

# A Resilient Fruit and Vegetable Supply for a Healthy Victoria

Working together to secure the future

© 2011 Food Alliance

All rights reserved: No part of this publication may be reproduced in any form without permission of the copyright owners.

Authors: Rachel Carey and Kathy McConell

Contact:

Kathy McConell  
Food Alliance  
+61 3 9244 3802  
Kathy.mcconell@deakin.edu.au

Citation: Carey, R and McConell, K (2011) A Resilient Fruit and Vegetable Supply for a Healthy Victoria. Working together to secure the future. A report by the Food Alliance.

Acknowledgements:

Thank you to the people who provided assistance and feedback during the development of this report. In particular, we would like to thank the following:

Lis Blandamer  
Cate Burns  
Trevor Budge  
Jonathan Drohan  
Sue Finger  
Fanny Krumholz  
Kirsten Larsen  
Mark Lawrence  
Kirsty Morieson  
Cathy Mansfield  
Beth Scholes  
Boyd Swinburn

This research was made possible through funding from VicHealth.

Disclaimer: The interpretations and conclusions contained in this report are those of the authors and do not represent the views of VicHealth or Deakin University. While care has been taken in preparing the content of this material, the Food Alliance, Deakin University and VicHealth and their employees cannot accept any liability, including for any loss or damage, resulting from the reliance on the content, or for its accuracy, currency and completeness.

# A Resilient Fruit and Vegetable Supply for a Healthy Victoria

Working together to secure the future

## Contents

<b>Executive Summary</b>	<b>4</b>
<b>1 Introduction</b>	<b>5</b>
1.1 About the Food Alliance	5
1.2 About this document	5
<b>2 The issue</b>	<b>7</b>
2.1 The issue 'in a nutshell'	8
2.2 An overview of Victoria's fruit and vegetable supply	10
2.3 The health benefits of fruit and vegetable farming in Victoria	12
2.4 The economic opportunity for fruit and vegetable farming in Victoria	13
2.5 Victoria's fruit and vegetable suppliers are under pressure	13
2.6 Why not just import fruit and vegetables?	14
2.7 What are the challenges facing Victoria's fruit and vegetable supply?	15
<b>3 Current policy approach</b>	<b>21</b>
3.1 An overview of the Victorian policy environment	22
3.2 The need for an integrated policy approach	23
<b>4 An integrated approach for Victoria</b>	<b>24</b>
4.1 The UK Fruit and Vegetable Taskforce	25
4.2 A way forward for Victoria	25
<b>5 Contact the Food Alliance</b>	<b>26</b>

# Executive Summary

Victoria is a major food producer, and scenarios of food shortages in the future seem unlikely. However, recent modeling studies have shown that **Victoria may face shortages of fruit and vegetables in the future.**

Fruit and vegetable supplies are more vulnerable than supplies of other foods, because unlike most other agricultural industries in Victoria, the fruit and vegetable industries produce primarily for the Australian market rather than for export markets, hence there is no surplus to act as a 'buffer' when supplies are affected.

Fruit and vegetable supplies are also more vulnerable because these industries are particularly affected by some of the issues currently facing Australian agriculture, such as **low farmgate prices, loss of productive agricultural land and diminishing water supplies.** In addition, Victoria's fruit and vegetable farmers are affected by the **rising costs of fuel, fertilisers and pesticides** and the **increasing frequency of extreme weather events.**

The challenges facing fruit and vegetable producers are becoming overwhelming. Farmers are leaving the industry, and fewer young farmers are taking up fruit and vegetable farming, adding to the threat of the long-term security of Victoria's fruit and vegetable supply.

The ability to import fruit and vegetables is an essential part of a resilient food supply. However, **relying on fruit and vegetable imports would create vulnerabilities in Victoria's food system,** particularly because of emerging challenges such as **climate change and peak oil.**

Victoria's fruit and vegetable industries also bring **economic benefits** to the state. Victoria is one of Australia's two main **horticultural producers, and horticultural production is worth about \$1.3 billion per year to the state.** In fact, the food sector as a whole is one of the most significant industries in Victoria, generating around 15% of the state's gross value added.

**The industry also plays a critical role in delivering health benefits.** Less than 10% of Victorians currently eat the recommended number of serves of fruit and vegetables. **Victorians need to increase their consumption of fruit and vegetables,** and targets have been set for achieving this. In order to support this increase, **the state needs an adequate fruit and vegetable supply.**

The Food Alliance believes that there is a need for stakeholders from across the fruit and vegetable supply chain and from other sectors (including health, land use planning and water) to work together to **identify strategies to improve the resilience of Victoria's fruit and vegetable supply and to increase the consumption of fruit and vegetables in the state.** Key issues that should be considered by this cross-sector and cross-supply chain group include:

- identifying and **protecting productive agricultural land**
- increasing the **water security** of key fruit and vegetable production areas
- **improving farm profitability** through regulatory measures and supply chain innovation
- promoting **sustainable and resilient production systems**
- **increasing consumption** of fruit and vegetables.

# 1 Introduction



## 1.1 About the Food Alliance

The Food Alliance is an organisation funded by VicHealth (the Victorian Health Promotion Foundation) and auspiced by the Food Policy Unit at Deakin University. The Food Alliance aims to identify, analyse and advocate for evidence-informed policies and regulatory reform to enable sustainable food security and healthy eating in the Victorian population. A resilient fruit and vegetable supply is one of three key areas of advocacy for the Food Alliance. The other areas are:

- healthy and sustainable public sector food
  - the need for mandatory minimum standards
- healthy and sustainable food policy
  - the need for an integrated food strategy.

## 1.2 About this document

This paper describes the challenges currently facing Victoria's fruit and vegetable farmers, which have the potential to undermine the long-term security of Victoria's fruit and vegetable supply. The paper proposes an integrated 'whole of government' and 'whole of supply chain' approach to addressing these issues in order to improve the resilience of the state's fruit and vegetable supply.



## 2 The issue



### Key challenges that impact on Victoria's fruit and vegetable supply chain

- **Low farmgate prices:** the cost to farmers of producing fruit and vegetables is increasing but the prices they receive remain low.
- **Land availability:** there is less land available for fruit and vegetable production and it is becoming more expensive due to urban growth.
- **Water availability:** less water has been available for fruit and vegetable production due to drought and competing demands.
- **Climate change:** fruit and vegetable production is highly sensitive to climate variability.
- **Fertiliser availability:** supplies of fertiliser inputs are declining and prices are rising.
- **Waste:** there is significant post-harvest and household waste of fruit and vegetables that represents a waste of energy, water and fertilisers.

## 2.1 The issue 'in a nutshell'

Victoria is a major food producer [1], and most Victorians have never considered the possibility that the state might face future food shortages. Victoria exports large quantities of meat, dairy and grains [1], and when food production in the state is reduced due to drought or flood, this surplus can be redirected to the domestic market to prevent shortages of these foods and to limit price increases.

However, fruit and vegetable production in Victoria is different. The state's fruit and vegetable industries produce mainly for the Australian market, not for export [2-3], and there is no significant surplus to draw on when local supplies are affected. As a result, fruit and vegetable prices tend to increase more than those of other foods during times of drought or flood [4].

Victoria's fruit and vegetable supplies are more vulnerable than the supplies of other foods in the state and they deserve special attention. Not only are the fruit and vegetable industries among the few domestically-oriented agricultural industries in the state, they are also particularly affected by other issues currently facing Australian agriculture, such as **low farmgate prices, loss of prime agricultural land and diminishing water supplies.**

**Over half of Victoria's vegetables and around 17% of its fruit are produced on prime agricultural land on Melbourne's fringes**

The potential for future shortages in fruit and vegetable supplies in Victoria due to land and water shortages has been confirmed by several recent modeling studies (see section 2.5). **Over half of Victoria's vegetables and around 17% of its fruit are produced on prime agricultural land on Melbourne's fringes** (see section 2.7). Some of these 'peri-urban' areas are highly significant production areas in terms of the national fruit and vegetable supply [5-6], because they provide the ideal soil and climate conditions for particular crops. Yet many of these areas are now earmarked for development to meet Melbourne's housing needs. Despite the potential loss of prime horticultural land, the use of this land for housing is regarded as more economically valuable than continuing to use the land for fruit and vegetable production. As a result this increases the vulnerability of Victoria's fruit and vegetable supply.

The ability to import fruit and vegetables is also an essential part of a resilient food supply (see section 2.6). However, relying on fruit and vegetable imports to meet basic population needs would create vulnerabilities in Victoria's food system, particularly because of emerging challenges, such as climate change and peak oil. The state's capacity to meet a high proportion of its own fruit and vegetable supply is important to the resilience of Victoria's food system, and enhances the state's capacity to adapt to future challenges and sudden 'shocks' to the food supply, such as extreme weather events interstate or interruptions in the global food supply. A plentiful, local fruit and vegetable supply is also important for encouraging consumption.

It is important that Victoria maintains a strong fruit and vegetable supply, yet the state's fruit and vegetable producers face an increasing number of challenges that undermine the viability of fruit and vegetable production in the state. In addition to the economic pressures already mentioned, and shortages of available land and water, other challenges include the **rising costs of fuel, fertilisers and pesticides and the increased frequency of extreme weather events**. Victoria is not alone in facing these challenges, and there is concern among horticultural groups both in Victoria and other states that these problems now threaten to overwhelm the fruit and vegetable industries [7-8]. As a result, there are increasing calls within the horticultural industries in Australia for a high level government response. This paper explores the issues facing the fruit and vegetable industries in Victoria in more detail and discusses the kind of high level government and industry response that is required.



**Victoria's fruit and vegetable producers face an increasing number of challenges that undermine the viability of fruit and vegetable production.**

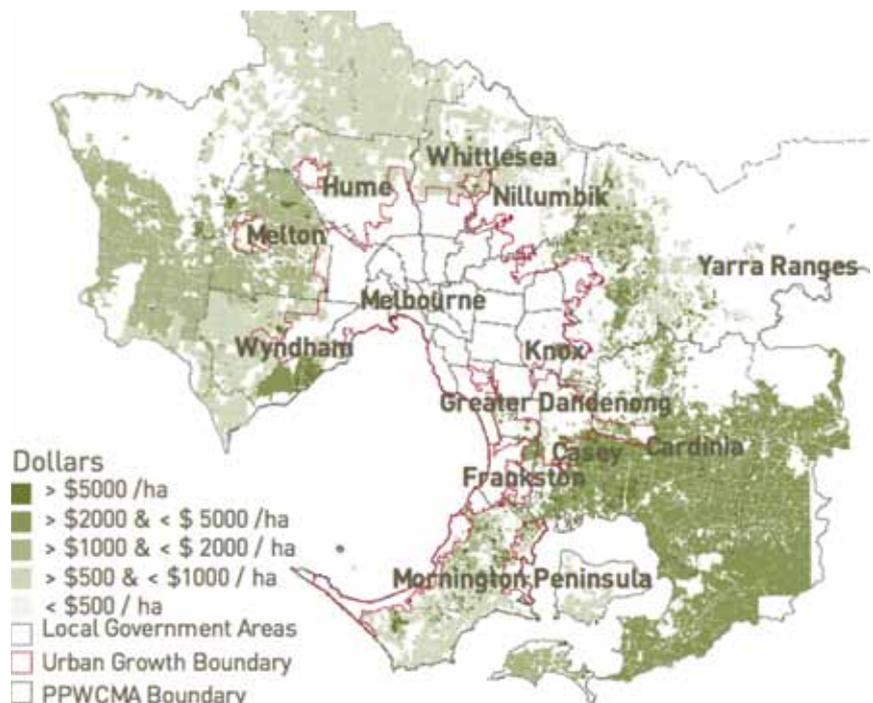
**2.2 An overview of Victoria's fruit and vegetable supply**

Victoria has around 3375 horticultural farms [9]. Many are small-scale, family farms, although the average farm size is getting bigger [10]. Fruit production in Victoria is located mainly in the north of the state in the Goulburn Valley, and along the Murray River in Swan Hill and Mildura, which are some of the state's main irrigation districts. The Goulburn Murray Valley produces most of the state's apples and pears, and a significant proportion of its stone fruit [2], while Mildura produces around 70% of Australia's crop of table grapes and around 95% of dried grapes [11]. Unlike other types of fruit, most of the state's berry crop is grown close to Melbourne, with over 90% of Victoria's berries produced in the Port Philip and Westernport region in 2008-9 [12].

While most of Victoria's fruit is grown in the north of the state, vegetables are grown much closer to the city. At least half of Victoria's vegetables are grown within 100 kilometres of Melbourne in the Port Philip and Westernport region<sup>1</sup>. Peri-urban Melbourne has been an important vegetable growing region since the city was first established, and market gardens in areas such as Moorabbin, Bentleigh, Coburg and Werribee supplied most of Melbourne's vegetable requirements prior to the second World War. However, by the late 1950s, post-war suburban expansion had pushed market gardens further out of the city, and of these original market garden

<sup>1</sup> An ABS survey on the value of agricultural commodities 2008-9 reports that 52% of Victoria's vegetables were grown in Port Philip and Westernport, while the Victorian Vegetable Growers Association report that over 70% of Victoria's vegetables were grown in the 'Melbourne' region in 2005-6. See [http://www.vgavic.org.au/communication/statistics/regional\\_production\\_2005\\_6.htm](http://www.vgavic.org.au/communication/statistics/regional_production_2005_6.htm)

**Figure 1: Agricultural Production in Victoria in 1999-2000**



Source: Melbourne Atlas, retrieved from [http://www.dpcc.vic.gov.au/\\_data/assets/pdf\\_file/0003/31179/Agriculture.pdf](http://www.dpcc.vic.gov.au/_data/assets/pdf_file/0003/31179/Agriculture.pdf)



areas, only Werribee is still a significant area of vegetable production [13]. New market garden areas have been established on the city fringe, but they too are under constant threat from urban expansion.

The main vegetable growing areas in Victoria include Bacchus Marsh (in Moorabool), Werribee (in Wyndham), Cranbourne (in Casey), Koo Wee Rup (in Cardinia) and the Yarra Ranges. These peri-urban areas still produce a significant proportion of Victoria's vegetable crop, including over 90% of the state's cucumbers, celery, leeks, parsnips, Asian vegetables, silverbeet and spinach [12].

**Table 1. Fruit and vegetable production in peri-urban Melbourne**

PRODUCT	% OF PRODUCTION IN PERI-URBAN MELBOURNE
Brussel sprouts	100
Celery	99
Strawberries	98
Asian vegetables	97
Cucumbers	97
Leeks	96
Silverbeet and spinach	93
Beetroot	89
Raspberries	89
Lettuce (outdoor grown)	86

*This table shows the percentage of total Victorian vegetable and berry production that occurs in the Port Phillip and Westernport Natural Resource Management area for selected fruits and vegetables (Source: ABS, Agricultural Commodities Australia 2008-9)*

Some peri-urban areas are highly significant areas of production for specific crops. For example, Koo Wee Rup provides 90% of Australia's asparagus [5] and Werribee South produces up to 70% of South Eastern Australia's leaf and kale crops [6]. Highly productive farmland suitable for horticultural production is scarce in Victoria [14], and areas like Koo Wee Rup and Werribee have become significant for the production of particular crops

because they have the right soil and climatic conditions, as well their proximity to markets.

While a significant proportion of some Victorian-grown fruits are exported, such as grapes and citrus [2], the bulk of Victoria's fruit and vegetable crop is consumed domestically<sup>2</sup>. Some of Victoria's fruit crop is processed into dried or canned fruit at facilities such as Sunbeam's dried fruit processing factory at Mildura or SPC-Ardmona's processing facility in the Goulburn Valley. Significant quantities of potatoes and tomatoes are also processed in Victoria, (potatoes and tomatoes are among the top three vegetable crops grown in the state by value of production [3]). Processing plants have traditionally provided an important sales channel for Victorian growers and a valuable market for lower grade fruit. However, the recent closure of Victorian processing facilities owned by Heinz and SPC Ardmona constrains the market for Victorian growers [16]. The large multinational corporations that own these processing facilities<sup>3</sup> increasingly source fruit and vegetables globally in order to minimise costs and maximise efficiency, and Victorian farmers find it difficult to compete with this cheaper produce that is sourced from overseas.

Australia also imports some fruit and vegetables. Historically, Australia has been almost self-sufficient in fruit and vegetable production. Over 90% of the fresh vegetables sold in Australian supermarkets, and almost all the fresh fruit consumed are Australian-grown [17-18]. However, imports of processed fruit and vegetables have increased significantly since the mid-1990s, and exports of fresh and processed fruit and vegetables have also declined [19], so that Australia is now a net importer of horticultural products [20].

<sup>2</sup> Around 15% of Australia's fruit crop was exported in 2004-5 and just 5% of the national vegetable crop 15. Spencer, S. and M. Kneebone, *Foodmap: A comparative analysis of Australian food distribution channels*. Australian Government Department of Agriculture, Fisheries and Forestry. Canberra 2007.

<sup>3</sup> For example, SPC-Ardmona's processing plant in the Goulburn Valley is owned by Coca-Cola Amatil. McCain Foods, Simplot and Heinz are also large, foreign-owned food companies with global operations.

**Less than 10% of Victorians eat the recommended number of serves of vegetables.**



Although imports are increasing, they still make up a relatively small proportion of the fruit and vegetables bought in Australia today, and Victoria has to date managed to retain significant horticultural production capacity, but this should not be taken for granted. In the UK, imports of fruit and vegetables increased dramatically over the last decade, so that they now account for 88% of the UK's fruit supply and 40% of its vegetable supply [21]. The result is a significant reduction in the UK's capacity to produce its own fruit and vegetables, which creates vulnerability in the UK's food supply [22], which they are now attempting to address.

### **2.3 The health benefits of fruit and vegetable farming in Victoria**

A strong horticultural sector that provides a good supply of fruit and vegetables is also important to the health of Victorians. Research suggests that adequate consumption of fruit and vegetables is important to health and prevention of chronic diseases. It reduces the risk of developing cardiovascular disease and has an indirect role in reducing the risk of some cancers [23]. However, less than half of Victorian adults eat the recommended number of serves of fruit daily and **less than 10% eat the recommended number of serves of vegetables**. Moreover, the number of Victorians that meet recommended intake levels for fruit and vegetables has fallen in recent years [24].

Crop losses due to drought and floods over the last decade have led to spikes in fruit and vegetable prices. During the 2005-7 drought, vegetable prices in Australia increased by 33% and fruit prices by 43%, compared to an overall increase in food prices of 12% [4]. The January 2011 floods in several states are expected to lead to significant increases in the prices of some fruit and vegetable crops. The impact of these price increases on fruit and vegetable consumption is unclear due to lack of data.

However, the evidence suggests that consumers are likely to reduce their consumption of fresh foods as prices rise [25]. Poor nutrition is estimated to be responsible for around 16% of Victoria's total burden

of disease, while inadequate fruit and vegetable intake is estimated to be responsible for around 3.3% of the total burden of disease, mostly due to ischaemic heart disease, stroke and cancer [26]. Inadequate fruit and vegetable intake is estimated to ‘cost’ the nation around \$232 million<sup>4</sup>.

Victorians need to eat more fruit and vegetables, and benchmarks have been set for increasing consumption as part of the National Partnership Agreement on Preventative Health [27]. In order to support this increase, Victoria needs an adequate fruit and vegetable supply. Gaps in fruit and vegetable supply can be met through food imports, but it is important for the resilience of Victoria’s food system that the state maintains a strong domestic fruit and vegetable supply (see section 2.6).

## 2.4 The economic opportunity for fruit and vegetable farming in Victoria

**Horticultural production is worth about \$1.3 billion per year to Victoria [28].** Most fruit and vegetables grown in Victoria are sold and consumed in Australia. However, as only 10% of Australians eat the recommended number of serves of fruit and vegetables daily, there are significant opportunities to grow the market by increasing Australians’ consumption of fruit and vegetables to recommended levels<sup>5</sup>.

There are also potential economic opportunities in increasing the consumption of Victorian-grown fruit and vegetables in the state. It is unclear how much

4 This figure represents the ‘opportunity and cost savings’ related to health sector costs and work, leisure and household production effects over the lifetime of the 2008 Australian population. In Cadilhac, D et al (2009) *The Health and Economic Benefits of Reducing Disease Risk Factors: Research Report*. A report prepared for VicHealth. July 2009

5 Data from the 2008 Victorian and NSW Population Health Surveys show that around 10% of people in NSW and Victoria consume the recommended number of serves of fruit and vegetables daily. Data from Queensland suggest similar levels of consumption - <http://www.health.qld.gov.au/publications/infocirc/info74.pdf>.

of the fruit and vegetables consumed in Victoria is grown in the state and how much is grown interstate or overseas, but horticultural imports have been steadily increasing in Australia, such that we are now a net importer of fruit and vegetables, mostly processed [29]. This represents a lost opportunity to support Victorian farmers by buying more seasonal produce grown in the region.

Victorians’ interest in buying from Victorian farmers is growing, as evidenced in the growth of farmers markets in the state. Victoria now has around 90 farmers markets, which are estimated to contribute about \$227 million per year to the Victorian economy [30]. Buying direct from Victorian farmers also enables consumers to reconnect with where their food comes from and how it is grown, strengthening links between cities and rural areas.

## 2.5 Victoria’s fruit and vegetable suppliers are under pressure

There are multiple signs that Victoria’s fruit and vegetable farmers are under pressure and that the long-term security of the state’s fruit and vegetable supply may be compromised:

- several **recent modeling studies point to vulnerabilities in Victoria’s fruit and vegetable supply** in coming decades, due to limitations on the availability of natural resources, such as land and water [31-32]
- at a national level, there is a **gap between the amounts of some fruits and vegetables** (such as leafy green vegetables) **produced in Australia and the amounts required** to meet the nutritional needs of the population<sup>6</sup>

6 Amanda Lee (2011) *Should food be treated purely as a tradeable commodity, left to market forces?* Presentation to the National Sustainable Food Summit. Melbourne, 4 May 2011, Available: [http://www.3pillarsnetwork.com.au/p8\\_Knowledge-Base.html?&entry=430](http://www.3pillarsnetwork.com.au/p8_Knowledge-Base.html?&entry=430)

**Relying on other regions for supplies of core foods, such as fruit and vegetables, is a risky strategy in an environment plagued by uncertainty of supplies and natural resources.**

- production of some types of vegetables has declined nationally over the last decade [33]
- the **area of land planted to vegetables has also decreased** nationally [34]
- the **average age of vegetable farmers is increasing**, and fewer young farmers are joining the industry [35]<sup>7</sup>
- the **number of vegetable farmers is falling** nationally. The number of vegetable growers in Australia fell 23% between 2000 and 2005 [36]

A 23% decrease in the number of vegetable farmers nationally does not indicate that overall production of vegetables has dropped to that degree [34, 37]. Instead, it reflects a trend to fewer, larger vegetable farms [10]. Small- to medium-sized vegetable farms tend to be less profitable than larger vegetable farms, and it is the owners of these farms who are leaving the industry. In peri-urban areas of Melbourne, where some of the most fertile horticultural land is located, small farms still dominate [37], and these farms have limited opportunities to gain economies of scale by expanding because of a shortage of land to expand into, making them especially vulnerable [38]. However, data from the US Department of Agriculture (USDA) suggests that small farms on the fringes of cities have the potential to be profitable, particularly as part of food economies that are regionally-oriented [39].



7 The average age of vegetable farmers in Victoria was 55 in 2008-9. In Crooks (2010).

## 2.6 Why not just import fruit and vegetables?

The ability to import fruit and vegetables from interstate and overseas is important to a resilient food supply, particularly in the event of supply interruptions due to extreme weather events, such as drought and flood. However, it is equally important to maintain a robust local supply of fruit and vegetables, particularly in view of emerging challenges such as peak oil and climate change.

**World oil supplies are approaching their 'peak'** (or may already have peaked) and global demand for oil is likely to exceed supply within the next 20 years, leading to increases in oil prices [40-41]. Like other food supply chains, the fruit and vegetable supply chain is dependent on oil [42]. Fuel for farm machinery, fertilisers and pesticides are all oil-derived, and transportation and refrigeration of produce is also oil-dependent. As oil prices rise, **the cost of imported fruit and vegetables will rise to reflect higher transportation and refrigeration costs**. The transportation and refrigeration of fruit and vegetables is also a source of greenhouse gas (GHG) emissions. Local sourcing of seasonal food, that minimizes transportation and refrigerated storage, is likely to be a key strategy in the re-orienting of food supply chains in the shift to a low carbon economy [43].

The Asia-Pacific region is also predicted to be one of the regions most affected by the **impacts of climate change** [44], and fruit and vegetable production in other exporting nations within the region may be impacted through the effects of water scarcity and extreme weather events. Relying on other regions for supplies of core foods, such as fruit and vegetables, is a risky strategy in a world where there is increasing uncertainty surrounding global supplies of food and natural resources. In 2008, when oil prices reached record levels, the UK was more severely affected by food inflation than other countries in Europe because of its reliance on food imports<sup>8</sup>, and the UK is now implementing policies to rebuild its fruit and vegetable production capacity [22].

8 The UK imports around 88% of its total fruit supply, and 40% of its vegetables – Defra (2010) Basic horticultural statistics 2010

## 2.7 What are the challenges facing Victoria's fruit and vegetable supply?

Victoria's fruit and vegetable producers face many different challenges, of which the three most significant are **loss of productive agricultural land, diminishing water supplies and low farmgate prices.**

### 2.7.1 Loss of productive agricultural land

Victoria has a relatively small amount of productive agricultural land [37, 45]. Land suitable for fruit and vegetable production is in short supply and becoming more expensive in Victoria due to urban growth, which particularly affects vegetable producers in peri-urban areas. Over half of Victoria's vegetables are grown within 100 km of Melbourne, and 17% of Victoria's fruit [12]. Melbourne's peri-urban areas of fruit and vegetable production are part of the city's 'Green Wedges'. The 'Green Wedges' comprise land outside the city's Urban Growth Boundary that has been set aside to preserve open spaces, and to provide for a variety of purposes, including agriculture [14].

Melbourne's Urban Growth Boundary was introduced in 2002 to provide long-term stability to the limits of urban development, but has been expanded three times since. The most recent changes to the Urban Growth Boundary were in July 2010, when the boundary was expanded by 43,000 hectares [46]. In May 2011, the Urban Growth Boundary was under review again [47]. Some of the areas proposed for urban expansion are important areas for fruit and vegetable production. The expansion of the urban growth boundary in July 2010 included 4,000 hectares of highly productive market garden land in Casey [46]. This land is also potentially 'drought-proof' due to its proximity to the Eastern Water Treatment Plant (see the next section). The City of Casey estimates that development of this land would result in the loss of \$20-30 million in agricultural production per annum in the shire and around 550 jobs [48].

The agricultural land in these peri-urban areas is some of the most productive agricultural land in the state.

## Agricultural Land Reserve - British Columbia, Canada

The Agricultural Land Reserve is a 4.7 million hectare zone in the Province of British Columbia in which agriculture is recognized as the priority land use. The Reserve covers about 5% of British Columbia and was established in 1976 to protect the Province's dwindling supply of productive agricultural land. The quality of agricultural land in the Province is also rated according to a 7-step land capability classification, based on its soil type and climate. In 1995, the Province introduced a Right to Farm Act that gives farmers the right to farm on land zoned for agricultural use and protects farmers from 'nuisance lawsuits' arising from normal farm practices.

Between 1992 and 1996, peri-urban areas of Victoria generated around 25% of Victoria's total agricultural value on just 13% of the land [14]. The peri-urban areas along the developed coastal regions of Australia also include some of the areas of highest rainfall [37]. However, there is currently no monitoring of how much of this productive peri-urban land is being lost to other uses [37].

The introduction of the Urban Growth Boundary in 2002 had the potential to deliver significant protection for productive agricultural land in Victoria [14], but the constant expansion of this boundary since suggests that protection of agricultural land has been a low priority [45]. There is also no agreed national framework for the protection of agricultural land and no consistent national approach to classifying productive land [37]. However, some Victorian city council planning schemes, such as those of Moorabool, Casey and Wyndham, do include measures to protect agricultural land [37].

The consequences for farmers of this constantly shifting Urban Growth Boundary are rising land prices and taxes, and a lack of certainty that impedes long-term decision-making and investment [38]. There have been several research reports and inquiries into the issues surrounding land use planning and agriculture in Victoria in recent years [38, 45]. All investigations stress the need for long-term stabilisation of the Urban Growth Boundary for at least 10 to 15 years to provide certainty for farmers, as well as the need to identify and protect productive agricultural land. These reports highlight a number of potential mechanisms for protecting productive agricultural land in Victoria,

**All investigations stress the need for long-term stabilisation of the Urban Growth Boundary for at least 10 to 15 years to provide certainty for farmers and encourage investment.**

including possible amendments to the State Planning Policy Framework. Measures to protect productive agricultural land also need to consider the options available to individual peri-urban farmers to exit the industry or relocate if continuing to farm on the urban fringe becomes, for them, unviable.

### 2.7.2 Water availability

Fruit and vegetable production in Victoria is dependent on irrigation water [2, 10]. However, less water has been available in recent years due to drought. Between, 2005 and 2008, water use for irrigation in Victoria fell 40%. Vegetable producers in Bacchus Marsh nearly ran out of water, and were only able to continue production through the provision of 'emergency' water allocations [49].

Only a small proportion of Victoria's water is used for vegetable production (see Table 2)<sup>9</sup>. The majority of the state's water is used for dairy and meat production. A significant proportion of these dairy and meat products are exported, resulting in the 'export' of around 35% of the water harvested annually from Victoria's river systems as virtual water in food products [50]<sup>10</sup>.

9 Horticulture is also one of the most efficient and productive users of water for agriculture. Vegetable production delivers the highest return per ML of water of any agricultural commodity in Australia - Tisdell et al, 2000, in McGuickan (2000) *Consequences of current and proposed water reform on Australian horticulture. Final report to HAL.*

10 This figure includes some 'interstate' exports as well as international exports.

**Figure 2. Melbourne's Green Wedges.**



Source: The Melbourne Atlas, State of Victoria, Department of Planning & Community Development, copyright © 2010; available at [http://www.dpcd.vic.gov.au/\\_\\_\\_data/assets/pdf\\_file/0017/56123/Melbournes\\_Green\\_Wedges.pdf](http://www.dpcd.vic.gov.au/___data/assets/pdf_file/0017/56123/Melbournes_Green_Wedges.pdf)

## Bunyip Food Belt - Victoria

The Bunyip Food Belt is a region south-east of Melbourne (around Cranbourne, Koo Wee Rup and the Mornington Peninsula) that contains some of the most fertile farmland in Victoria and is a significant area of horticultural production. Local councils in the region are investigating whether the region could be supplied with Class A recycled water from the nearby Eastern Treatment Plant, and they have also proposed a planning overlay that would preserve the land for agricultural purposes. This project has the potential to significantly enhance Melbourne's food security by developing a key area of fruit and vegetable production on the fringe of the city as a potentially 'drought proof' food bowl.

**Table 2. Agricultural water use in Victoria**

COMMODITY	% OF AGRICULTURAL WATER USE IN VICTORIA
Dairy cattle farming	47.0
Fruit tree and nut growing	23.0
Sheep, beef cattle and grain farming	20.0
Other crop growing	1.0
Other livestock farming	1.5
Poultry farming	0.5
<b>Mushroom and vegetable growing</b>	<b>6.0</b>
Nursery and floriculture production	1.0
Total	100.0

*This table shows the % of total agricultural water use in Victoria accounted for by specific commodities (Source: ABS, Water Account Australia 2008-9)*

While 2010 and 2011 have been unusually wet years for Victoria, less water is likely to be available for agriculture in coming decades [51]. Climate modeling suggests that Victoria will experience further falls in water availability, and large cuts in agricultural water use are required to restore environmental flows in the Murray Darling Basin [52].

The Victorian Government has responded to the reduction in water availability with policy initiatives that aim to increase water efficiency and to maximise the economic value generated from water [53-54]. These initiatives include the Food Bowl Modernisation Project, which aims to improve the efficiency of irrigation infrastructure in the Northern Food Bowl [55], and the introduction of water trading, which allows farmers to buy and sell water entitlements [56].

Over half of Victoria's vegetable farmers see the availability of irrigation water as an impediment to the future viability of their business [10]. Vegetable growers in peri-urban Melbourne have benefited less from irrigation upgrades in the Northern Food Bowl and from the introduction of water trading, because trade in peri-urban areas is limited by the available infrastructure for moving water and by the small size of the trading areas [57].

One of the best options for improving water security in these areas is through recycled water schemes. Fortunately, some of Melbourne's best horticultural land is located close to the city's two water treatment plants, the Eastern and Western Treatment Plants, located in Cranbourne and Werribee respectively. Land in these areas, where optimal soil and climatic conditions co-occur with a potentially secure source of water, should be regarded as being of the highest possible agricultural value and protected from housing development.

There is also potential to extend and improve the infrastructure that supplies recycled water in these areas in order to develop them as 'drought-proof' food bowls. To secure the long-term viability of the Werribee district for vegetable production, the quality of recycled water from the Western Treatment Plant needs to be improved in order to avoid soil and crop damage [58].

The proposed Bunyip Food Belt could be developed as a second 'drought-proof' food bowl, but requires the support of the Victorian Government to extend the use of recycled water from the Eastern Treatment Plant [59].



## Food Hub – Charlottesville, Virginia

The Charlottesville Local Food Hub in Virginia is a food warehouse that buys and aggregates locally grown produce from small family farms and sells it on to local schools, hospitals, restaurants, markets and consumers. It is a ‘not for profit’ venture that buys produce at a fair price and aims to strengthen the local food supply by supporting small family farms and increasing the amount of fresh food available to the community. The food hub also has a variety of outreach programs, including an educational farm, and donates more than 5% of warehouse sales to local food banks and community groups.

### 2.7.3 Low farmgate prices

Over the last twenty years, Australian farmers have increasingly become caught in a ‘cost price squeeze’. The cost of farm inputs - like fuel, fertilisers and pesticides - has been rising faster than the prices that farmers receive for their produce [60]. Although the prices paid by consumers have risen considerably for some foods over the last decade [61], higher prices at the checkout have generally not translated into higher farmgate prices.

There is disagreement about the factors driving low farmgate prices. Farmers point to the power of the major supermarkets in driving down prices [62]. At least 55% of fruit and vegetables in Australia are sold through the major supermarkets [15]. However, an inquiry by the Australian Competition and Consumer Commission into the ‘competitiveness of retail prices for standard groceries’ in 2008 found that low prices were not due to the behaviour of the supermarkets, but to other market pressures [61]. Other significant influences on prices are the high Australian dollar, which has reduced export opportunities [63], and low cost imports from other countries in the Asia-Pacific region, which produce fruit and vegetables more cheaply due to lower labour costs [64]. Nonetheless, concerns remain about the power and behaviour of the major supermarkets in the fresh food supply chain, and these concerns have recently been reignited as a result of the ‘milk price wars’ [65].

Choice and the Australian Food and Grocery Council have called for the establishment of a ‘supermarket ombudsman’ to mediate in disputes and to promote fairness and transparency along the supply chain [66]. The Victorian Farmers Federation has also called for an extension of the Horticulture Code.

The Horticulture Code applies to trade between growers and wholesalers, and the Victorian Farmers Federation has called for the Code to be extended to cover trade between growers and all buyers at the ‘first point of sale’, including supermarkets [62].

Another response to address falling farmgate prices is the development of alternative supply chains, such as farmers’ markets and box schemes. Victoria now has around 90 farmers’ markets, and more than 2000 farmers use these markets to sell their produce direct to consumers, gaining a bigger share of the retail price for their produce [67]. These alternative forms of supply also have other benefits, such as educating consumers about the source of their food.

New developments in alternative supply chains that give farmers more power in the supply chain and more opportunities to connect directly with consumers are likely to play an important role in improving the terms of trade for farmers. One approach gaining interest in the United States is the development of food hubs. Food hubs are places where growers and buyers in a region can connect. They provide shared infrastructure such as warehouses, refrigerated storage, transport and packing facilities and enable small farmers to collectively supply to larger buyers. Many food hubs are located in ‘food deserts’ and also facilitate access to fresh fruit and vegetables for consumers. There are now over 100 food hubs in the United States and the United States Department of Agriculture (USDA) is actively promoting their development [68].

A related approach in Australia is the development of farmer co-operatives. Funding has been provided in recent years by the Victorian Government to trial marketing co-operatives [69], and the current Coalition Government has made an election commitment to further fund co-operatives.

### 2.7.4 Climate change

Fruit and vegetable production is highly sensitive to environmental extremes. An assessment of the impacts of climate change on Australian horticulture found that temperature increases are likely to affect the quality, yield and production windows for fruit and vegetable crops [70]. CSIRO’s climate change projections for Victoria suggest that annual average temperatures

## **Alternative supply chains such as farmers' markets benefit Victorians by giving farmers a better share of the retail price for their produce and educating consumers about the source of their food.**

will rise by up to 1.2°C by 2030, with a higher number of 'extreme' temperature days [71]. Average annual rainfall is also likely to decrease, and there could be an increase in the frequency of drought and in the number of extreme weather events, such as storms and floods.

Climate change is also likely to worsen pest and disease activity in horticultural crops, due to higher temperatures, and may lead to increased pesticide use [70]. Flood events also have the potential to increase pest activity, as the recent locust outbreak in Victoria demonstrates [72]<sup>11</sup>.

Climate modeling suggests that Australia could experience fruit and vegetable supply interruptions and price spikes once every two to four years in a warming climate, rather than the current average of about once every ten years [4].

A multi-pronged approach is likely to be needed to encourage resilience in Victoria's fruit and vegetable supply in the face of these climate pressures, including the development of more adaptable fruit and vegetable cultivars [70], 'drought-proofing' of key peri-urban vegetable production areas and more support for backyard and community fruit and vegetable production to increase community resilience to fruit and vegetable price spikes.

### **2.7.5 Honey bees**

Fruit and vegetable production is particularly dependent on pollination by honey bees. Crops such as stone fruits, apples and pears, melons, pumpkins and avocados all rely on honey bees for pollination [73]. However, there are increasing concerns about the health of Australia's honey bee population, due to the arrival in Australia of the Asian bee and the likely spread of the varroa mite [74].

The Asian bee arrived in Australia about four years ago and is currently restricted to the area around Cairns, but there is concern that the bee could become endemic in Australia. Asian bees rob European honey bees of their honey, and compete with the European bees for floral resources [75]. Varroa mite is a bee parasite that

attacks bees, destroying the colony [76]. Australia is one of the few countries in the world that is still free of varroa mite. Most European countries have lost about 20% of their honey bee colonies in recent years [74].

There is concern that the horticultural industry could be devastated if a significant proportion of honey bee colonies in Australia collapse due to these issues [77], and there have been calls for concerted action to address the threat to honey bees in Australia [74]. The Victorian Government recently announced a Bee Force pilot project that will place 'sentinel bee hives' around the Port of Melbourne, with the aim of detecting varroa mite should it enter the state [78]. This initiative has been welcomed by the horticulture industry but the industry continues to call for measures to eradicate the Asian bee [77].

### **2.7.6 Fertiliser availability**

Fruit and vegetable production is heavily dependent on the use of commercial fertilisers [79]. Fertiliser prices have increased significantly in recent years [60] and are likely to continue to increase in the long term, due to increased demand for fertilisers and declining supplies of the primary sources of key fertiliser inputs (fossil fuels for Nitrogen and phosphate rock for Phosphorous) [80].

Fertiliser and pesticide use are higher in horticultural production than in most other agricultural industries. Excessive use of fertilisers can affect soil and water quality, causing soil acidification and algal blooms in rivers [81]. The horticultural industry has responded to community concerns about the environmental impacts of excess fertilisers and pesticides with the introduction of environmental management systems [82]. However, concerns about the environmental damage caused by excess use of these inputs and about the long-term outlook for global fertiliser supplies has also led to calls for a greater focus on sustainable production systems, such as low input and agro-ecological production approaches [83], and for systems that treat and recycle organic waste, feeding it back into systems of food production [84].

<sup>11</sup> Victoria is experiencing its worst locust outbreak in 40 years, which has been linked to flooding in Queensland (Magee, 2010).

**A multi-pronged approach is likely to be needed to encourage resilience in Victoria's fruit and vegetable supply.**



### 2.6.7 Waste

Over 40% of household residual rubbish sent to landfill in Melbourne is food waste [84], and the main type of food waste is fruit and vegetables. Australian consumers throw out \$1.1 billion worth of fruit and vegetables every year [85]. Food waste sent to landfill creates methane during decomposition, and is estimated to produce around 5.25 Mt CO<sub>2</sub>-e emissions annually [85].

There is a lack of detailed data about waste at other stages of the fruit and vegetable supply chain in Australia [86], but the available evidence suggests that the losses are likely to be considerable. A case study of banana waste found that a third of the Queensland banana crop is destroyed post-harvest [87].

Wasted fruit and vegetables represent a waste of inputs such as water, fertilisers and energy, as well as embodied greenhouse gas emissions. One of the main reasons for post-harvest waste is that the product fails to meet the strict product specifications of Australia's two main retailers [87]. This type of waste could increase in a warming climate, because of an increase in blemished fruit and vegetables [70]. The trend to overseas sourcing of product by Victorian fruit and vegetable processors (see section 2.2) could also lead to an increase in post-harvest waste because food processors have traditionally been one of the main markets for second grade product.

When the 2008-9 drought resulted in tight supply, the major retailers relaxed their standards to accept heat-damaged produce [88], and consumers were encouraged to continue buying blemished produce [89]. Given the environmental impacts of increased resource use and the likelihood that Australian fruit and vegetable production will be subject to more frequent extreme weather events, there is an argument that retail product specifications should be relaxed permanently<sup>12</sup>.

12 Extreme temperatures cause changes in the size and colour of fruit and vegetables, as well as a variety of 'blemishes' – Deuter (2008) Defining the impacts of climate change on horticulture in Australia. Queensland Dept of Primary Industries and Fisheries.

# 3 Current policy approach



### 3.1 An overview of the Victorian policy environment

There is currently a **fragmented and ‘silo-ed’ approach** to addressing the issues affecting fruit and vegetable production in Victoria. Issues such as land management, water management and the promotion of industry growth are managed by different departments<sup>13</sup>, with no overall coordinating framework. Policy related to fruit and vegetable production is also unconnected to policy related to promoting consumption<sup>14</sup>. The effects of this lack of overall co-ordination are potential conflicts among the policies of different departments, significant issues ‘falling between the cracks’, and missed opportunities to deliver additional value by maximising the benefits from coordinated policy initiatives and investments. In 2010, the Victorian Liberal Nationals Coalition Government created a new policy portfolio for food security under the Minister for Agriculture and Food Security. However, the state currently lacks an integrated policy framework for promoting food security, and sufficient attention needs to be given to food security in the management of critical resources such as land and water [45].

The overall policy approach across many issues related to fruit and vegetable supply is market-oriented and economically-driven, and resources like land and water are valued mainly in economic terms.

A key policy aim for the management of these resources is to ensure that they are used for their ‘highest and best use’; that is, the use that has the highest economic value. However, the use with the highest economic value is not always the use with the best social, environmental or health value. In the case of land, the ‘highest and best use’ is almost always housing [45]. Budge and Slade’s

2009 review of ‘Integrated Land Use Planning and Community Food Security’ in Victoria emphasises that this approach, “will ultimately see all highly productive land on the urban fringe turned over to the last crop ‘housing’”. In the case of water, the ‘highest and best use’ is the use that generates the highest revenue per Megalitre of water [90]. This can result in perverse outcomes such as the use of irrigation water to fill urban swimming pools or water golf courses rather than grow food during severe droughts, because water is more highly valued for these uses [91].

The consequence of valuing production and critical resources such as land and water in purely economic terms is that opportunities are missed to also achieve policy objectives related to a broader social, health and environmental sustainability agenda. For example, viewed solely in economic terms, horticulture is a less important agricultural sector than the dairy and red meat industries and, consequently, attracts less government investment [63]. If horticulture were also valued in terms of its health benefits for the population or its potential to reduce the GHG emissions associated with imported fruit and vegetables, it might attract more government investment. Similarly, if a greater emphasis were placed on the value of resources such as land and water for food security, this could open up alternate policy options, such as prioritizing water for fruit and vegetable production or protecting significant areas of peri-urban vegetable production from urban expansion.



13 Strategic land management issues are the responsibility of the Department of Planning and Community Development, while day to day decisions are primarily the responsibility of local government. Water management issues come under the Department of Sustainability and Environment and promoting economic development is the responsibility of the Department of Primary Industries and the Department of Business and Innovation.

14 The Victorian Department of Health is responsible for health promotion and oversees a statutory body for health promotion, the Victorian Health Promotion Foundation (VicHealth).

**The consequence of valuing production and critical resources such as land and water in purely economic terms is that opportunities are missed to also achieve policy objectives related to a broader social, health and environmental sustainability agenda.**

### 3.2 The need for an integrated policy approach

An integrated, 'whole of food system' approach is needed to improve the resilience of Victoria's fruit and vegetable supply, rather than a series of individual policy measures, because:

- **there are multiple issues involved** – Policy measures are needed to protect productive agricultural land from urban expansion and also to encourage farmers to keep farming this land by improving farm profitability and water access
- **the issues and their solutions are interconnected** For example, water security is closely connected to land security. To develop the Bunyip Food Belt as a 'drought-proof food bowl', the land must be protected from urban expansion and the water security of the area needs to be improved through access to recycled water from the Eastern Treatment Plant
- **the issues cut across government departments** – For example, the Department of Planning and Community Development (DPCD) is responsible for land use planning policy, the Department of Sustainability and the Environment (DSE) is

responsible for water policy and the DPI and the Department of Business and Innovation (DBI) both have responsibility for promoting economic development

- **there are conflicts in the policy approaches between different government departments** – For example, The Victorian Minister for Agriculture and Food Security has stated that loss of agricultural land to urban development will impact food security, but the Minister for Planning has commissioned another review of the Urban Growth Boundary.
- **there are additional benefits to be gained through integrated solutions, often at no extra cost** - for example, many public sector institutions (such as hospitals, schools and prisons) purchase fruit and vegetables to supply food services. These fruits and vegetables could be sourced direct from Victorian farmers, which would deliver money back into the Victorian economy, give farmers a bigger share of the retail price, and generate multiple additional benefits (e.g. by purchasing seasonal rather than 'out of season' fruit or by purchasing second as well as first grade product).

#### A fragmented and silo-ed approach

**Policy conflicts:** The Victorian Minister for Agriculture and Food Security has stated that loss of agricultural land to urban development has impacts on food security, but the Minister for Planning has commissioned another review of the Urban Growth Boundary.

**Issues falling between the cracks:** Urban expansion creates a unique set of challenges for peri-urban agriculture, but the Victorian DPI currently has no peri-urban agriculture strategy to address them.

**Missed opportunity:** The Victorian Department of Education and Early Childhood has a *Free Fruit Friday* program that promotes fruit consumption by distributing free fruit to primary school children. This is an excellent opportunity to achieve multiple benefits by:

- sourcing produce direct from Victorian farmers so that they get a bigger share of the retail price
- educating children about where their food comes from through a 'Meet the farmers' program
- sourcing seasonal fruit, and second grade as well as first grade fruit, to educate children about seasonality and natural 'blemishes'.

These opportunities are missed because the *Free Fruit Friday* program could be better connected to other policy areas and fruit is likely sourced through standard retail channels.

# 4 An integrated approach for Victoria





## 4.1 The UK Fruit and Vegetable Taskforce

In 2009, the UK Department of Environment, Food and Rural Affairs (Defra) set up a Fruit and Vegetable Taskforce to take an integrated 'whole of government' approach to increasing the UK's production and consumption of fruit and vegetables. UK fruit and vegetable farmers face many of the same issues as Victorian farmers, including loss of land to urban expansion, low farmgate prices and, increasingly, water scarcity [22]. The UK faces a difficult task to increase its production of fruit and vegetables, because production capacity is now greatly reduced after years of relying on imports. There are many lessons to be learned for Victoria in this integrated approach to addressing the problems.

The aims of the Taskforce were to:

- develop strategies to increase the UK's production and consumption of fruit and vegetables
- make UK-grown fruit and vegetables more competitive on grounds of cost, availability and quality
- ensure that any increase in production was done sustainably.

The Taskforce included 25 people from across relevant government departments (including health, commerce and agriculture) and from across the supply chain (including representatives from the National Farmers Union, producer co-operatives, processors and retailers). The Taskforce was split into three working groups focused on production, the supply chain and consumption.

The Taskforce delivered an Action Plan with short, medium and long-term recommendations to address the major issues. It covered areas such as protection of agricultural land, water security, improving farmgate prices, research and development and labour availability.

## USDA 'Know your Farmer, Know your Food' Taskforce

The United States Department of Agriculture's (USDA) 'Know your Farmer, Know your Food' (KYF2) initiative is an integrated policy initiative that aims to support the development of local and regional food systems. The Taskforce is chaired by the Deputy Secretary of the USDA and involves members of multiple USDA agencies, as well as co-ordinating with other federal agencies. The Taskforce is designed to eliminate organisational silos and break down the structural barriers that inhibit local food system development.

Key recommendations included the appointment of a Grocery Adjudicator, a program of grants and loans to encourage supply chain innovation and efficiencies, the development of mandatory Government Buying Standards for Food and changes to the National Planning Policy to recognize the value of land for food production. The Taskforce did not make recommendations related to sustainable production, because this was the focus of another government initiative.

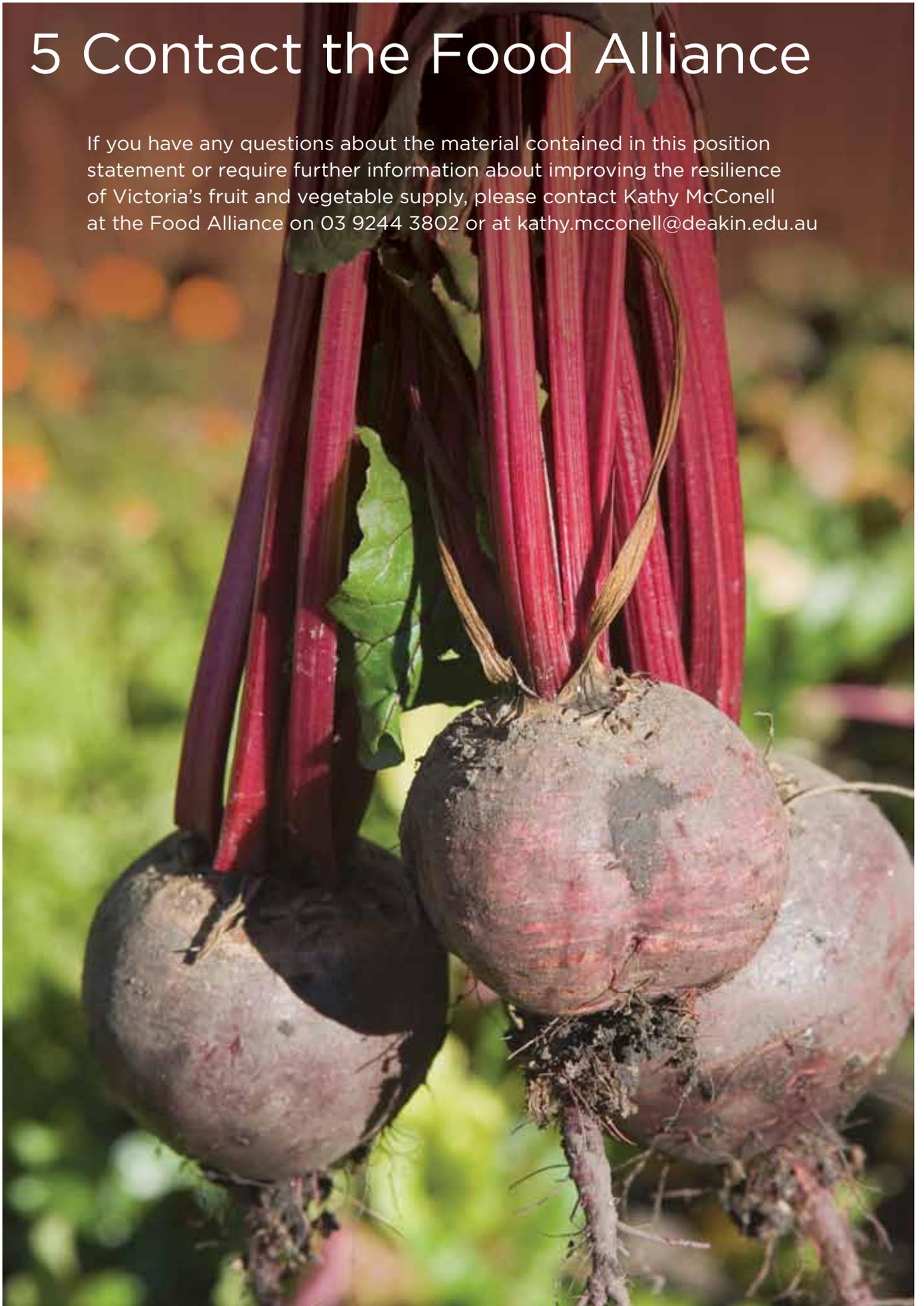
## 4.2 A way forward for Victoria

The UK Fruit and Vegetable Taskforce provides a model for addressing the issues that now face Victoria's fruit and vegetable producers. The Food Alliance believes that there is a need for stakeholders from across the fruit and vegetable supply chain and from other sectors (including health, land use planning and water) to work together to identify strategies for improving the resilience of Victoria's fruit and vegetable supply and for increasing the consumption of fruit and vegetables in the state. Key issues for this cross-sector and cross-supply chain group to address include:

- identifying and protecting productive agricultural land
- increasing the water security of key fruit and vegetable production areas
- improving farm profitability through regulatory measures and supply chain innovation
- promoting sustainable and resilient production systems
- increasing consumption of fruit and vegetables.

# 5 Contact the Food Alliance

If you have any questions about the material contained in this position statement or require further information about improving the resilience of Victoria's fruit and vegetable supply, please contact Kathy McConell at the Food Alliance on 03 9244 3802 or at [kathy.mcconell@deakin.edu.au](mailto:kathy.mcconell@deakin.edu.au)



# References

1. DPI, *Victoria's Food and Fibre Performance 2009-10*. 2011.
2. DPI, *Victoria's Fruit Industries Summer 2011*. Victorian Department of Primary Industries. 2011.
3. DPI, *Victoria's Vegetable Industry*. Summer. 2011.
4. Quiggin, J., *Drought, Climate change and Food prices in Australia*. 2007, University of Queensland.
5. City of Casey and Cardinia shire Council, *Joint Submission to the Parliamentary Inquiry into Sustainable Development of Agribusiness in Outer Suburban Melbourne*. 2008.
6. Buxton, M. and R. Goodman, *Maintaining Melbourne's Green Wedge: Planning policy and the future of Melbourne's Green Belt*. School of Social Science and Planning RMIT University Melbourne. 2002.
7. Reeves, T., et al., *Food security issues for the Australian horticulture industry*. 2011.
8. Littlely, B., *Australia faces food shortages within a decade*, in *The Advertiser*, Adelaide 2011.
9. DPI. *The horticulture industry at a glance - horticulture in Victoria 2011*; Available from: <http://new.dpi.vic.gov.au/agriculture/horticulture/dpi-services-to-horticulture-producers/horticulture-at-a-glance>.
10. Crooks, S., *Australian vegetable growing farms: an economic survey, 2006-07*. 2009, Horticulture Australia Ltd.
11. Board, S.M.E.D. *Grow Mildura Region, Table Grapes and Dried Fruit*. Available from: [http://www.growmilduraregion.com.au/table\\_grape.php](http://www.growmilduraregion.com.au/table_grape.php).
12. ABS, *Value of agricultural commodities produced, Australia 2008-9*. 2010.
13. Gaynor, A. *eMelbourne, the City past and Present, Market Gardens* Available from: <http://www.emelbourne.net.au/biogs/EM00902b.htm>.
14. Budge, T., *Farmland Preservation in Australia: Emerging Issues - Fragmented Responses in Farmland Preservation: Land for Future Generations*, W. Caldwell, S. Hilts, and B. Wilton, Editors. 2007. Ontario: Volumes Publishing.
15. Spencer, S. and M. Kneebone, *Foodmap: A comparative analysis of Australian food distribution channels*. Australian Government Department of Agriculture, Fisheries and Forestry. Canberra 2007.
16. Hunt, P., *Home brands hurting farmers*, in *Weekly Times* 1 June 2011.
17. Apted, S., et al., *International competitiveness of the Australian vegetable production sector*. 2006, Australian Bureau of Agricultural and Resource Economics.
18. *Apparent consumption of foodstuffs, 1997-98 and 1998-99*. 2000, Australian Bureau of Statistics (ABS).
19. Kim, M., N. Thompson, and J. Penm, *Recent trends in Australia's food trade*. *Australian Commodities* 17 (2) June quarter 2010.
20. Foster, M., et al., *Overview of the Australian Food Industry 2009-10*. The Australian Food Statistics 2009-10. ABARES. 2010.
21. Defra, *Basic horticultural statistics*. 2010, Department for Environment, Food and Rural Affairs.
22. Defra, *Report of the Fruit and Vegetables Taskforce 2010*.
23. *Fruit and vegetable promotion initiative / a meeting report*. 2003, World Health Organization.
24. DoH, *Victorian Population Health Survey*. Victorian Department of Health. 2008.
25. Friel, S., *Climate change, food insecurity and chronic diseases: sustainable and healthy policy opportunities for Australia*. NSW Public Health Bulletin. 21: p. 129-33.
26. Department of Human Services, *Victorian Burden of Disease Study: Mortality and Morbidity in 2001*. 2005, Public Health Group, Department of Human Services.
27. COAG, *National Partnership Agreement on Preventative Health: An Agreement Between the Commonwealth of Australia and the States and Territories*. Council of Australian Governments. 2009.
28. DPI. *Horticulture 2011*; Available from: <http://new.dpi.vic.gov.au/agriculture/horticulture>.
29. DAFF, *Australian Horticulture Fact Sheet 2010*.
30. VFMA, *Submission on issues paper to inform development of a national food policy 2011*.
31. Larsen, K., et al., *Victorian Food Supply Scenarios: Impacts on availability of a nutritious diet*. 2011, Victorian Eco-Innovation Lab (VEIL).
32. Soebels, J., et al., *Summary of Research into the Long-Term Physical Implications of Net Overseas Migration Australia in 2050*. 2010, National Institute of Labour Studies, Flinders University: Adelaide.
33. Ausveg. *Volume of Vegetable Production*. Data source: Australian Bureau of Statistics. 2010 Available from: <http://ausveg.businesscatalyst.com/resources/statistics/domestic-industry/vegetable-production.htm>

34. FAO, *Area harvested and production of vegetables*. . 2010, UN Food and Agriculture Organisation Statistical Division.
35. Crooks, S., *Australian vegetable growing farms: an economic survey, 2008-09*. 2010.
36. Ausveg., *Domestic Vegetable Industry Snapshot*. 2007.
37. Budge, T., A. Butt, and M. Buxton, *Does Australia need a national policy to preserve agricultural land? Draft summary of preliminary findings*. 2011
38. *Inquiry into sustainable development of agribusiness in outer suburban Melbourne*. 2010, Government Printer for the State of Victoria.
39. Hoppe, R., J. MacDonald, and P. Korb, *Small farms in the United States: Persistence under pressure*. 2010.
40. OECD/IEA, *World energy outlook 2010: Executive summary*.
41. PMSEIC, *Australia and food security in a changing world*. 2010: Canberra.
42. Estrada-Flores, S., A. Higgins, and K. Larsen, *Food distribution systems in a climate-challenged future: fruit and vegetables as a case study 2009*.
43. The Bristol Partnership/Bristol Green Capital, *Building a positive future for Bristol after Peak Oil 2010*.
44. Parry, M., et al., *Effects of climate change on global food production under SRES emissions and socio-economic scenarios*. *Global Environmental Change*, 2004. 14: p. 53-67.
45. Budge, T. and C. Slade, *Integrating Land use Planning and Community Food Security 2009*, Community Planning and Development Program La Trobe University, Bendigo Campus.
46. Dowling, J., *Green land cut back as Melbourne grows much bigger*, in *The Age*. 2010.
47. Department of Planning and Community Development. *Independent process for potential expansion of urban growth boundary*. 23 May 2011; Available from: <http://www.dpcd.vic.gov.au/planning/news-and-events/news/independent-process-for-potential-expansion-of-urban-growth-boundary>.
48. City of Casey, *Vision for the future, Special council meeting of the City of Casey Council, 14 July 2009*.
49. Sobey, E., *Moorabool Shire Council: Veggie industry collapse looms*, in *The Courier* 2010.
50. GHD, *Report on the virtual water cycle of Victoria*. . 2008, Victorian Water Trust.
51. DSE, *Climate change in Victoria: 2008 summary*, Department of Sustainability and the Environment, 2008.
52. MDBA, *Guide to the proposed basin plan: overview*, M.D.B. Authority, Editor. 2010: Canberra.
53. DSE, *Securing our water future together: Victorian Government white paper*, Department of Sustainability and the Environment. 2004.
54. DSE, *Our water, our future: the next stage of the Government's water plan* Department of Sustainability and the Environment. 2007.
55. NVIRP, *Northern Victoria Irrigation Renewal Project: Water for Growth*. 2010.
56. DSE, *A governance guide to the Victorian water industry*, Department of Sustainability and the Environment 2009.
57. McGuckian, R., *Consequences of current and proposed water reform on Australian horticulture*. 2002.
58. Ker, P., *Growing pains*. *The Age*, 2009.
59. Cardinia Shire Council. *Study to commence into viability of Bunyip Food Belt*. 2011; Available from: [http://www.cardinia.vic.gov.au/Page/Page.aspx?Page\\_id=3258](http://www.cardinia.vic.gov.au/Page/Page.aspx?Page_id=3258).
60. The Treasury, *Media release: ACCC examination of fertiliser prices 22 August 2008*.
61. ACCC, *Report of the ACCC inquiry into the competitiveness of retail prices for standard groceries 2008*.
62. VFF, *Submission to the ACCC Inquiry into the competitiveness of retail prices for standard groceries. July 2008*, Victorian Farmers Federation.
63. DPI, *DPI Services to horticulture producers. Discussion Draft June 2010*, Victorian Department of Primary Industries.
64. James, I., *Australia-China trade in vegetables*. 2006, AUSVEG Ltd.
65. Coorey, P., *Milk war heats up as Woolies sides with farmers*. , in *Sydney Morning Herald*. 2011.
66. Aus Food News. *AFGC joins Choice in calls for supermarket Ombudsman 2011*; Available from: <http://www.ausfoodnews.com.au/2011/04/29/afgc-joins-choice-in-calls-for-supermarket-ombudsman.html>.
67. Victorian Farmers Market Association, *About the VFMA*. 2011.
68. USDA. *Food hubs: building stronger infrastructure for small and mid-sized producers 2011*; Available from: <http://www.ams.usda.gov/AMSV1.0/foodhubs>.

69. Victorian Liberal Nationals Coalition. Vic Coalition will back food and fibre marketing co-operatives 2010; Available from: [http://www.peterwalsh.org.au/\\_blog/Media\\_Releases/post/VIC\\_COALITION\\_WILL\\_BACK\\_FOOD\\_AND\\_FIBRE\\_MARKETING\\_CO-OPERATIVES/](http://www.peterwalsh.org.au/_blog/Media_Releases/post/VIC_COALITION_WILL_BACK_FOOD_AND_FIBRE_MARKETING_CO-OPERATIVES/)
70. Deuter, P., *Defining the impacts of climate change on horticulture on Australia*. 2008, Department of Primary Industries and Fisheries, Queensland.
71. Victorian Climate Change Adaptation Program, *Climate change in Victoria: 2008 summary*. 2008.
72. Magee, A., *Farmer fears as plague of locusts sweeping across Victoria* in *Herald Sun*. 2010.
73. DAFF, *Varroa mite*. 2009, Department of Agriculture, Fisheries and Forestry.
74. Smith, B., *Fight the mite's might* in *The Age* 2011.
75. Fact Sheet - *Asian bee. Food security needs bee security* 2011.
76. DAFF. *Varroa mite* 2011; Available from: <http://www.daff.gov.au/animal-plant-health/pests-diseases-weeds/animal/varroa-mite>.
77. VFF. Media release: *Bee force pilot project only beneficial if Asian bee eradicated too*. Available from: [http://www.vff.org.au/common\\_php/get\\_file.php?id=1292](http://www.vff.org.au/common_php/get_file.php?id=1292).
78. Taffa, B., *Walsh is buzzing with excitement*, in *The Southern Thunderer* 2011.
79. Commissioner for Environmental Sustainability Victoria, *Victoria 2008 State of the Environment Report*. 2008.
80. Dawson, C.J. and J. Hilton, *Fertiliser availability in a resource-limited world: Production and recycling of nitrogen and phosphorous*. *Food Policy* 2011. 36: p. S14-S22.
81. Stringer, R., *Environmental Policy and Australia's Horticulture Sector*. 1998, University of Adelaide - Centre for International Economic Studies (CIES).
82. Ausveg. *What is enviroveg?* 2009; Available from: <http://www.ausveg.com.au/docs/Enviroveg%20Information%20Pack.pdf>.
83. Larsen, K., C. Ryan, and A.B. Abraham, *Sustainable and secure Food systems for Victoria: What do we know? What do we need to know?* 2008, Victorian Eco-Innovation Lab (VEIL).
84. Donovan, J., K. Larsen, and J. McWhinne, *Food-sensitive planning and urban design: A conceptual framework for achieving a sustainable and healthy food system*. 2011.
85. Baker, D., J. Fear, and D. Richard, *What a waste: An analysis of household expenditure on food*. 2009, The Australia Institute.
86. Morgan, E., *Fruit and vegetable consumption and waste in Australia* 2007, VicHealth and Deakin University.
87. Marriner, C., *What's yellow, small and costing growers a packet?*, in *The Age* 2010.
88. Palmer, D., *Harsh weather cuts fresh food supplies: Woolworths*. AFN thought for food, 2009.
89. Minister for Agriculture, Forestry and Fisheries. *Support heat and flood affected farmers at your supermarket*. 2010; Available from: [http://www.maff.gov.au/media\\_office/media\\_releases/Burke-media-releases/2009/march\\_2009/support\\_heat\\_and\\_flood\\_affected\\_farmers\\_at\\_your\\_supermarket](http://www.maff.gov.au/media_office/media_releases/Burke-media-releases/2009/march_2009/support_heat_and_flood_affected_farmers_at_your_supermarket).
90. Fullerton, T., *Watershed: Deciding our water future*. 2001, Sydney: ABC Books.
91. Godden, L., *Property in urban water: private rights and public governance*, in *Troubled Waters: Confronting the water crisis in Australia's cities*, P. Troy, Editor. 2008, ANU E-Press.

