately convert the unit output into weight, provide more detail into inputs, etc
Growers unable/unwilling to provide accurate data	▪ More specific regional data is able to be captured by industry groups, such as Lockyer Valley Growers ▪ However, growers are either unable to give accurate information or unwilling to provide data for privacy reasons	▪ Lockyer Valley Growers have already commenced data collection from individual farms in the region ▪ It should continue to do so on a regular basis (i.e. annually), including the development of a standard template for optimal (and consistent) data collection ▪ The growers' group should advocate the important of data collection and how it can be used to benefit the industry

4.2. Benchmarks

In addition to the gap analysis, Stafford has identified data benchmarks (in terms of data categories) that should be provided and published to improve data accuracy and increase understanding of the horticultural industry. These include (but are not limited to) the following[37]:

- employment figures – both size and cost of labour for each commodity;
- the land use required (by area), as well as the location of production;
- the costs of all other inputs, such as water, seeds, etc;
- packing and harvesting costs;
- the gross value of production;
- the volume and type of exports (i.e. processed vs fresh produce);
- the volume and type of imports (i.e. processed vs fresh produce);
- the financial performance of the region's farms, in terms of total income;
- identification of any challenges in production, such as water supply, soil quality, etc; and
- the need for external support from the growers' group or Council to support production.

[37] These benchmarks were adapted from a variety of sources, including: Department of Economic Development Jobs, Transport and Resources (Victoria), Vegetable Industry Profile, 2014; National Horticultural Research Network, National Research, Development & Industry Development Framework for Horticulture, 2010

4.2.1. Case Study: Agbiz tools

The Queensland Department of Agriculture and Fisheries (QDAF) publishes a useful online resource, *Agbiz tools*, that provides excel spreadsheets for a variety of crops to help farmers calculate profit, construct budgets and cashflows, and improve decision-making.[38]

This covers regional data (for Southern Queensland) and includes the following important statistical information (Table 15).

Table 15: Benchmarked Horticultural Data[39]

Type of Data	Details
Crop Revenue	▪ Market prices ▪ Yield ▪ Freight costs
Crop Expenditure	▪ Pre-harvest costs (e.g. inputs), including: o machinery; o planting; o fertiliser, insecticides, etc; and o irrigation. ▪ Harvesting costs (picking, washing, etc) ▪ Packing costs
Gross Margin	▪ In terms of $/weight and $/hectare

An illustrative example of the data that could be produced for the region's horticultural crops is shown in Figure 11. We recommend this data be replicated for Lockyer Valley growers, as it provides useful information for the region's horticulture industry that could help improve decision making by demonstrating the following (as an example):

- the profitability of each crop (as well as the 'breakeven' point);
- the cost effectiveness of inputs, in terms of how much yield and value it generates;
- the cost effectiveness of transporting goods and whether there are any efficiencies that can be realised;
- whether the use of labour is efficient and effective, in terms of total employees and hours needed; and
- the effectiveness of the downstream supply chain services (e.g. distribution and transport).

[38] https://publications.qld.gov.au/dataset/agbiz-tools-plants-vegetables
[39] Ibid

Figure 11: Example of Agbiz tools (carrots)

(1) REVENUE

		Allocation	Price		$/Bag/Carton	$/Ha
Price:	Market Price ($/20kg ctns)	75%	$8.00			
	Market Price ($/20kg bags)	25%	$6.00			
	Market Price		**$7.50**	/bag/ctn		
Yield:		1900		bags/ctns/ha		
		50		bags/ctns/pallet		
Less Freight:		% Allocation	$/pallet	$ Cost/Ha		
Destination	Brisbane	25%	$55.00	$522.50		
	Sydney	25%	$75.00	$712.50		
	Melbourne	25%	$125.00	$1,187.50		
	Other	25%	$35.00	$332.50		
		100.00%		$1.45	/Carton	
	Levies		2.50%	$0.19	/Carton	
			On Farm Price	**$5.86**	/Carton	
					$5.86	**$11,134.00**

Disclaimer: This is not a "district gross margin". The data in all gross margins should be checked & changed where necessary to account for different practices and results by different producers.

(2) PRE HARVEST COSTS

		Operations	$/Operation		$/Bag/Carton	$/Ha
Machinery Costs	Ripping ($/ha)	2	$45.37		$0.05	$90.74
(F.O.R.M.)	Chisel Plough ($/ha)	0	$46.90			$0.00
	Rotary hoeing ($/ha)	1	$119.49		$0.06	$119.49
	Bedforming ($/ha)	1	$27.81		$0.01	$27.81
	Cultivation ($/ha)	2	$20.47		$0.02	$40.94
	Deep ploughing ($/ha)	1	$112.02		$0.06	$112.02
	Fertiliser Spread	3	$10.20		$0.02	$30.60
	Spray App.	8	$6.52		$0.03	$52.16
	Precision Planter	1	$57.21		$0.03	$57.21
						$0.00
		Seed (kg/ha)	**$/kg**			
Planting	Seed (Kg/Ha)	3	$300.00		$0.47	$900.00
		Hrs	**$/Hr**			
	Labour					$0.00
		Applications	**Kgs/Ha**	**$/Kg**		
Fertiliser	CK55s (kg)	1	500.00	$0.70	$0.18	$350.00
	Solubor (kg)	1	10.00	$3.25	$0.02	$32.50
	Nitroblue (kg)	1	125.00	$0.65	$0.04	$81.25
		Applications	**L or Kgs/Ha**	**$/Kg or L**		
Herbicide	Roundup	1	3.00	$7.50	$0.01	$22.50
	Stomp 330E (ltr)	1	2.10	$9.38	$0.01	$19.70
	Linuron (kg)	1	1.70	$33.25	$0.03	$56.53
						$0.00
Insecticide	Lorsban 500EC	1	1.50	$10.00	$0.01	$15.00
	Rogor	2	1.00	$8.00	$0.01	$16.00
						$0.00
Fungicide	Dithane M-45 (kg)	2	2.00	$7.30	$0.02	$29.20
	Vapam	1	225.00	$1.30	$0.15	$292.50
Irrigation		**ML/Ha**	**$/ML**			
	Water Charges	4.00	$0.00			$0.00
	Pumping (electricity)				$0.08	$160.00
		Hrs	**$/hr**			
	Labour		$16.70			$0.00
	Pump Repairs		$23.00	per ML	$0.05	$92.00
		$/Ha				
Crop Monitoring						$0.00
TOTAL PRE HARVEST COSTS					**$1.37**	**$2,598.14**

(3) HARVEST AND PACK COSTS

			Allocation	$/Bag/ctn		$/Bag/Carton	$/Ha
Harvest and Pack	Carrot Bag		25%	$0.34		$0.09	$161.50
	Carrot Carton		75%	$2.18		$1.64	$3,106.50
			Appn	**bags/hr**	**Cost/Hr**		
	Carrots Lifting ($/ha)		1	220.00	$205.19	$0.93	$1,772.10
	Labour: Picking ($/hr)		1	220	$16.70	$0.08	$144.23
	Labour: Washing ($/hr)		4	110.00	$16.70	$0.61	$1,153.82
	Labour: Grading ($/hr)					$0.00	0
	Labour: Packing ($/hr)					$0.00	$0.00
	Tractor/Trailer ($/hr)		1	220	$35.00	$0.16	$302.27
			Units/Ha				
	Cooling ($/ctn)	Nominate No	1900.0	$0.20	/ctn	$0.20	$380.00
	Bin Hire	Nominate No	76.0	$3.60	/bin	$0.14	$273.60
	Pallet Hire	Nominate No			/pallet	$0.00	$0.00
TOTAL HARVEST AND PACK COSTS						**$3.84**	**$7,294.01**

SUMMARY TABLE

	$/Bag/Carton	$/Ha
TOTAL PRE HARVEST COSTS	$1.37	$2,598.14
TOTAL HARVEST AND PACK COSTS	$3.84	$7,294.01
TOTAL VARIABLE COSTS	$5.21	$9,892.16
GROSS MARGIN	**$0.65**	**$1,241.84**

5. Opportunities

5.1. Overview

This section details the opportunities and growth potential for the horticultural industry, using the available data from ABS, regional growers and stakeholder consultation.

5.2. Capacity to Grow the Horticultural Industry

Growth in horticultural production is predicated on growers in the region being able to fully utilise agricultural land and, importantly, having access to additional water for irrigating these new areas. We note that farms are able to utilise the land to increase output, through either existing land (which may be operating at less than full capacity), using additional land on outskirts of the region, or implementing innovative techniques (such as introducing greenhouses which can quadruple the production capacity) to increase productivity.

However, to increase production, it is critical that growers gain access to additional water, which is a major constraint affecting output. Council is currently working to try to secure and guarantee water supply for the region through:

- obtaining grant funding from The National Water Infrastructure Development Fund (NWIDF). Securing these funds, through the development of a feasibility study, will allow for growth in horticultural food production; and
- an application to the Maturing the Infrastructure Pipeline Program (MIPP), aiming to transfer water from Lake Wivenhoe and also supply the region with recycled water from the Western Corridor Recycled Water Scheme.

These are two potential sources which the Lockyer Valley aims to secure its water supply. Water security may come from these funds, or other government funding/programs as they arise.

The capacity to grow the industry - which is examined below – assumes for now that farmers have the required inputs and the resources to increase production:

- There is available additional land though it may not always be optimal production land;
- There are ways to improve capacity output from currently farmed land;
- There are new technological innovations which can improve production capacity such as introducing hot houses or similar;
- Major and mid-size growers have the capital capacity to expand production and output; and
- Additional labour can be found if production capacity grows from a mix of sources.

Table 16 summarises some of the survey data provided by the growers' group, particularly the value of labour cost and production output for selected crops (noting that this does not represent the total value of regional production or the full range of regional crops).

The reason only 7 crops is applied is because they were the only products included in the survey response provided by the growers' groups, which included 10 different growers (out of 42). To provide a complete dataset would ideally require a response from all growers in the region though statistically, the 25% members of the growers'

group who did respond, may offer a valid sample basis if this includes major, mid-size and smaller growers participating.

Using the labour cost as a proxy for inputs, we calculated the input-output ratio for these crops by dividing the total value of production by the value of inputs. In effect, the ratio reflects the value of outputs for every additional dollar of inputs. As such, we note the following key points:

- carrots are the most cost-effective crop, as every dollar of input generates an additional $3.2 in output value; and
- pumpkins, broccoli and cauliflowers are the least cost-effective crop, generating an additional $1.3 in output value for every dollar of input.

Table 16: Input-Output Ratio, Growers' Group Survey Data

Commodity	Input (Labour Cost)	Value of Production	Input-Output Ratio
Carrots	$500k	$1.6m	$3.2
Potatoes	$2.0m	$4.5m	$2.3
Eshallots[40]	$5.1m	$9.7m	$1.9
Lettuce	$1.8m	$3.3m	$1.9
Pumpkins	$280k	$350k	$1.3
Broccoli	$1.4m	$1.8m	$1.3
Cauliflowers	$520k	$660k	$1.3

Whilst we appreciate that labour costs comprise a significant proportion of total inputs, we would ideally require the value of all inputs, for each crop, to determine a more accurate ratio. This would include the cost of materials (seeds, fertilisers, pesticides etc.), machinery utilisation and operating costs, etc.

Using these estimated ratios, however, the data below demonstrates the capacity to grow production output and generate increases in production value, from incremental increases in input.

5.2.1. Capacity for Additional Output

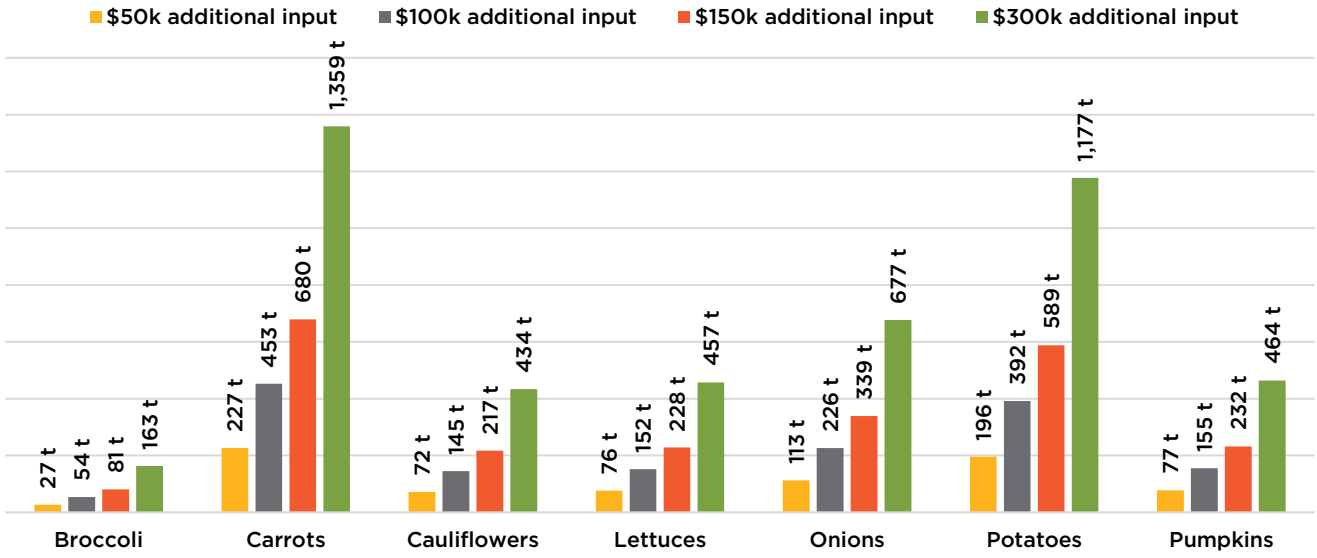
We have estimated the capacity for additional output subject to different increases in total input (by $50k, $100k, $150k and $300k). These input levels are deliberately conservative to reflect, for illustrative purposes, what a small percentage of additional input can have on output able to be generated. As such, we are aware they may not necessarily reflect the cost of all inputs (e.g. they exclude machinery, seeds, fertilisers, pesticides etc).

These results are shown in Figure 12, which demonstrate incremental increases in total output as additional spending on input is provided. Key points to note include:

- the total cumulative output for the crops included in the survey response is expected to increase by a range of 788 tonnes ($50k additional input) to 4,700 tonnes ($300k additional input); and
- the greatest capacity for output growth is generated by carrots (maximum additional output of 1,359 tonnes), followed by potatoes (1,177 tonnes) and onions (677 tonnes).

[40] Used as a proxy for Onion crops

Figure 12: Capacity for Additional Output[41]

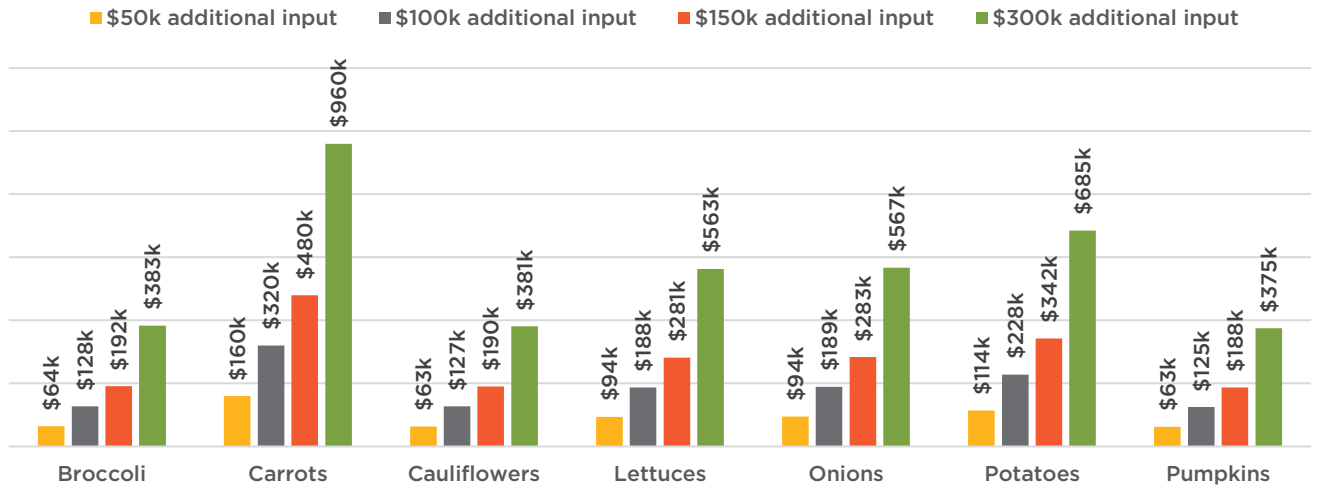


5.2.2. Capacity for Additional Value

We have also applied the ratios to determine the capacity to generate additional gross value of production, based on increases in total input costs (by $50k, $100k, $150k and $300k). As shown in Figure 13, the total cumulative value of output, across the range of crops included in the survey response, has the capacity to increase by up to $3.9m (from $300k of additional input).

The greatest potential for additional value is found in carrot crops (maximum additional value of $960k), followed by potatoes ($685k) and onions ($567k).

Figure 13: Capacity for Additional Value



These results provide a snapshot of the capacity for industry growth, as it is based on the input-output ratios for 7 crops only. A complete dataset, with information for all horticultural crops, would provide a more accurate representation of the capacity for increases in output and value.

[41] Additional output was calculated by applying the average value per tonne (Section 3.8.1) for each crop

5.3. Economic Impact of Additional Input

Additional input into horticultural production will also generate additional economic benefit to the region, primarily through additional employment and subsequent increases in employee spend. Using the same range of input increases ($50k, $100k, $150k and $300k), we have calculated the number of additional employment days that this would generate. The results are shown in Table 17, which show a range of total additional employment days from 286 days ($50k) to 1,716 days ($300k). Key points to note include:

- The total number of days was calculated based on an average cost per worker, per hour of $23[42], as well as an average work day of 7.6 hours;
- The work days are divided by employee type as follows:
  - 30% full time employee (i.e. professional workers residing in the region);
  - 20% transient workers (i.e. domestic workers that reside outside the region); and
  - 50% international workers (i.e. seasonal and back packers).[43]

Table 17: Additional Employment Days in the Lockyer Valley

Type of Employee	$50k additional input	$100k additional input	$150k additional input	$300k additional input
Full time	86	172	257	515
Transient (domestic)	57	114	172	343
International	143	286	429	858
Total	**286**	**572**	**858**	**1,716**

With additional employment days resulting from increases in input, additional employee spend will occur within the Lockyer Valley, contributing to economic growth. For domestic employees (full time and transient), it is assumed that total spend per worker is approximately $10,500 per annum.[44] It is also assumed that full time workers will spend approximately 50% of this in the region; while transient workers will spend approximately 25%.[45] This implies that, on average, full time workers will spend $5,250 per annum ($22 per day) and transient workers will spend $2,625 per annum ($11 per day) in the region.

In addition, international workers are likely to spend approximately $59 per day in the Lockyer Valley, which equates to 75% of total daily spend for international visitors to the region.[46]

Therefore, as shown in Table 18, additional employee spend in the Lockyer Valley (based on additional input to the surveyed crops) is likely to range from $11k ($50k input) up to $65k ($300k input). We note that the scale of this amount is relatively low, however, it is based on surveyed data for 7 crops. Additional information for the full range of horticultural commodities would illustrate significantly higher increases in spend and a greater contribution to the economy.

[42] Industry standard rate provided by Lockyer Valley Regional Council
[43] Indicative proportions provided by Council
[44] https://urbis.com.au/office-workers-survey/
[45] Transient workers commute to the Lockyer Valley on a regular basis, therefore are less likely to spend within the region
[46] According to Tourism Research Australia, international visitors spend an average of $78 per night in the Brisbane Region. Therefore, a 25% discount has been applied to account for the location and market prices specific to the Lockyer Valley.

Table 18: Additional Employee Spend in the Lockyer Valley

Type of Employee	Ave spend per day	$50 additional input	$100 additional input	$150 additional input	$300 additional input
Full time	$22	$1.9k	$3.8k	$5.6k	$11k
Transient (domestic)	$11	$626	$1.3k	$1.9k	$3.8k
International	$59	$8.4k	$17k	$25k	$50k
Total	**n/a**	**$11k**	**$22k**	**$33k**	**$65k**

5.4. Capacity to Maximise Use of Waste

This section estimates the volume of generated waste from each crop and estimates the potential gross value it can add to the industry. Survey data provided by the growers' group provided an estimated proportion of waste for a number of crops (noting that this is an estimate only, with the need to provide more accurate waste data detailed in Section 4.1). This data estimated levels of waste of between 0% to an average of 10%.

We examined the capacity for waste to generate additional output and gross value – should it be re-used as an input commodity – by applying average waste proportions (of 5%, 10% and 15%) for all crops within the fruit and nut and vegetable categories[47].

Table 19 shows the estimated levels of potential waste that could be re-used as an input, by applying the waste proportions against total commodity output (detailed in Section 3.5). This demonstrates that the potential volume of horticultural waste could range from 8,251 tonnes (5% waste level) to 24,752 (15% waste level).

Table 19: Estimated Volumes of Waste (tonne)

Commodity	5% Waste Levels (t)	10% Waste Levels (t)	15% Waste Levels (t)
Limes	2.8	5.7	8.5
Grapes	0.1	0.2	0.4
Avocados	9.8	19.6	29.3
Mangoes	3.9	7.9	11.8
Nectarines	6.2	12.3	18.5
Peaches	5.6	11.2	16.8
Beans	461.3	922.6	1,383.9
broccoli	658.8	1,317.7	1,976.5
Cabbages	840.6	1,681.2	2,521.7
Capsicums	2.2	4.5	6.7
Carrots	252.9	505.8	758.7
Cauliflowers	410.7	821.4	1,232.1
Lettuces	1,240.9	2,481.8	3,722.6
Melons	145.4	290.9	436.3
Mushrooms	1.1	2.2	3.2
Onions	605.4	1,210.8	1,816.2
Potatoes	978.7	1,957.3	2,936.0
Pumpkins	608.9	1,217.8	1,826.7
Sweet Corn	1,859.0	3,718.0	5,577.0
Tomatoes	156.4	312.9	469.3
Total	**8,250.8**	**16,501.5**	**24,752.3**

[47] Commodities within the nurseries, flowers and turf category were excluded from this analysis due to a lack of production output data.

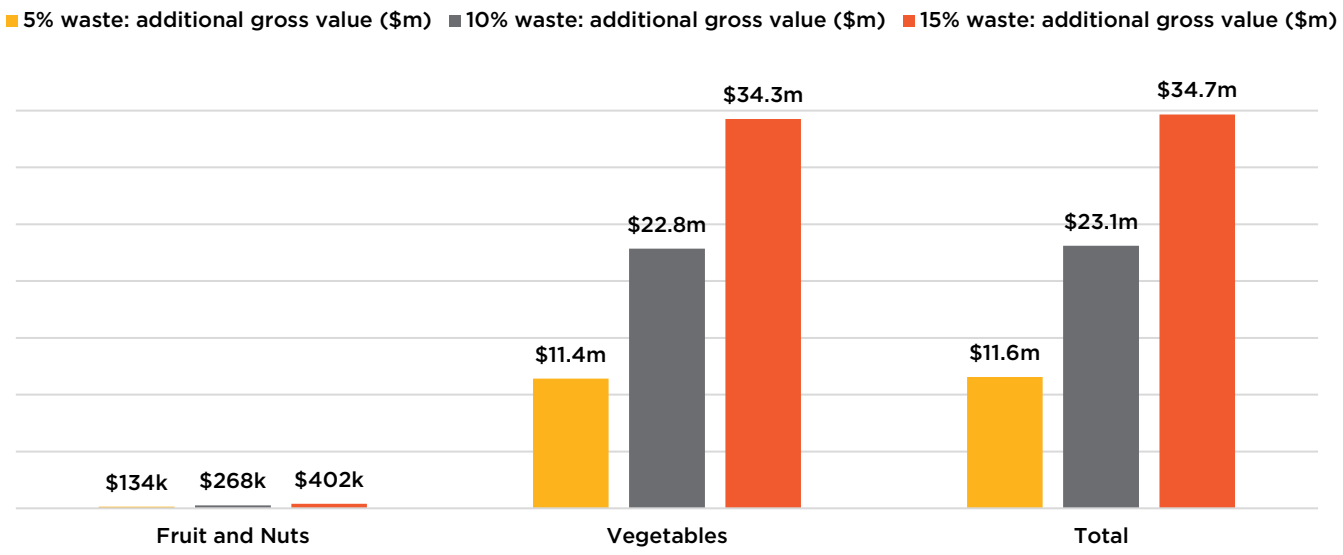
The graphs below show the potential to convert this into additional gross value, by applying the waste volumes against the value per tonne for each commodity (Section 3.7). For this exercise, we have assumed that the existing value per tonne for each crop applies to the levels of waste. Ideally, we would need the output per tonne of waste material to determine, with greater accuracy, the production value this would equate to.

According to Figure 14, re-using the range of estimated waste could result in:

- an additional $11.6m in total value (for 5% waste);
- an additional $23.1m in total value (for 10% waste); and
- an additional $34.7m in total value (for 15% waste.

The additional value is primarily generated by vegetable crop wastage being used as an input commodity due to the very limited output of fruit and nuts waste estimated.

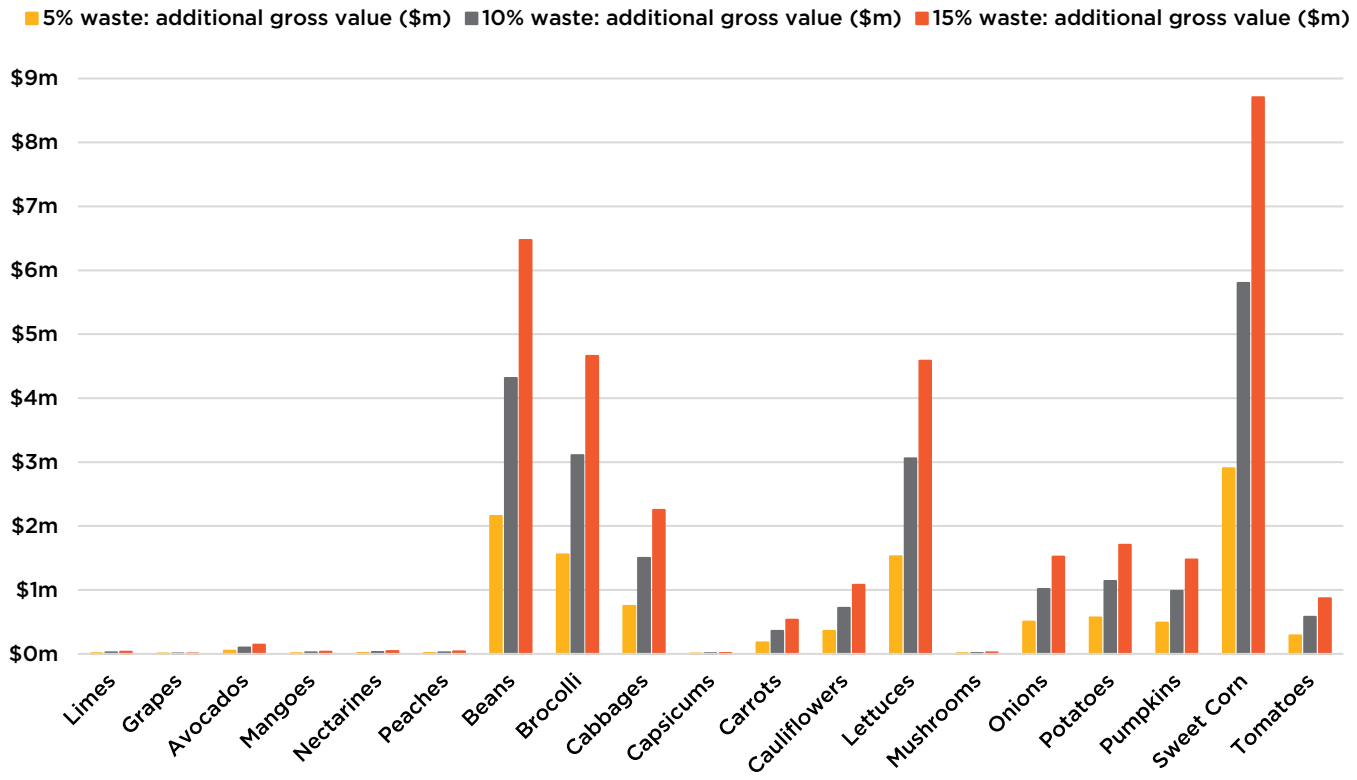
Figure 14: Capacity to Increase Value of Production, Horticultural Categories



As per Figure 15:

- due to the relatively small volume of waste for fruit and nut commodities, it's capacity to generate additional value is constrained;
- sweet corn has the capacity to generate the highest levels of additional value from waste ($8.7m at 15%), followed by beans ($6.5m), broccoli ($4.7m) and lettuce ($4.6m), due to the relatively high levels of estimated waste.

Figure 15: Capacity to Increase Value of Production, Individual Crops



The potential value that can be generated by waste is important for Council to consider, as it represents the level of additional value that could be realised if a bio-processing facility was developed. Such a facility would utilise waste from the agricultural sector to maximise production output and harness potential bio-energy for the region.

However, some farmers indicated that they reprocess leftover/waste materials themselves, either onsite or to a company owned facility outside the region. This would limit the total volume of waste that can be as an input in a major reprocessing facility. Farmers would, therefore, require incentives to provide waste to such a facility, rather than reuse it separately.

In addition, these results are based on assumptions to the survey data. Therefore, we recommend greater investigation is undertaken into the actual levels of waste and the ability for this waste to be processed as an input commodity for another use.

Noting that a major cannery facility is contemplating establishing in the Lockyer Valley (on the GWIZ site), discussions should be held on the potential to generate bio-energy as a waste product. Dependent on the value a major cannery may place on waste material, this could also influence how many growers decide to deal with leftover material/waste, as this may offer a more profitable solution to them.

Once this data is understood, it is important to demonstrate the potential value of waste to growers and the ability to transform this into a valuable commodity that generates growth and additional profits. An example of this is detailed in Figure 16.

Figure 16: Value of Reusing Waste: Case Study[48]

A successful example for how waste is maximised to generate output and profit is demonstrated by *Kalfresh Vegetables*, a produce business that grows, packs and markets fresh vegetables out of the Fassifern Valley. The company upgraded its packing facility in 2015 to produce pre-prepared vegetable products, which enables them to re-process vegetable waste by cutting, shredding and re-using leftover crops.

Coinciding with an increase in demand for pre-packaged fruit and vegetables across Australia, this gave rise to a 'Just Veg' Kalfresh range that is now distributed to over 650 Woolworths stores across Queensland, Victoria and NSW. This range includes providing pre-packed, cut, washed and 'ready to use' vegetables. This is now a highly valued and important product line for the company.

5.4.1. Bio-Energy Project Case Studies

Table 20 details several existing bio-energy projects and facilities across Australia that are either constructed or underway. The purpose of this is to identify the potential scope and scale of bio-processing, including estimated costs and output (where information is available). Further research needs to be conducted, however, to identify the technology required and the level of input (i.e. waste) needed to make the facility viable.

Table 20: Bio-Energy Facility: Comparative Analysis

Facility	Location	Description	Project Costs	Other Information
Hunter Valley Biofuel Facility[49]	Hunter Valley (NSW)	The facility is designed to produce ethanol from a range of waste plant matter left over from crop harvesting and forestry	$30m	Expected to produce 270,000 litres of biofuel per annum.
MSM Milling Biomass Fuel Switch Project[50]	Manildra (NSW)	The project involves replacing current LPG fuelled boilers with a biomass fuelled boiler using locally sourced timber residue as a fuel source.	$5.4m	This project reduces emissions by changing the energy sources or mix of energy sources used by existing energy-consuming equipment.
Northern oil advanced biofuels laboratory[51]	Yarwun (QLD)	The plant will use biomass material such as sugarcane bagasse and prickly acacia as feedstock for the production of bio crude oil, which will be refined into saleable kerosene and diesel products.	$18m	Target to produce 1m litres of fuel for productive use
Goulburn Bioenergy Project[52]	Goulburn (Victoria)	The Project will build an anaerobic digester that will capture biogas from the breakdown of organic waste from the Southern Meats abattoir. The gas will then be fed into biogas generators to produce electricity for Southern Meats to operate their abattoir	$5.75m	The Project will reduce site energy costs, reduce methane emissions, and improve effluent quality.

[48] http://www.abc.net.au/news/2016-04-09/kalfresh-rural-business-turns-problem-into-profit/7310450; http://kalfresh.com.au/main/about-kalfresh/
[49] https://www.sustainabilitymatters.net.au/content/energy/news/arena-announces-funding-for-hunter-valley-biofuel-facility-637326117
[50] https://arena.gov.au/projects/msm-milling-biomass-fuel-switch-project/
[51] https://arena.gov.au/projects/northern-oil-advanced-biofuels-laboratory/
[52] https://arena.gov.au/projects/goulburn-bioenergy-project/

Other key points to note include:

- these projects start out as pilot/research projects, obtaining funding from various government agencies and research bodies (i.e. Universities); and
- the Australian Renewable Energy Agency (ARENA) is a common project partner, providing funding and advocacy to facilitate the development of these projects.

Therefore, establishment costs could potentially be partially offset by engaging with funding partners and government; while the operation of the facility and implementation of innovative technologies could be facilitated by third party stakeholders from industry or University partnerships (such as University of Queensland Gatton Campus).

6. Recommendations

Based on the research and analysis to-date, we recommend the following next steps are explored in greater detail to help realise sustainable growth in the horticultural industry (whilst some initial results have been generated above, through use of assumptions and estimations, more robust and complete data would strengthen these conclusions):

- there is a pressing need for more timely and accurate datasets, including a possible revision of the ABS data requests as well as an annual survey of growers in the region;
- identify how to incentivise growers to provide more accurate data to the ABS, as well as provide specific data to independent third parties working to ultimately assist the sector;
- the data gaps need to be filled in before considering the feasibility of a bio-processing facility (that could harness potential bio-energy as the accuracy of bio-processing plant viability, is dependent on accurate input assessments of waste levels available and related costs;
- undertake a national and global study of best practice bio-energy plants (of a comparable scale) to determine optimum wastage requirements to make it a viable project;
- assess the cost benefit for additional crop wastage to be transported to the Lockyer Valley (from other growing regions) and examine the cost effectiveness of using this waste as an input in a bio-energy plant;
- determine the economic value of employment from increases in input, leading to greater production output and associated value;
- determine the direct and indirect economic value and benefits of increased employment and higher production levels;
- determine the broader economic value generated from production gains and employment, including wages/salary growth, spend patterns, etc;
- examine how increases in horticultural production and value would position the region in comparison with other major growth areas across Australia (e.g. percentage of total output, contribution to GDP, etc);
- through this, identifying the comparative advantages that the Lockyer Valley has over other regions and quantify these; and
- identify the net effect of growth potential in horticultural production on the region.

STAFFORD STRATEGY

SYDNEY OFFICE

3.02 POST 46a MacLeay Street
Potts Point NSW 2011, Australia

E admin@thestaffordgroup.com.au

O +61 29331 6222

BRISBANE OFFICE

PO BOX 265
Sandgate QLD 4017, Australia

E admin@thestaffordgroup.com.au

MELBOURNE OFFICE

Level 19, 567 Collins Street
Melbourne VIC 3000, Australia

E admin@thestaffordgroup.com.au