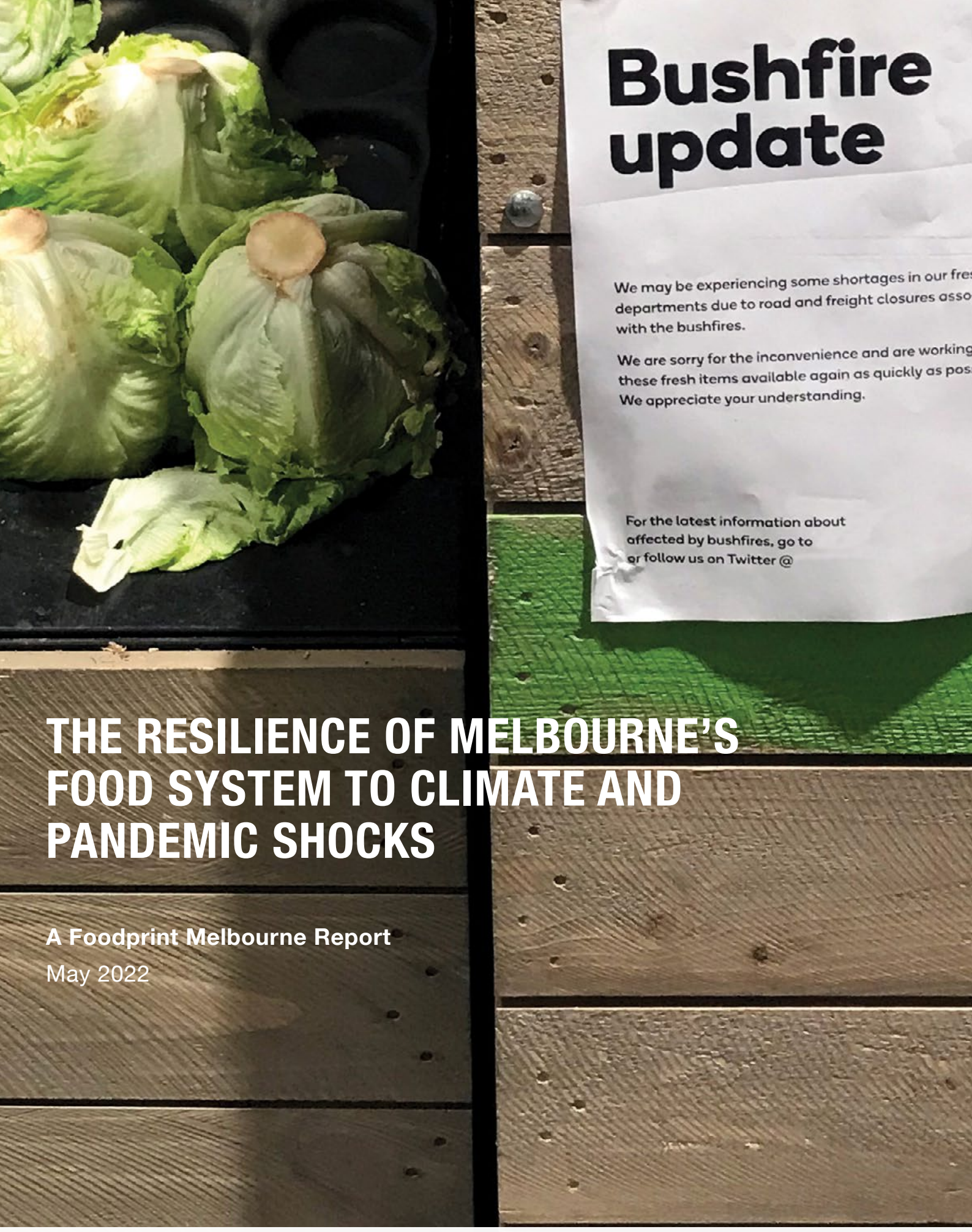

THE RESILIENCE OF MELBOURNE'S FOOD SYSTEM TO CLIMATE AND PANDEMIC SHOCKS

A Foodprint Melbourne Report

May 2022

LORD MAYOR'S CHARITABLE FOUNDATION

THE UNIVERSITY OF MELBOURNE

In memory of **Lillian Lane Murphy**
(31 December 2003 – 4 November 2021)

Funder
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For enquiries about this report, contact:
Dr Rachel Carey in the Faculty of Veterinary and Agricultural Sciences at the University of Melbourne
rachel.carey@unimelb.edu.au
+61 3 8344 1567

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Figures and tables

Right: Image Lilly Murphy

Executive summary

This report outlines the findings of an investigation into the resilience of Melbourne's food system to shocks and stresses. The findings of this research include:

- Melbourne's food system will face **more frequent and severe shocks** in future related to **climate change**, including fire, flood and drought
- Melbourne's food system faces **a range of other shocks and stresses** including pandemic, energy shocks and ecological stresses
- Melbourne's food system will also experience **compounding effects** from shocks and stresses that co-occur or follow closely on each other, exacerbating the impacts
- The **2019-2020 bushfires** in south-east Australia and the **COVID-19 pandemic** had impacts throughout the food system from production to consumption
- **Vulnerabilities** in Melbourne's food system include geographic and corporate concentration, long 'just in time' supply chains, insecure employment in food and farming and high levels of food loss and waste
- The resilience of Melbourne's food system is undermined by **ongoing food insecurity** in the region, which is exacerbated by shocks and stresses
- Shocks and stresses have the **greatest impact on those who are already vulnerable** to food insecurity, particularly those on low incomes
- Rising food insecurity during shocks and stresses is mainly addressed through **emergency food relief**, which is the responsibility of the **charitable sector**
- During the **COVID-19 pandemic**, demand for food relief increased rapidly at the same time as donations of food from the private sector fell and as the sector lost its volunteer workforce
- The **private sector plays a key role** in managing food supplies in the event of a shock
- **Diversity is a key feature** of resilient food systems – in the geographic locations that food is sourced from, the scale of food and farming enterprises, the types of enterprises that supply food and the types of food that are grown
- **Other features of resilient food systems** include adaptation and innovation, decentralisation, and collaboration and networks
- The **COVID-19 pandemic** has created a transformational moment with the potential for deep systemic change in food systems
- There is a need for **long term planning for the resilience of food supplies** that draws on the lessons learned from recent shocks to the food system, such as the 2019-2020 bushfires and the COVID-19 pandemic
- As the frequency and severity of shocks and stresses increases, there is a need for **government leadership** in food resilience planning
- **Food resilience planning** should take place at all levels of government, with a focus on the food security of those who are most vulnerable to the impacts of shocks and stresses

SECTION 1

Introduction

1.1 Acknowledgement

We begin this report by acknowledging the Traditional Owners and Custodians of the unceded lands that the report focuses on – Narrm, the Melbourne region, and its surrounding areas.[1] We pay our respects to the Traditional Owners of these lands and their Elders – the Bunurong Boon Wurrung, Dja Dja Wurrung, Eastern Marr, Gulidjan, Gadubanud, Taungurung, Wadawurrung, Wathaurong and Wurundjeri Woi Wurrung peoples – and we acknowledge their careful management of these lands over tens of thousands of years. The First Peoples of this region have produced food on these lands for millennia, taking only what was needed and caring for Country. We recognise the importance of their knowledge and practices in food production and land management for a resilient and sustainable food system for the region.

1.2 About this report

This report from the *Foodprint Melbourne* project summarises the findings of an investigation into the resilience of Melbourne's food system[2] to shocks and stresses. It focuses particularly on the resilience of Melbourne's food system to climate and pandemic shocks and stresses. However, it also considers longer term underlying stresses on Melbourne's food system from declining supplies of natural resources and environmental degradation.

The report discusses the impacts of shocks and stresses throughout the food system from food production to consumption and the generation of waste. It identifies vulnerabilities in the city's food system to these shocks and stresses, and it discusses the features of a resilient food system.

The findings of this investigation informed the Foodprint Melbourne report, *Building the resilience of Melbourne's food system – a roadmap*[3], which presents strategies and policy approaches for strengthening the resilience of Melbourne's food system to shocks and stresses. These strategies were co-developed with stakeholders from government, industry and civil society in a series of online workshops.[4]

1.3. About the Foodprint Melbourne project

The Foodprint Melbourne project is based in the Faculty of Veterinary and Agricultural Sciences at the University of Melbourne. The project is funded by the Lord Mayor's Charitable Foundation and involves a number of project partners, including the City of Melbourne and other local governments in Melbourne's city region.[5]

Previous phases of the Foodprint Melbourne project generated an evidence base about the significance of Melbourne's foodbowl to the city's food supply in the context of a rapidly growing population and pressures on food production from climate change and declining supplies of natural resources, such as land and water.[6]

Left: Unsplash.com/Somi Jaiswal

1 For details of the region that this report focuses on, see section 1.4 and Appendix A.

2 The geographic focus of this research is Melbourne's city region, defined as the 31 local government areas of metropolitan Melbourne and another 9 local government areas that form a second peri-urban ring around Greater Melbourne. For a full list of local government included see Appendix A.

3 Carey, R., Murphy, M., Alexandra, L., Sheridan, J., Larsen, K. and McGill, E. (2022) *Building the resilience of Melbourne's food system – a roadmap*. University of Melbourne, Australia

4 For more information, see Carey, R. et al. (2022) As above.

5 For a full list of project partners, see Appendix B.

6 See Carey, R., Sheridan, J. and Larsen, K. (2018) *Food for thought: Challenges and opportunities for farming in Melbourne's foodbowl*. University of Melbourne, Australia.

This phase of the project extends this earlier research by addressing resilience across the city's food system – from production through processing, distribution, retail, consumption and waste resources. It focuses on the resilience of the city's food system to sudden climate shocks, such as bushfires and floods, and long-term climate stresses such as drought and sea level rise. It also includes a focus on pandemic shocks to the food system. The research draws on the 'city region food system' approach developed by the Food and Agriculture Organization of the United Nations in partnership with RUAF.[7]

1.4. Our approach

The findings presented in this report are based on (i) a desktop review of policies that influence the resilience of Melbourne's food system at federal, state and local government level, (ii) mapping of data about risks to Melbourne's food system, (iii) interviews with Victorian (and Australian) stakeholders about the resilience of Melbourne's food system to shocks and stresses, and (iv) co-design workshops with Victorian stakeholders.

Desktop review included a review of the federal, state and local government policy influences on the resilience of Melbourne's food system. The review focused particularly on policy influences on the governance of food supply chains during a shock to the food system and the governance of food relief. This included analysis of relevant policy documents, legislation, reports of government inquiries, media releases and the websites of government departments.

Geographic Information System (GIS) mapping was used to map risks to Melbourne's food system, particularly related to climate change, and to identify geographic areas of vulnerability.

Interviews were conducted with 41 stakeholders (in 34 interviews, some involving more than one participant). Participants came from state and local government, industry (including farmers) and civil society groups. Interviews lasted 45-60 minutes and were recorded with the consent of interviewees.

Co-design workshops were conducted between October 2020 and May 2021 with participants from government, industry and civil society. Five workshops were conducted with around 24 participants per workshop, and 81 participants were involved in total (some participants attended more than one workshop). Workshops were conducted on Zoom due to COVID-19 restrictions.

During workshops, participants were asked to work in cross-sector teams (involving stakeholders from local and state government departments, industry and civil society groups) to identify strategies to strengthen the resilience of Melbourne's system. A 'co-design' approach was adopted, in which representatives of key stakeholder groups collaborated in the workshops on developing solutions. Participants were asked to consent to the use of the 'Chatham House Rule' during workshops, in which they were free to use information gained during the workshop, but not to reveal the identity of participants. The participants and organisations involved are also not identified here.

This research was informed by discussions and exchanges with the Food and Agriculture Organization of the United Nations and RUAF as part of the City Region Food System (CRFS) Programme. Our independent project in Melbourne was not a formal participant in the CRFS Programme. However, it built on the FAO-RUAF CRFS approach and methodology and shadowed other cities participating in a CRFS project to assess their resilience to climate and pandemic shocks, and exchanges took place on approaches, methodologies and the overall process followed.

7 See www.fao.org/in-action/food-for-cities-programme/overview/crfs/en/

Melbourne's city region was the focus of our assessment. This region was defined as the 31 local government areas that make up metropolitan Melbourne and another 9 local government areas that form a second peri-urban ring around Greater Melbourne. For a full list of the local government areas in this region, see Appendix A.

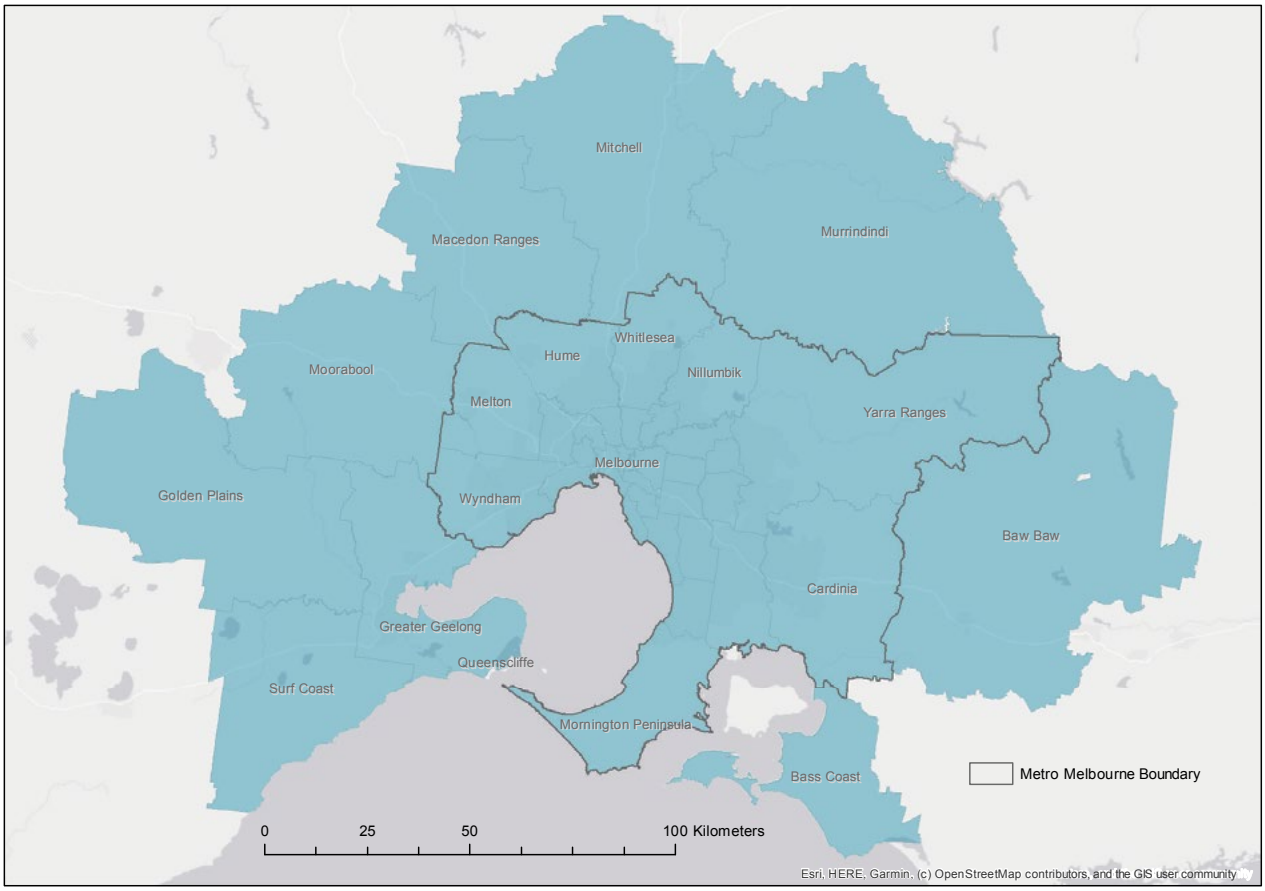


Figure 1. Melbourne's city region

1.5. Melbourne's food system

This research investigated the impacts of shocks and stresses throughout Melbourne's food system. A food system includes all the activities involved in producing, processing, distributing, retailing and consuming food, as well as the management of food waste resources (see Table 1). It also includes all the organisations, people, infrastructure and animals involved in these activities.[8]

8 Carey, R., Larsen, K., Sheridan, J. and Candy, S. (2016) *Melbourne's food future: Planning a resilient city foodbow*l. Victorian Eco-Innovation Lab, University of Melbourne, Australia.

Table 1. Food system stages

Food system stage	
Production	Food is produced by farmers and producers in soil-based and soil-less systems (e.g. hydroponics) in regional, peri-urban and urban areas. Food is also produced by communities e.g. in backyards and community gardens.
Processing	Raw foods are processed into food products during processing and manufacturing. This includes meat processors, dairy processors, manufacturers of preserved, canned and frozen fruit and vegetables, and manufacturers of cereal, bread and baked goods.
Distribution	Food distribution comprises transport networks, and wholesaler and distribution centre infrastructure. Food wholesalers and distributors range from small-scale food hubs to large-scale supermarket distribution centres. Food is transported by road, rail, sea and air.
Retail	Food is sold in retail outlets that include supermarkets, fresh produce markets, farmer's markets, grocery stores, butchers, bakeries, restaurants, cafes and other hospitality outlets.
Consumption	Food is consumed in households and other settings in the community. People who are food insecure may access food through food relief organisations or community food programs.
Waste resources	Food and organic waste resources are generated at all stages of the food system. Managing waste through prevention, or by reducing, reusing and recycling waste resources can keep nutrients and other resources within the food system.

Melbourne's population is fed through a complex food system that includes local, regional, national and global sources of food. In 2015, Melbourne's foodbowl[9] produced enough food to meet around 41% of the city's food needs, so most of the population's demand for food is met from outside this region.

Melbourne's population is fed through a complex food system that includes local, regional, national and global sources of food

It is unclear exactly how much of the food consumed in Melbourne comes from Melbourne's foodbowl or from the state of Victoria, due to lack of data about food freight.[10] However, many fresh foods are sourced from within the state to keep highly perishable foods fresh and to reduce transport costs. This includes dairy, eggs, chicken meat and fresh fruit and vegetables during the local growing season. Outside of the Victorian growing season, many non-seasonal fruits and vegetables are sourced from northern states, particularly Queensland.[11]

This report focuses primarily on risks to food production, processing, distribution and retail within Melbourne's city region, and considers risks to major food supply routes into the city from other parts of Victoria.

9 Melbourne's foodbowl is defined here as the food growing areas in Melbourne's city region (see Figure 1). For more information on Melbourne's foodbowl, see Sheridan, J., Larsen, K. and Carey, R. (2015) *Melbourne's foodbowl: Now and at seven million*. Victorian Eco-Innovation Lab, University of Melbourne, Australia.

10 Sheridan, J., Larsen, K. and Carey, R. (2015) As above.

11 Deloitte Access Economics (2016) *The economic contribution of Melbourne's foodbowl. A report for the Foodprint Melbourne project, University of Melbourne July 2016*. Deloitte Access Economics. Canberra, Australia.

1.6. Resilience

Resilience is a concept that has been applied to food systems relatively recently. There is no widely accepted definition of what a 'resilient' food system is and we know little about what makes food systems resilient.[12] Resilience is generally understood as the capacity of a food system to deliver adequate food to everyone in the face of disturbances due to shocks.[13] By 'adequate' food, we mean sufficient nutritious and culturally acceptable food for an active and healthy life, adopting the common understanding of food security.[14]

Resilient food systems are increasingly seen as having the capacity to not only 'bounce back' from shocks, but to adapt and transform, building longer term resilience.[15] The capacity to adapt and transform is important in the context of more frequent shocks to food systems, particularly due to climate change (see section 2). The capacity of households and communities to respond to food system shocks and stresses is also central to the emerging understanding of food system resilience.[16]

The resilience of food systems is closely related to their sustainability. Food systems will not be sustainable over the long term if they are not resilient to shocks and stresses.[17] The resilience of food systems is also undermined over the long term by underlying environmental stressors. They include the damaging effects of intensive food production on the environment and declining supplies of the natural resources the underpin food production.[18] Our research considers the impacts of these long-term environmental stresses on the resilience of Melbourne's food system and their interactions with other food system shocks and stresses.

12 Fanzo, J. et al. (2021) Viewpoint: Rigorous monitoring is necessary to guide food system transformation in the countdown to the 2030 global goals. *Food Policy* 104, 102163.

13 Tendall, D., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q., Kruetli, P., Grant, M. and Six, J. (2015) Food system resilience: Defining the concept. *Global Food Security* 6: 17-23.

14 HLPE (2020) *Food security and nutrition: building a global narrative towards 2030*. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. Rome, Italy.

15 Biehl, E., Buzogany, S., Baja, K. and Neff, R. (2018) Planning for a resilient urban food system: A case study from Baltimore City, Maryland. *Journal of Agriculture, Food Systems and Community Development* 8 (2): 39-53.

16 Bene, C. (2020) Resilience of local food systems and links to food security – A review of some important concepts in the context of COVID-19 and other shocks. *Food Security* 12: 805-822.

17 Fanzo, J. et al. (2021) As above.

18 Carey, R., Larsen, K., Sheridan, J. and Candy, S. (2016) As above.

The University of Oxford's Food Systems Transformation Group identifies four key questions that can be used to frame studies of resilience[19]:

Food systems will not be sustainable over the long term if they are not resilient to shocks and stresses

Resilience of what?

We focused on the resilience of all stages of Melbourne's food system – production, processing, distribution, retail, consumption and waste resources (see section 1.5).

Resilience from whose perspective?

We investigated the views of a range of stakeholders about the resilience of Melbourne's food system, including government, industry and civil society stakeholders (see section 1.4). A key focus though was on identifying groups who were most vulnerable to shocks and stresses affecting the city's food system (see section 3.6 and 4.8).

Resilience to what?

We focused on four types of shocks or stresses that could affect (or have affected) Melbourne's food system: fire, flood, drought and pandemic (see section 2). Shortly after our research began in late 2019, Melbourne's food system was affected by major bushfires in south-east Victoria in December 2019 and January 2020, followed closely by the start of the COVID-19 pandemic. A key focus of this research was therefore to learn lessons from the experience of these shocks – their impacts on the city's food system, where the food system was vulnerable and how it adapted – and what this tells us about how the resilience of Melbourne's food system can be strengthened to future shocks and stresses.

Resilience over what timeframe?

We identified the short-term impacts of the 2019-2020 bushfires and the COVID-19 pandemic, but our primary focus was on identifying strategies that will develop the long-term resilience of Melbourne's food system to 2050 and beyond.[20]

Food system resilience

Food system resilience means that the food system can continue to deliver an adequate supply of nutritious and culturally acceptable food to everyone, even during shocks to the system.[21] Resilience is also about the capacity of the food system to adapt to changing circumstances and to transform, building longer term resilience to future shocks and stresses.[22] Community resilience is central to the resilience of the food system – our capacity to respond personally and collectively.[23]

Right: Image Lilly Murphy

19 Food Systems Transformation Group (2022) *Enhancing the resilience of London's food system*. Environmental Change Institute, University of Oxford, UK. ISBN: 978-1-874370-86-4.

20 Carey, R., Murphy, M., Alexandra, L., Sheridan, J., Larsen, K. and McGill, E. (2022) As above.

21 Candy, S., Biggs, C., Larsen, K., and Turner, G. (2015) Modelling food system resilience: A scenario-based simulation modelling approach to explore future shocks and adaptations in the Australian food system. *Journal of Environmental Studies and Sciences*, 5(4), 712–731.

22 Biehl, E., Buzogany, S., Baja, K. and Neff, R. (2018) As above.

23 Smith, K. and Lawrence, G. (2014) Flooding and food security: A case study of community resilience in Rockhampton. *Rural Society* 23 (3): 216-228.

SECTION 2

Shocks and stresses to Melbourne's food system

2.1 Introduction

Some of the key shocks and stresses facing Melbourne's food system are related to climate change. The mean temperature in Australia has risen by over 1°C since 1910[24], and mean temperatures have also risen across Victoria (see Figure 2).[25]

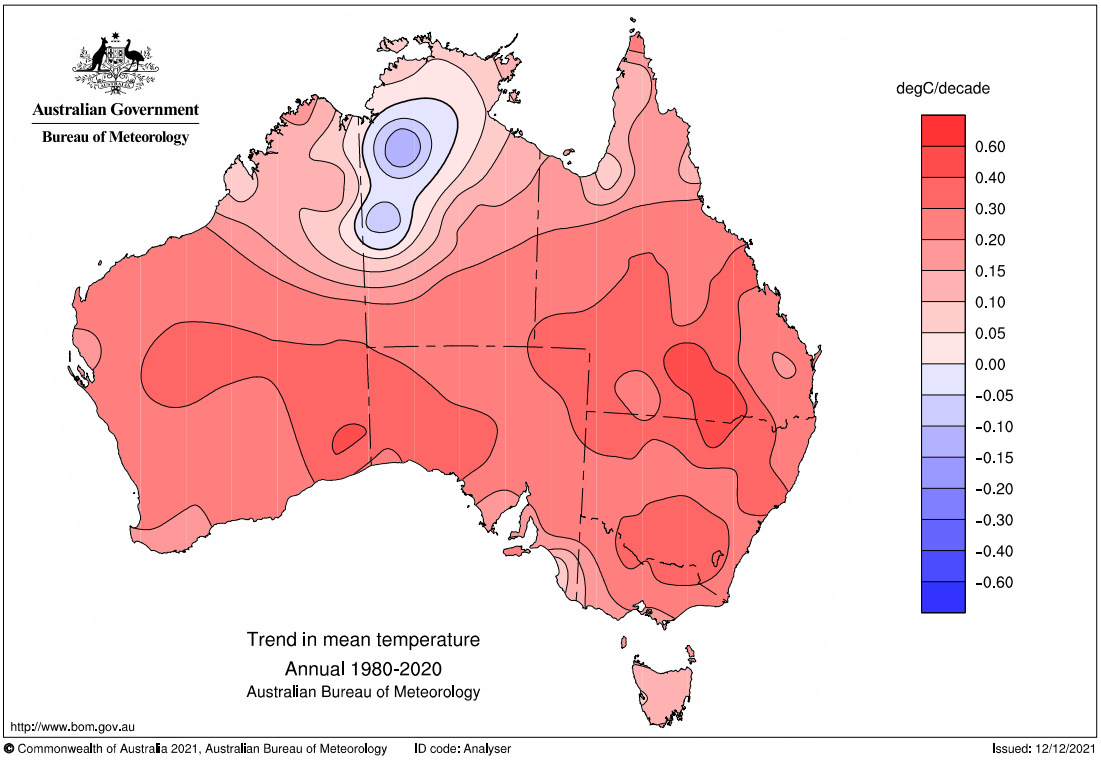


Figure 2. Trend in mean temperature – Annual 1980-2020

Temperatures across Victoria will continue to rise. By 2030, temperatures in Greater Melbourne are expected to be 0.8 to 1.6 degrees above those of 1986-2005 and by 2050, they are expected to be between 1.0 and 2.7 degrees higher.[26]

Melbourne is likely to experience more extreme weather events associated with climate change

Melbourne is likely to experience more extreme weather events associated with climate change. The region is expected to experience more extreme temperature days and more frequent and severe heatwaves.[27,28] It is also likely to experience more frequent and severe fire danger days and more time in drought, but also more intense rainfall events that could lead to flooding.[29] These extreme weather events can cause significant loss and damage throughout the food system – in production, processing, distribution, retail, consumption and the generation of waste (see section 3).

Left: Unsplash.com/PhillipFlores

24 Bureau of Meteorology and CSIRO (2020) *State of the Climate 2020*. Canberra, Australia.

25 Figure 2 is sourced from the Bureau of Meteorology.

26 Clarke, J., Grose, M., Thatcher, M., Round, V., and Heady, C. (2019) *Greater Melbourne Climate Projections 2019*. CSIRO, Melbourne, Australia.

27 Grose, M., D. Abbs, J. Bhend, F. Chiew, J. Church, M. Ekström, D. Kirono, A. Lenton, C. Lucas, K. McInnes, A. Moise, D. Monselesan, F. Mpelasoka, L. Webb and P. Whetton (2015) Southern Slopes Cluster Report, in *Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports*. M. Ekström, P. Whetton, C. Gerbing et al. Australia, CSIRO and Bureau of Meteorology. Australia.

28 Timbal, B., Ekstrom, M., Fiddes, S. L., Grose, M., Kirono, D. G. C., Lim, E., Lucas, C. and Wilson, L. (2016) *Climate change science and Victoria. Bureau Research Report No. 014*. Bureau of Meterology. Melbourne, Australia.

29 Clarke, J. et al. (2019) As above.

Climate shocks and stresses are increasingly likely to co-occur or may occur at the same time as other non-climatic shocks, compounding the risks and impacts on the food system. For example, sea level rise could combine with extreme rainfall and storm surges to increase the risks and impacts of flooding.[30] The COVID-19 pandemic followed closely on the 2019-2020 bushfires in south-east Australia, leaving little time for recovery in between.

Melbourne's food system is also affected by long term environmental stresses

Melbourne's food system is also affected by long term environmental stresses, including loss of agricultural land, land degradation and biodiversity loss.[31] Other potential shocks that could affect the city's food system include energy shocks (disruptions to supply or rising prices), geopolitical shocks (for example, Russia's invasion of Ukraine) or cyber attack.

In this chapter, we examine the key shocks and stresses that could affect Melbourne's food system, including sudden shocks, such as fire and flood, and chronic long-term stresses, such as drought.

2.2. Fire

The risk of fire is increasing in most parts of Australia. Figure 3 shows the change in the number of dangerous fire weather days between the periods July 1950 – June 1985 and July 1985 – June 2020.[32] Measures of fire weather are based on temperature, humidity, wind speed, fuel dryness, and soil moisture.[33]

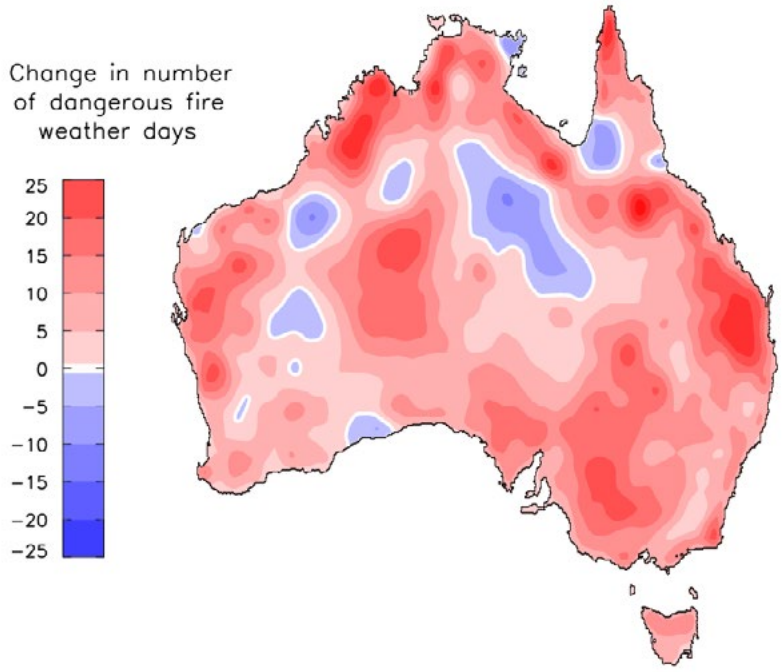


Figure 3. Change in the number of dangerous fire weather days 1950 – 2020 (source: Bureau of Meteorology)

30 IPCC (2022) Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

31 Carey, R., Larsen, K. and Sheridan, J. (2019) *Roadmap for a resilient and sustainable Melbourne foodbowl.* University of Melbourne, Australia. doi.10.26188/5c92e85dd6edf

32 Figure 3 is sourced from the Bureau of Meteorology.

33 Clarke, J.M., Grose, M., Thatcher, M., Hernaman, V., Heady, C., Round, V., Rafter, T., Trenham, C. and Wilson, L. (2019) *Victorian Climate Projections 2019 Technical Report*. CSIRO, Melbourne, Australia.

Victoria is one of the most fire-prone regions of Australia[34], and climate change is leading to harsher fire weather, with more high and extreme fire danger days and more frequent fires. The bushfire season is also lengthening.[35]

The Melbourne region has many areas of high fire risk

Greater Melbourne and the interface areas on the fringes of the city have many areas of high fire risk[36], and a major bushfire event in the region has the potential to cause significant disruption to the city's food system. Bushfires impact food production and processing, distribution networks, retail and consumption (see section 3). The 2009 bushfires on Melbourne's peri-urban fringe caused an estimated $1.2 billion damage to land, infrastructure, commercial buildings and dwellings.[37]

2.3. Drought

One of the main ways that climate change affects food production is through changes to the availability of water.[38] Between 1980 and 2020, most of Victoria experienced a decline in annual rainfall (see Figure 4).[39] The Millennium Drought from 1997 to 2009 saw the lowest total inflows to Melbourne's water supply on record.[40] Rainfall is likely to continue to decline in the Melbourne region[41], and droughts are likely to increase in duration and frequency.[42]

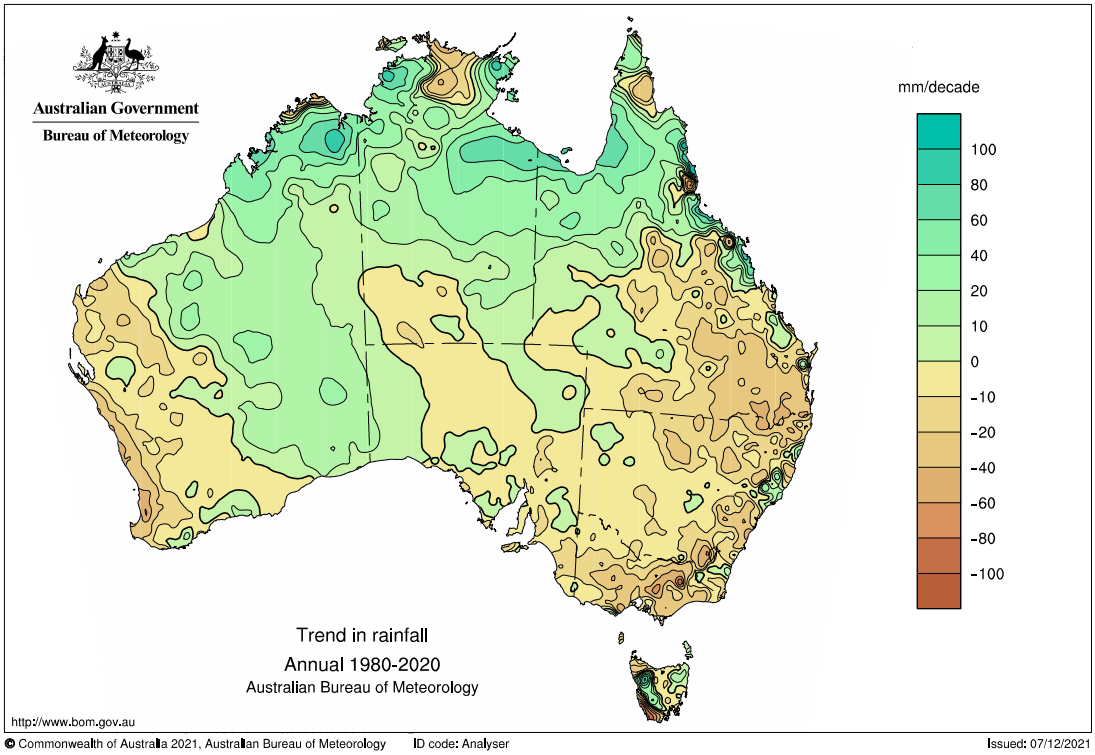


Figure 4. Trend in total rainfall - Annual 1980-2020

34 DELWP (2020) *Metropolitan bushfire management strategy 2020*. Department of Environment, Land, Water and Planning. Melbourne, Australia.

35 Harris, S. and Lucas, C. (2019) Understanding the variability of Australian fire weather between 1973 and 2017. *PLOS ONE* 14 (9): e0222328.

36 DELWP (2020) As above.

37 Gonzalez-Mathiesen, C., March, A. and Stanley, J. (2019) Challenges for wildfire-prone urban-rural interfaces: The case of Melbourne. *Urbano*. 22(39): p. 88-105.

38 Climate Council (2015) *Feeding a hungry nation: climate change, food and farming in Australia*. Climate Council of Australia. Sydney, Australia.

39 Figure 4 is sourced from the Bureau of Meteorology.

40 Hope, P., Timbal, B., Hendon, H., Ekström, M. and Potter, N. (2017) *A Synthesis of Findings from the Victorian Climate Initiative*. Bureau of Meteorology. Melbourne, Australia.

41 Clarke, J., Grose, M., Thatcher, M., Round, V. and Heady, C. (2019). *Greater Melbourne Climate Projections 2019.* CSIRO, Melbourne, Australia.

42 Grose, M. et al. (2015) As above.

Drought has significant impacts on food systems, particularly on food production. The Millennium Drought reduced crop yields in the Murray-Darling Basin, Australia's main foodbowl, by around 20%[43], and yields of key crops in south-east Australia are expected to reduce further by 2030.[44] The impacts of drought have flow on effects throughout the food system, increasing food prices and food insecurity. During the height of the Millennium Drought between September 2005 and September 2007, the cost of food in Australia rose 12%, while the cost of fresh vegetables rose by 33% and the cost of fresh fruit by 43%.[45] Drought also has a significant impact on farm profits. Drought conditions have reduced annual farm profits in Victoria by around 37% since the year 2000.[46]

Drought leads to rising food prices and food insecurity

2.4. Flood

The Melbourne region is at risk of riverine and storm water flooding, as well as coastal inundation due to sea level rise (see section 2.5). Figure 5 shows areas at risk of riverine flooding in the Melbourne region.

The areas at greatest risk of riverine flooding in the region include Koo Wee Rup, an important area of horticultural production that produces over 90% of Australia's asparagus, and Werribee in Melbourne's west, which produces around 10% of Victoria's vegetables.[47] Koo Wee Rup is on low lying swamplands which have been drained, making it particularly vulnerable to flooding.[48]

Some important areas of vegetable production in the Melbourne region are at risk of flooding

> *We have…done a fair bit of work to understand the potential for coastal inundation from sea level rise…the Koo Wee Rup swamp is obviously a really productive agricultural area and that suffers from significant flooding that may be aggravated by sea level rise given just the elevation there and the nature of the historic drainage that was constructed when that area was settled and opened up for agriculture.***– Interview 18, Government**

Although overall rainfall is decreasing in Victoria, the frequency and intensity of extreme rainfall events is increasing due to climate change, because a warmer atmosphere can hold more moisture.[49,50] Population growth and urban development is also increasing the risk of flooding, because the increase in hard surfaces like roads and rooftops increases stormwater runoff.[51]

Flooding can disrupt food production, processing, transport, storage and retail.[52,53] Heavy rains can wash away valuable topsoil, reducing agricultural productivity.[54] The 2010-2011 Victorian floods affected 70 of the 79 local government areas in Victoria, damaging roads, railway tracks and bridges.[55] Roads and transport networks were also damaged during the Queensland floods in 2011, cutting major food supply routes into Brisbane.[56]

43 Steffan, W., Mallon, K., Kompass, T., Dean, A. and Rice, M. (2019) Compound Costs: *How climate change is damaging Australia's economy*. Climate Council of Australia. Sydney, Australia.

44 Climate Council (2015) As above.

45 Quiggin, J. (2007) *Drought, Climate Change and Food Prices in Australia.* University of Queensland, Brisbane, Australia.

46 Hughes, N., Galeano, D. and Hattfield-Dodds, S. (2019) *The effects of drought and climate variability on Australian farms*. Australian Bureau of Agricultural and Resource Economics and Sciences. Canberra, Australia.

47 Sheridan, J., Larsen, K. and Carey, R. (2015) As above.

48 State Emergency Service (2013) Local flood guide: *Koo Wee Rup*. State Government of Victoria. Melbourne, Australia.

49 DELWP (2019) *Victoria's Climate Science Report 2019*. Department of Environment, Land, Water and Planning. Melbourne, Australia.

50 Grose, M., et al. (2015) As above.

51 Melbourne Water (2021) *Flood management strategy: Port Phillip and Westernport 2021-2031*. Melbourne, Australia. Melbourne Water.

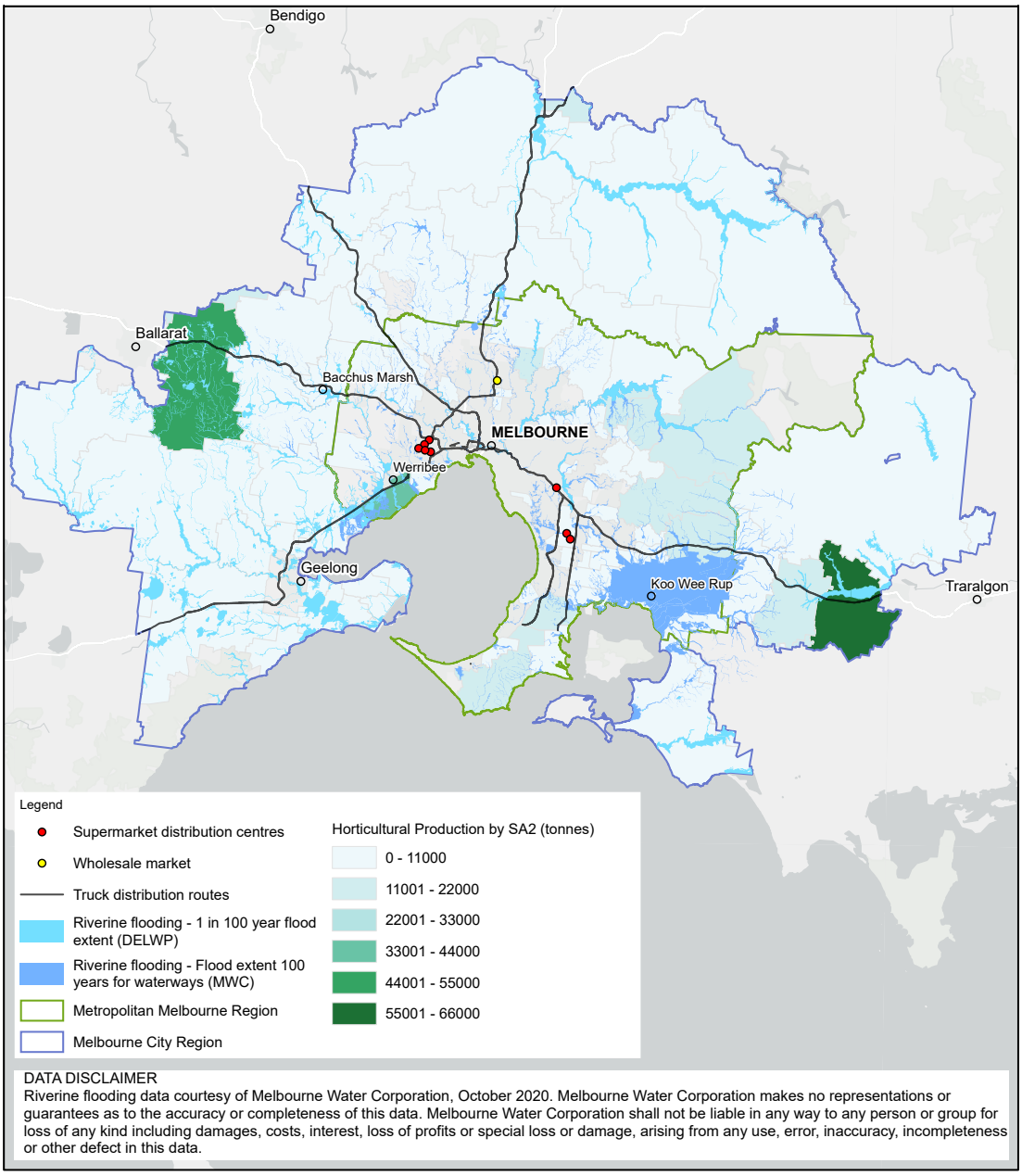
52 Mbow, C., et al. (2019) Food Security, in *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*, P.R. Shukla, et al., Editors.

53 Steffen, W., Mallon, K., Kompas, T., Dean, A. and Rice, M. (2019) As above.

54 Pimentel, D., Burgess, M. (2013) Soil Erosion Threatens Food Production.*Agriculture*, 3 (3): 443-463.

55 Comrie, N. (2011) Review of the 2010–11 *Flood Warnings and Response*. State of Victoria, Melbourne, Australia.

56 Smith, K., G. Lawrence, A. MacMahon, J. Muller and M. Brady (2016) The resilience of long and short food chains: a case study of flooding in Queensland, Australia. *Agriculture and Human Values* 33 (1): 45-60.



Data source: Riverine flooding, Victorian Flood Database – Probable Maximum Flood Extent, DELWP, 2014; Riverine flooding, Melbourne Water Corporation, 2020; Horticultural Production, Agricultural commodities 2015-16, ABS 2017.

Figure 5. Areas at risk of riverine flooding in Melbourne's city region

2.5. Sea level rise

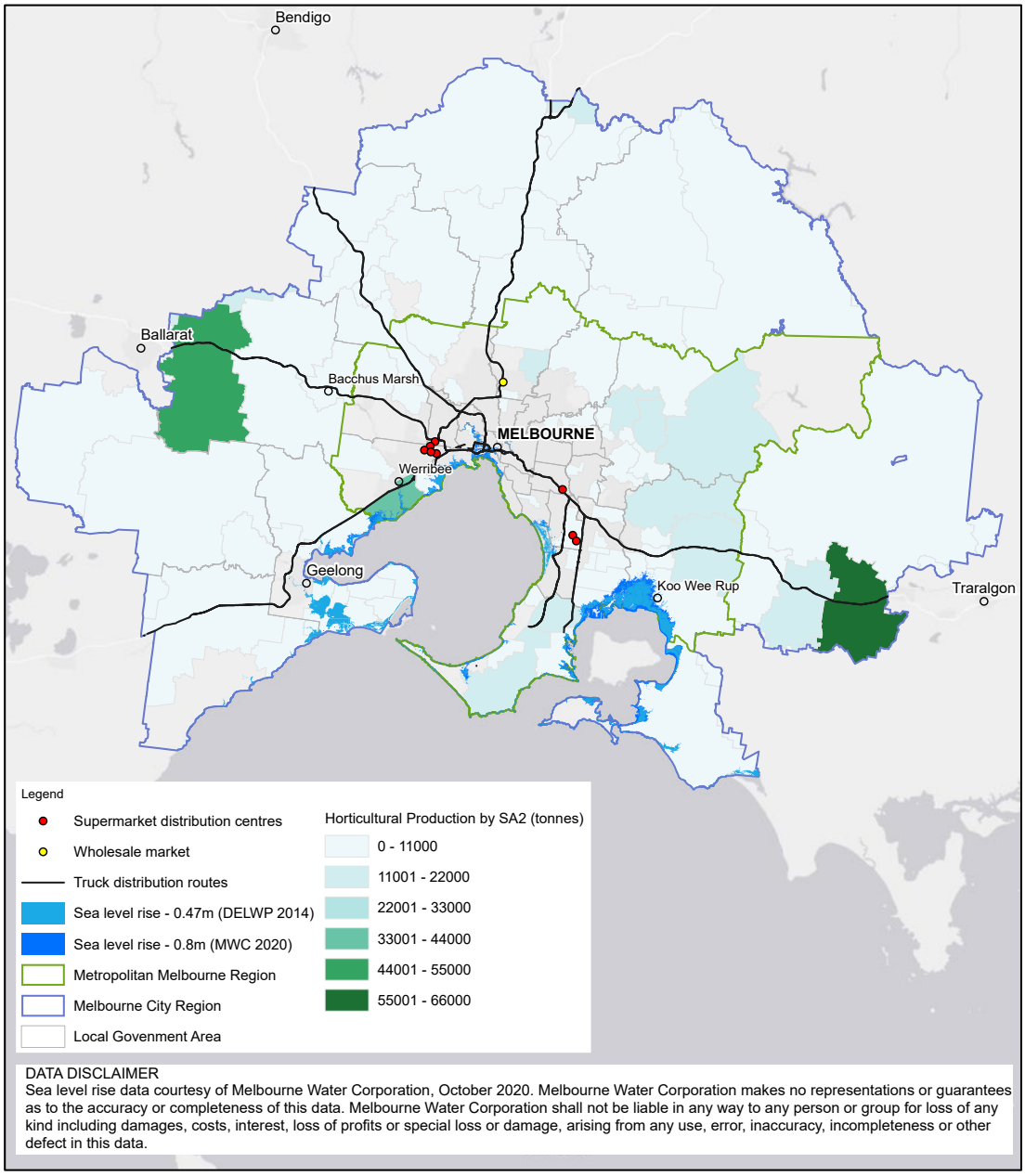
The risk of coastal inundation and salt water intrusion in low lying areas of Melbourne is increasing due to sea level rise and more frequent extreme wave and storm tide events.[57] The mean sea level at Williamstown in Melbourne's west has risen by approximately 2 mm per year since 1966.[58] Sea levels will continue to rise as the oceans warm and will combine with storm surges and extreme rainfall events to increase the risk of floods.[59]

57 DELWP (2016) *Victorian Floodplain Management Strategy*. Department of Environment, Land, Water and Planning, Melbourne, Australia.

58 DELWP (2019) As above.

59 IPCC (2022) As above.

In Victoria, state government policy is to plan for a sea level rise of at least 0.2 m by 2040 and 0.8 m by 2100. At 0.8 m sea level rise, parts of the Koo Wee Rup and Werribee market garden areas could be inundated (see Figure 6),[60] posing a long-term risk to agricultural productivity in these areas.



Data source: sea level rise 47cm, Victorian Coastal Inundation Dataset, DELWP, 2014; 0.8m sea level rise, Melbourne Water Corporation, 2020; Horticultural Production, Agricultural commodities 2015-16, ABS 2017.

Figure 6. Areas at risk of sea level rise in Melbourne's city region

60 Melbourne Water (2017) *Planning for Sea Level Rise Guidelines*. Melbourne, Australia.

2.6. Pandemic

Pandemics cause widespread disruption to food systems

The potential for a flu pandemic to disrupt food systems was an early focus of food resilience planning by industry and government in Australia.[61] Pandemics are widespread events that can cause disruption over large geographic areas nationally and globally, which makes it difficult to minimise disruption to food supply chains by sourcing from areas that are unaffected by the event. Pandemics can also cause sustained disruption, becoming a long-term stress on the food system. All stages of Melbourne's food system have been affected by the COVID-19 pandemic from food production to retail, consumption and the generation of waste (see section 3). The impacts have changed through the pandemic from temporary shortages of staple foods due to increased consumer demand during early lockdowns[62], to shortages of fresh foods due to the number of food workers isolating during later waves of the pandemic.[63] The evidence suggests that pandemics will occur more frequently due to biodiversity loss, environmental degradation and closer human contact with wild species.[64]

2.7. Other shocks and stresses

Melbourne's food system is also at risk from global geopolitical shocks, such as Russia's invasion of Ukraine. Ukraine and Russia are major exporters of wheat[65], a core ingredient in many processed foods and a stock feed for livestock.[66] Russia is the world's biggest exporter of fertilisers[67], and the impacts of the crisis on rising oil prices will affect many parts of the food system, including the cost of fuel for farm machinery and food freight.[68]

Food systems are heavily dependent on other sectors, such as energy, transport, banking and telecommunications.[69] Any significant disruption to these sectors is also likely to affect Melbourne's food system. Food systems are complex and their 'just in time' supply chains depend on sophisticated data management. This makes them vulnerable to cyber attack. A cyber attack on the food sector or another sector that it is dependent on could lead to disruption.[70,71]

Food systems are also dependent on natural ecosystems. They rely on multiple ecosystem services, such as pollination, nutrient cycling, maintenance of soil and water quality and biological pest control.[72] Natural resources such as land, water and fossil fuels are also inputs to food production. Food systems are therefore vulnerable to degradation of natural ecosystems.

61 DAFF (2012) *Resilience in the Australian food supply chain.* Department of Agriculture, Fisheries and Forestry. Canberra, Australia.

62 Carey, R., Murphy, M., and Alexandra, L. (2020) COVID-19 highlights the need to plan for healthy, equitable and resilient food systems. *Cities & Health*, 1-4. DOI: 10.1080/23748834.2020.1791442

63 Macau, F. (2022) Supermarket Shortages Are Different This Time: How to Respond and Avoid Panic. *The Conversation*, 10 January 2022.

64 IPBES (2020) *Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services*. Daszak, P. et al. IPBES secretariat, Bonn, Germany.

65 OEC data for 2020 – https://oec.world/en/profile/hs92/wheat

66 Agriculture Victoria (2020) *A guide to introducing grain to sheep and cattle.* Available: https://agriculture.vic.gov.au/__data/assets/pdf_file/0005/567104/Introducing-grain-to-sheep-and-cattle.pdf (accessed 29 March 2022).

67 Australian Trade and Investment Commission (2022) *Insight – Farm, food costs rise due to higher energy prices*. 4 March 2022. Available: https://www.austrade.gov.au/news/insights/insight-farm-food-costs-rise-due-to-higher-energy-prices (accessed 9 April 2022).

68 PWC (2019) *Powering the global food bowl: How captive energy solutions are growing Australia's rural investments*. PriceWaterhouseCoopers, Australia.

69 DEFRA (2021) *UK food security report 2021*. Department for Environment, Food and Rural Affairs. London, UK.

70 DAFF (2012) As above.

71 One of Australia's biggest meat processors, the international JBS Foods, experienced a cyber attack in June 2021 that disrupted local operations. See https://www.abc.net.au/news/rural/2021-06-10/jbs-foods-pays-14million-ransom-cyber-attack/100204240

72 Varyvoda, Y. and Taren, D. (2022) Considering ecosystem services in food system resilience. *International Journal of Environmental Research and Public Health* 19, 3652.

Biodiversity loss is a significant risk to food systems. Around 70% of the most commonly produced food plants globally rely on insect pollination.[73] A collapse of pollinator species in Victoria or Australia would have a major impact on the availability of foods in Melbourne, such as fruit and vegetables. Food systems also depend on the biodiversity of soil microorganisms which keep soils healthy and fertile.[74] Agriculture is the major driver of global biodiversity loss through land clearing and the impacts of intensive food production on the environment.[75]

The impacts of intensive agriculture on land and water systems in Victoria undermine the long-term resilience of Melbourne's food system. Around half of Victoria's land is used for agriculture[76], and agriculture is the major water user in the state.[77] Removal of vegetation and overgrazing leads to soil erosion and the loss of valuable top soil. It also leads to soil acidification, which can reduce crop productivity. Overuse of nitrogen-based fertilisers is also a cause of soil acidification.[78,79]

Excess nutrients from overuse of fertilisers can leach into waterways, causing algal blooms.[80] Major river systems in Victoria, such as the Murray-Darling, have also been degraded by over-extraction of water for irrigated agriculture.[81] Population growth in Victoria and increasing demand for food will continue to put pressure on natural resources and ecosystems in the state, particularly through growing competition for land and water.[82]

High levels of food waste intensify pressure on the natural resources that underpin food production and undermine the long-term resilience of Melbourne's food system. Around 200 kilograms of food waste is generated per person per year in feeding Melbourne.[83] Food waste generates methane gas, a powerful greenhouse gas (GHG), as it decomposes in landfill. Food waste is also a waste of all the natural resources used to produce food, including land, water, fossil fuels and phosphorous (a key element of fertilisers derived from phosphate rock, a non-renewable resource). These natural resources are now limited in supply.[84]

High levels of food waste undermine the long-term resilience of Melbourne's food system

73 FAO (2019) *The State of the World's Biodiversity for Food and Agriculture*, J. Bélanger & D. Pilling (eds.). FAO Commission on Genetic Resources for Food and Agriculture Assessments. Food and Agriculture Organization of the United Nations. Rome, Italy.

74 FAO (2019) As above.

75 IPBES (2019) *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. https://doi.org/10.5281/zenodo.3831673

76 Commissioner for Environmental Sustainability Victoria (CES) (2018) *Scientific assessments part III: Biodiversity*. Melbourne: Commissioner for Environmental Sustainability Victoria.

77 Deloitte Access Economics (2018) *Megatrends and the Victorian Environment: A report for the Victorian Commissioner for Environmental Sustainability*. Deloitte Access Economics. Melbourne, Australia

78 CES (2018) As above.

79 Agriculture Victoria (2020) *Soil acidity*. Available: https://agriculture.vic.gov.au/farm-management/soil/soil-acidity (accessed 26 April 2022).

80 Department of Agriculture, Water and the Environment (2022) *Cyanobacteria (blue-green algae) and water quality*. Available: www.waterquality.gov.au/issues/blue-green-algae (accessed 26 April 2022).

81 Williams, J. (2017) Water reform in the Murray-Darling Basin: a challenge in complexity in balancing social, economic and environmental perspectives. *Journal and Proceedings of the Royal Society of New South Wales* 150 (1): 68-92.

82 Deloitte Access Economics (2018) As above.

83 Sheridan, J., Carey, R. and Candy, S. (2016) As above.

84 Wunderlich, S. and Martinez, N. (2018) Conserving natural resources through food loss reduction: Production and consumption stages of the food supply chain. *International Soil and Water Conservation Research* 6 (4): 331-339.

2.8. Compound shocks and stresses

Food systems are affected by multiple shocks and stresses which interact, compounding the overall risks and impacts

Food systems are affected by multiple shocks and stresses which interact, compounding the overall risks and impacts.[85] Multiple extreme weather events related to climate change may occur together or consecutively, leading to more severe impacts.[86] For example, drought conditions and heatwaves lead to increased bushfire risk.[87] Extreme rainfall, storm surges and sea level rise can combine to increase the magnitude of coastal inundation.[88]

Climate shocks can also interact with other types of stresses, magnifying the impacts on food production. Biodiversity loss is driven to a large extent by land clearing for agriculture (see section 2.7), but is exacerbated by climate change.[89] The impacts of drought on food production are increased by loss of organic matter from soils due to intensive agriculture, which reduces water retention.[90] The impacts of drought are also intensified by over-extraction of water from river and groundwater systems, and high levels of food waste put further pressure on limited land and water resources.[91]

There will be more frequent compounding risks and impacts from climate shocks and their interactions with other stresses in future, leading to rising food prices and food insecurity.[92] The impacts of climate shocks and stresses need to be considered in the context of interactions with other underlying stresses that affect the natural ecosystems on which food production depends.

2.9. Summary

This chapter has outlined key shocks and stresses to Melbourne's food system. Many of the shocks and stresses are directly linked to the region's warming and drying climate. We have experienced a range of climate shocks in Victoria in recent years – such as bushfire, floods, heatwaves and storms - that have affected parts of the food system. At times, these shocks have interacted with other food system stresses, intensifying their impacts. In the next chapter, we examine the impacts of two recent shocks, the 2019-2020 bushfires and the COVID-19 pandemic, on different stages of the food system.

85 IPCC (2022) As above.

86 Bureau of Meteorology and CSIRO (2020) *State of the Climate 2020*. Canberra, Australia.

87 Sharples, J., Lewis, C. and Perkins-Kirkpatrick, E. (2021) Modulating influence of drought on the synergy between heatwaves and dead fine fuel moisture content of bushfire fuels in the Southeast Australian region. Weather and Climate Extremes, 31, p.100300.

88 DELWP (2019) As above.

89 Mbow, C., et al. (2019) As above.

90 Yawls, W., Pachepsky, J., Ritchie, T., Sobecki, T. and Bloodworth, H. (2003) Effect of soil organic carbon on soil water retention. *Geoderma* 116 (1-2): 61-76.

91 Wunderlich, S. and Martinez, N. (2018) Conserving natural resources through food loss reduction: Production and consumption stages of the food supply chain. *International Soil and Water Conservation Research* 6 (4): 331-339.

92 IPCC (2022) As above.

SECTION 3

Impacts on Melbourne's food system

3.1 Introduction

The 2019-2020 bushfires in south-east Australia and the COVID-19 pandemic, which began shortly after, provide an opportunity to examine the impacts of shocks on Melbourne's food system and (more broadly in the state of Victoria) and to learn lessons from those impacts. This chapter draws on material from interviews with stakeholders from government, industry and civil society (see section 1.4). The interviews began in May 2020, shortly after the pandemic took hold, and when Victoria was still recovering from major bushfires which had affected the east of the state. This chapter therefore focuses particularly on the impacts of these recent shocks on the food system. Section 6.3 discusses features of the food system that enabled it to adapt or bounce back from these shocks and stresses.

The 2019-2020 bushfire crisis had significant impacts on the state's food system

The 2019-2020 bushfire crisis had significant impacts on the state's food system. The bushfires were unprecedented in their extent, length and intensity. Roads were closed, and transport and telecommunications infrastructure impacted. Around 1.5 million hectares of land was burned in Victoria, 10,000 livestock were lost and the economic impact on farms was around $325 million. Many of the fire affected areas were already experiencing or recovering from drought.[93]

By mid-2020, Victoria's food system was also feeling the impacts of the global COVID-19 pandemic. Early in the pandemic, sudden surges in consumer demand for food during lockdowns led to shortages of staple food items such as rice, pasta, flour and tinned goods.[94] During the Omicron wave in early 2022, there were food shortages due to lack of labour in food production, processing and distribution.[95] Figure 7 summarises impacts of the bushfires and pandemic on different stages of the food system.

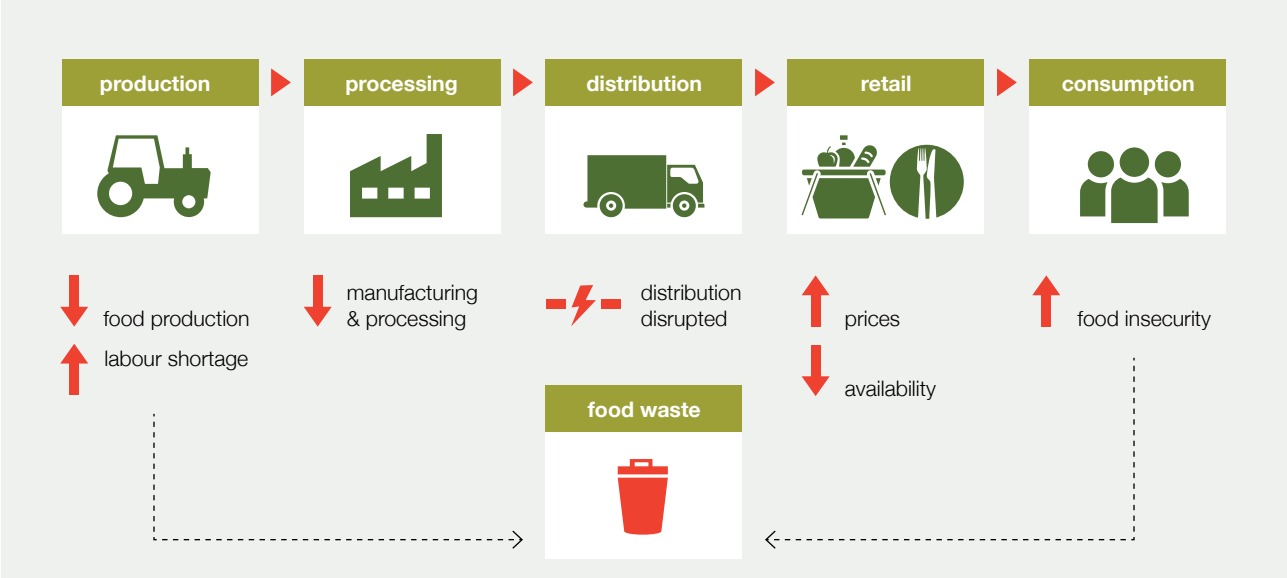


Figure 7. Food system impacts of the 2019-2020 bushfires and COVID-19 pandemic

Left: Unsplash.com/Nolan Di Meo

93 Bushfire Recovery Victoria (2020) *Eastern Victorian Fires 2019–20 State Recovery Plan*. Melbourne, Australia

94 Carey, R., Murphy, M., & Alexandra, L. (2020b) Insights from Melbourne, Australia during COVID-19: Civil society leading the response to strengthen the city region food system. *City Region Food Systems Programme News* 12 May 2020. Available https://www.fao.org/in-action/food-for-cities-programme/news/detail/fr/c/1275112/ (accessed 24 February 2022).

95 Macau, F. (2022) Supermarket Shortages Are Different This Time: How to Respond and Avoid Panic. *The Conversation*, 10 January 2022.

3.2. Production

Food production systems are vulnerable to sudden shocks such as bushfires and pandemic. Agriculture is affected during bushfires by the destruction of farm infrastructure, loss of crops and livestock, and smoke taint in crops.[96] Soils can be damaged by the intense heat of bushfires and are more susceptible to erosion after loss of vegetation.[97] It is estimated that 22% of agricultural land was burned in fire affected areas during the 2019-2020 bushfires.[98] Damage and losses from the fires to Australia's food sector are estimated to be around $4 to $5 billion, including damage to agricultural property, infrastructure and land, and losses in food production.[99]

The COVID-19 pandemic caused significant disruption to food production

Bushfires also have indirect and less visible impacts on horticultural production, affecting the ability of farm workers to harvest crops and increasing the time it takes to grow crops. Some impacts are difficult to quantify, as this interviewee explains:

> *With bushfires we had significant impact…They'd never had so much smoke coverage on apple and stone fruit crops. The farmers in the industry weren't sure about the impact of that on the growth cycle of the trees, the long-term health of the trees, things like that. There were the short-term impacts during the stone fruit season. We had a pack shed that had to close because they had too much smoke or they [weren't] able to pick fruit…because it wasn't safe for workers to be going outside.* **– Interview 28, Industry**

The COVID-19 pandemic also caused significant disruption to food production.[100] Horticulture is labour intensive, and Australia is particularly reliant on temporary migrant workers, who comprise more than half of the seasonal harvesting workforce.[101] With international travel restrictions and closed borders during the COVID-19 pandemic, there was a shortage of labour in horticulture and other industries.[102]

The closure of restaurants and cafes in the hospitality sector due to COVID-19 restrictions affected Victorian producers who sold directly to the sector, leading to crop losses[103] and creating uncertainty about how to plan for future crops.

> *A lot of our smaller farms sell direct to [restaurants and cafes]…with the ongoing uncertainty around the timing of businesses and venues reopening it's becoming a real issue as we go into spring. This is when our farms are planting everything for the coming spring and summer and even into autumn.* **– Interview 24, Government**

96 Stephenson, C., Handmer, J., and Betts, R. (2013) Estimating the economic, social and environmental impacts of wildfires in Australia. *Environmental Hazards* 12 (2): 93-111.

97 Joehnk, K. Biswas, T., Karim, F., Kumar, A., Guerschman, J., Wilkinson, S., Rees, G., McInerney, P., Zampatti, B., Sullivan, A., and Nyman, P. (2020) *Water quality responses for post 2019-20 bushfires floods in south eastern Australia: a catchment scale analysis*. Synthesis Report. CSIRO, Melbourne, Australia.

98 Bushfire Recovery Victoria (2020) As above.

99 Bishop, J., Bell, T. Huang, C. and Ward, M. (2021) *Fire on the Farm. Assessing the impacts of the 2019-2020 bushfires on food and agriculture in Australia*. Sydney, Australia.

100 Carey, R., Murphy, M., and Alexandra, L. (2020) As above.

101 Fair Work Commission (2021) *Decision – Application to vary the Horticulture Award 2021, AM2020/104*. Commonwealth of Australia.

102 ABARES (2021) *Labour use in Australian agriculture: Analysis of survey results*. Australian Bureau of Agricultural and Resource Economics and Sciences. Canberra, Australia.

103 Hope, Z. (2020) Farmers ploughing fresh veggies back into soil as restaurant ban bites. *The Age*, 25 April 2020. Available: www.theage.com.au/national/victoria/farmers-ploughing-fresh-veggies-back-into-soil-as-restaurant-ban-bites-20200424-p54n0q.html (accessed 13 April 2022).

3.3. Processing

Food processing and manufacturing enterprises were impacted by the 2019-2020 bushfires in fire-affected areas.[104] However, the most significant disruptions occurred during the COVID-19 pandemic.

Disruptions to global trade during the pandemic highlighted the reliance of food manufacturers on imported materials. Supplies of some additives, packaging and frozen produce were delayed[105], leading to temporary shortages and price increases.

> *Manufacturers that were getting raw materials from overseas, had some difficulties in supply stock…one of the key learnings for the organisation has been the ability to diversify sources of supply, especially products or raw materials that are imported. For example, we had to switch supply of frozen products mainly to New Zealand, to make sure we had adequate stock levels of frozen vegetables, potatoes etc. Some of these products would [usually] come from Asia or Europe.* **– Interview 21, Industry**

Meat processing was affected by significant COVID-19 outbreaks internationally and in Victoria.[106,107] Abattoirs and other processing plants, where large numbers of people work in close proximity, were particularly vulnerable.[108] The Victorian Government responded with restrictions on the capacity of meat processing facilities[109], which forced suppliers to look to other states to fill gaps in meat supply.

Meat processing was affected by COVID-19 outbreaks

> *In Victoria, we went to 60 per cent capacity at our meat plants, so that really did drive some challenges from meat supply in Victoria. We were bringing meats in from WA, Queensland and other places to support what we couldn't produce in Victoria.* **– Interview 34, Industry**

Restrictions on the capacity of meat processing facilities in Victoria had severe impacts on the chicken and pig meat industries, because of the short production cycles for these animals.[110] There were concerns about animal welfare in addition to supply shortages, and some animals were transported interstate to South Australia for processing.[111] The Australian Competition and Consumer Commission also permitted some of Victoria's major chicken meat processors to collaborate in order to maintain supply.[112]

104 Bishop, J., Bell, T. Huang, C. and Ward, M. (2021) As above.

105 AFGC (2020) *AFGC submission to the Joint Standing Committee on Foreign Affairs, Defence and Trade Inquiry into the strategic implications of the COVID-19 pandemic for Australia's foreign affairs, defence and trade*. Non-confidential submission. June 2020. Australian Food and Grocery Council, Canberra, Australia

106 Hobbs, J. (2021) Food supply chain resilience and the COVID-19 pandemic: What have we learned? *Canadian Journal of Agricultural Economics* 69 (2): 189-196.

107 Bucci, N. (2020) Meatworks and coronavirus: The 'domino' effect from Victoria's abattoirs pushing COVID-19 case numbers higher. *ABC News*, 26 July 2020. Available: https://www.abc.net.au/news/2020-07-26/coronavirus-covid-19-meatworks-abattoirs-victoria/12490178 (accessed 11 April 2022).

108 Bucci, N. (2020) As above.

109 MLA (2020) *Impact of Victorian processing restrictions*. News 6 August 2020. Meat and Livestock Australia. Available: https://www.mla.com.au/prices-markets/market-news/2020/impact-of-victorian-processing-restrictions/ (accessed 11 April 2022).

110 Farrer, M. (2020) Pig and chicken cull possible as Victoria coronavirus lockdown hits abattoirs. *The Guardian*, 5 August 2020. Available: https://www.theguardian.com/australia-news/2020/aug/05/pig-and-chicken-cull-possible-as-victoria-coronavirus-lockdown-hits-abattoirs (accessed 11 April 2022).

111 Baptista, J. et al. (2021) Impact of the COVID-19 pandemic on the welfare of animals in Australia. *Frontiers in Veterinary Science: Animal Welfare and Behaviour* 28 January 2021. https://doi.org/10.3389/fvets.2020.621843

112 Marshall, A. (2020) ACCC lets chicken plants collaborate to deal with coronavirus restrictions. *Farm Online*, 10 August 2020. Available: https://www.farmonline.com.au/story/6871888/poultry-processors-collaborate-to-deal-with-victorian-lockdown-limits/ (accessed 11 April 2022).

3.4. Distribution

Road and rail closures during fire and flood emergencies can disrupt the transportation of food and affect the quality and availability of fresh produce. Isolated communities are particularly vulnerable. During the 2019-2020 bushfires, road and rail transport to some fire-affected parts of eastern Victoria was completely severed. This included the isolated coastal town of Mallacoota.

> *In the case of the bushfires, the normal food supply trucks literally couldn't get into places like Mallacoota, so we had to work with them to establish alternative supply routes, we had to find alternative ways to supply the supermarkets and shops. So, we did air drops, we worked with the ADF [Australian Defence Force], we helped find alternative supply routes.* **– Interview 8, Government**

A major bushfire event close to key transport routes into Melbourne could impact the city's food supply

Road closures on major transport routes in fire-affected areas also impacted food freight to other parts of Victoria and interstate freight between Victoria and New South Wales. Some food freight had to be rerouted, adding time and cost to delivery, which particularly affected transportation of perishable foods like fresh vegetables.[113] Food freight to Melbourne was less affected than to some other destinations, because the fires were in the state's east near the New South Wales border. However, Melbourne has many fire-prone areas on its fringe and if a major bushfire event were to take place close to Melbourne or on a major transport route into the city, it could have a more significant impact on the city's food supply (see section 4.2.1).

Food distribution was also disrupted during the COVID-19 pandemic. The closure of international and state borders disrupted road, rail, air and sea freight. The grounding of passenger planes reduced air freight capacity by around 95%, which affected food imports and exports.[114] Food imports were also affected by reduced shipping and container capacity, disruptions to port operations and delays in customs clearance.[115] This affected the availability of some foods and some key inputs to food manufacturing, such as food additives and packaging (see section 3.3).

Food imports were affected by transport disruption during COVID-19

Unprecedented consumer demand for food early in the COVID-19 pandemic (see section 3.5) also strained the distribution network. Consumer demand exceeded the capacity of rail and road freight at times.

> *The demand was a lot higher than the Christmas peak, there was a lot of strain especially on the rail network. Every day there was delays and not enough equipment to move the freight volume. We also found that in terms of road transport, there was a lot of pressure there…if on any particular day they had to move 300,000 tonne of stock they could only move 200,000 tonnes [by rail].* **– Interview 21, Industry**

3.5. Retail

The 2019-2020 bushfires had a significant impact on supermarkets and other food retail stores in fire affected areas. Some stores had to close and some lost stock due to power outages. There were localised food shortages in bushfire affected communities.[116] Communities affected by extensive flooding in eastern Australia in early 2022 experienced similar temporary food shortages.[117]

113 Wong-See, T. and Jacques, O. (2020) Vegetable prices may soar 50 per cent as growers face perfect storm of bushfires and drought. *ABC News*, 14 January 2020. Available: www.abc.net.au/news/2020-01-14/vegetable-prices-in-australia-set-to-rise-fire-drought-impact/11866038 (accessed 11 April 2022).

114 AFGC (2020) As above.

115 AFGC (2020) As above.

116 Powell, D. (2020) Bushfires likely to impact Australian retailers, analysts say. *Sydney Morning Herald* 9 January 2020. Available: www.smh.com.au/business/companies/bushfires-likely-to-impact-australian-retailers-analysts-say-20200108-p53pqi.htm (accessed 11 April 2022).

117 Thiessen, T. (2022) 'We've run out of lettuce': supermarkets and restaurants face fresh food shortage after NSW and Queensland floods. *The Guardian*, 4 March 2022. Available: https://www.theguardian.com/australia-news/2022/mar/04/weve-run-out-of-lettuce-supermarkets-and-restaurants-face-fresh-food-shortage-after-nsw-and-queensland-floods (accessed 11 April 2022).

Retailers elsewhere in the country experienced shortages in supplies of produce from fire-affected areas. For example, smoke haze increased the time to harvest for some produce.

> *We were hearing from our vegetable growers that…the smoke haze was adding seven to nine days to their growing season for products. So, if you're growing something for 12 weeks like cauliflowers or capsicums and it's normally 12 weeks, adding another seven or nine days is fairly significant.* **– Interview 26, Industry**

Consumers elsewhere in Australia were affected by modest price increases on some foods, such as beef and fruit, but overall the effects of the bushfires on food prices were limited and short-lived.[118]

The impacts of the COVID-19 pandemic on food retail were more extensive. Food sales in supermarkets and grocery stores rose 23% in March 2020 due to a sudden increase in consumer demand at the start of the pandemic. There were huge increases in sales of some foods. Sales of some types of frozen vegetables were up 1000% compared to the same time the previous year.[119]

The COVID-19 pandemic led to unprecedented surges in consumer demand for food

Supermarkets struggled to respond to these sudden increases in consumer demand and had to make rapid changes to their processes to get more food on to shelves (see section 6.3.2). They activated their contingency plans for this sort of event.

> *You've actually already got documented plans on what you'll do to respond. They're end-to-end plans, so for things like the pandemic they include the way we handle customer behaviour in stores, the way we handle shopping limits, the way we handle moving product from our suppliers into our network.* **– Interview 34, Industry**

During the Omicron wave of the pandemic in early 2022, supermarkets again faced food supply shortages, but for different reasons. The number of workers isolating throughout the food supply chain significantly reduced supplies, particularly of fresh foods, such as chicken meat and fruit and vegetables.[120]

3.6. Consumption

Shocks to the food system can affect food consumption by reducing the availability of foods, increasing food prices and changing patterns of consumer behaviour and food consumption. The people who are most impacted by changes in food availability and food prices are those who were already at risk of food insecurity, particularly people on low incomes (see section 4.8).[121]

The 2019-2020 bushfires had relatively limited impacts on the availability of foods and food prices in Melbourne and other areas of Victoria outside of fire-affected areas. The greatest impacts on consumption were felt by people in eastern Victoria and New South Wales, who were directly impacted by the fires. Fire-affected communities faced store closures, limited availability of foods in stores, and disruption to payment systems due to telecommunications and power outages (see section 3.5). When shops reopened, many could only accept cash payments, but with banks closed and ATMs out of action, some people were unable to access cash to buy food.[122] Many people turned to relief centres for food, and some needed ongoing access to food relief in the recovery period.[123]

118 Bishop, J., Bell, T., Huang, C. and Ward, M. (2021) As above.

119 AFGC (2020) As above.

120 Butler, B. and Hannam, P. (2020) From empty shelves to cancelled festivals: how Omicron is wreaking havoc across Australia. *The Guardian*, 13 January 2022. Available: www.theguardian.com/australia-news/2022/jan/13/from-empty-shelves-to-cancelled-festivals-how-omicron-is-wreaking-havoc-across-australia (accessed 11 April 2022).

121 Jones, N., Bellamy, J., Bellotti, W., Ross, H., van Bommel, S. and Lu, Y. (2022) A shock to the system: What the COVID-19 pandemic reveals about Australia's food systems and their resilience. *Frontiers in Sustainable Food Systems* 5: 790694

122 Australian Government (2020) *Royal Commission into Natural Disasters report*. 28 October 2020. Australian Government. Canberra, Australia.

123 Foodbank (2020) *Responding to Victoria's bushfire crisis*. Available: /www.foodbank.org.au/victoria-bushfire-response/?state=vic (accessed 12 April 2022).

The COVID-19 pandemic had widespread impacts on food consumption across Victoria. People in Melbourne were particularly affected due to the number of lockdowns in the city and their duration. Melbourne is believed to have spent more days in lockdown than any other city in the world during the COVID-19 pandemic.[124] People in Melbourne faced temporary shortages of food in supermarkets at times (see section 3.5), and rising unemployment and loss of income during lockdowns led to an increase in food insecurity. There has been a 7.5% increase in food insecurity in the City of Melbourne local government area during the COVID-19 pandemic.[125]

Food security

The Food and Agriculture Organization of the United Nations defines food security as "a situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". There are six key dimensions of food security: the *availability* of food in the food supply, having the financial means to *access* adequate food, having the means for *utilization* of food, *stability* of food supply during shocks to the food system, *sustainability* in food production so that current generations can meet their food needs without compromising the capacity of future generations to feed themselves, and *agency* so that people can make their own choices about what they eat and can engage in decisions that shape food systems.[126]

There were other changes in food consumption patterns in Australia during the COVID-19 pandemic. There was an increase in home cooking and sales of baking products like flour.[127] People ordered more pre-cooked meals and consumed more discretionary foods (like chocolate, biscuits and fried foods).[128] There was also more interest in buying locally grown food[129] and in growing fruit and vegetables at home.[130] It's unclear whether these changes in consumption patterns are temporary or may turn into longer term trends.

3.7. Waste resources

Shocks and stresses can affect food loss and waste throughout the food system. During the 2019-2020 bushfires, there was food loss on farms directly impacted by the bushfires[131,132] and increased food waste elsewhere in the food supply chain due to power outages and delays in transportation.[133]

124 Kelly, L. (2021) Melbourne to ease world's longest COVID-19 lockdown as vaccinations rise. *Reuters*, 17 October 2022. Available: www.reuters.com/world/asia-pacific/melbourne-ease-worlds-longest-covid-19-lockdowns-vaccinations-rise-2021-10-17/ (accessed 12 April 2022).

125 City of Melbourne (2021) *Community food relief: 2021-2025. Planning for a food secure city.* City of Melbourne. Australia.

126 HLPE (2020) As above.

127 AFGC (2020) As above.

128 Jones, N., Bellamy, J., Bellotti, W., Ross, H., van Bommel, S. and Lu, Y. (2022) As above.

129 Carey, R., Larsen, K. and Clarke, J. (2020) *Good food for all: resetting our food system for health, equity, sustainability and resilience* VicHealth - Life and Health Re-imagined: paper 2. Melbourne, Australia.

130 Carter, J. (2021) Australians bought more plants than ever in 2020 with COVID-19 lockdowns fueling sales. ABC News, 31 March 2021. Available: www.abc.net.au/news/rural/2021-03-31/australians-bought-more-plants-than-ever-in-2020/100040258 (accessed 13 April 2022).

131 Bushfire Recovery Victoria (2020) As above.

132 Bishop, J., Bell, T., Huang, C. and Ward, M. (2021) As above.

133 Bishop, J., Bell, T., Huang, C. and Ward, M. (2021) As above.

Early in the COVID-19 pandemic, there was increased food loss and waste on Victorian farms when the hospitality industry shut down. Some farmers who sold directly into the sector were unable to sell produce and had to plough crops back into the soil.[134] There was also significant food waste in the food service distribution sector that supplies produce into hospitality.

[Food service distributors] generally sit on four to six weeks' worth of inventory. We're talking millions of dollars of stock…overnight, the government said, right, you can't supply these outlets [restaurants, cafes, pubs] any longer. Of those millions of dollars of inventory, a vast portion of that is perishable. **– Interview 23, Industry**

Shocks and stresses can affect food loss and waste

Food destined for the hospitality sector cannot easily be diverted to supermarkets or to food relief because it is packaged to sell in large quantities.

Rather than buying 400-gram tins of tinned tomatoes, [restaurants and caterers] buy A10, which is like three litres, or they've even moved to bladders which are 10 litres of pasta sauce. **– Interview 4, Civil society**

However, during peak periods of consumer demand (such as pandemic lockdowns), waste in the retail sector fell and supermarkets temporarily relaxed their tight production specifications to keep up with demand.

At the peak of COVID…there was actually less food waste because the demand was so high. The retailers opened the specs up and said that anything that is barely edible is going through to sale. So, the food waste went down because the demand was so high. **– Interview 16, Industry**

The impact of the COVID-19 pandemic on household food waste is unclear. There is some evidence that household food waste decreased in New South Wales early in the pandemic, and that people focused more on planning their shopping and using up leftovers.[135] Some international studies have had similar findings.[136,137] However, there are also concerns that stockpiling of food during lockdowns and greater use of food delivery apps during COVID-19 may have increased food waste.[138]

3.8. Summary

This chapter outlined the impacts on Melbourne's food system from shocks and stresses, with a focus on the 2019-2020 bushfires and the COVID-19 pandemic. It highlighted that these events had impacts throughout the food system from production, processing and distribution through to retail, consumption and waste. The next chapter will explore the food system vulnerabilities that have been revealed by these shocks and stresses.

134 Hope, Z. (2020) Farmers ploughing fresh veggies back into soil as restaurant ban bites. *The Age*, 25 April 2020. Available: https://www.theage.com.au/national/victoria/farmers-ploughing-fresh-veggies-back-into-soil-as-restaurant-ban-bites-20200424-p54n0q.html (accessed 13 April 2022).

135 NSW EPA (2020) *Less food wasted, farmers more appreciated during COVID-19 shutdown*. New South Wales Environment Protection Authority. Sydney, Australia. Available: www.epa.nsw.gov.au/news/media-releases/2020/epamedia200707-less-food-wasted-farmers-more-appreciated-during-covid-19-shutdown (accessed 13 April 2022).

136 Principato, L., Secondi, L., Ciratiello, C. and Mattia, G. (2020) Caring more about food: The unexpected positive effect of the COVID-19 lockdown on household food management and waste. *Socio-Economic Planning Sciences* 100953.

137 Rodgers, R., Lombardo, C., Cerolini, S. Franko, D., Omori, M., Linardon, J., Guillaume, S., Fischer, L. and Fuller-Tyszkiewicz, M. (2021). "Waste not and stay at home" evidence of decreased food waste during the COVID-19 pandemic from the U.S. and Italy. *Appetite* 160: 105110.

138 Sharma, R., Dhir, A., Talwar, S., Kaur, P. (2021) Over-ordering and food waste: The use of food delivery apps during a pandemic. *International Journal of Hospitality Management* 102977.

SECTION 4

Vulnerabilities in Melbourne's food system

4.1. Introduction

This chapter examines vulnerabilities in Melbourne's food system to shocks and stresses, specifically fire, flood, drought and pandemic. It focuses particularly on vulnerabilities highlighted by the 2019-2020 bushfires and the COVID-19 pandemic. It identifies the stakeholders and activities that are most exposed to, or sensitive to, the impacts of shocks and stresses on the food system. This chapter draws on desktop research, GIS mapping and stakeholder interviews with participants from government, industry and civil society (see section 1.4).

Food system vulnerabilities

A food system vulnerability is an element of the food system or a population group that is susceptible to the adverse effects of a shock or stress, and relates to its capacity to cope or adapt.[139,140]

4.2. Geographic and corporate concentration

Food supply chains have become highly concentrated. A small number of very large corporations often dominate sectors, wielding considerable power over other participants in the food system, including farmers, consumers and other smaller companies.[141] These companies often focus on achieving economies of scale and may have just a few very large processing or distribution sites in a region. When these sites experience disruptions, it can have a significant impact on food supply. This section examines the risks of corporate concentration to Melbourne's food system, focusing on examples of a few specific supply chains – major food retail, chicken meat and dairy.

4.2.1. Food retail

The food retail sector in Australia is highly concentrated. The two largest supermarket chains, Coles and Woolworths, hold 65% of market share. Aldi has almost 10% of the food and grocery market and Metcash (IGA) almost 7%, so together these four retailers have more than 80% of the market.[143] These retailers operate large distribution centres (DCs) in Australia's major state capitals that receive product from suppliers and distribute it to stores. In 2021, there were eight DCs in the Melbourne region belonging to the four major retailers. These DCs are concentrated in two areas of the city - five near Truganina in Melbourne's west and three near Dandenong in the city's south east (see Figure 8).

Supermarket distribution centres are concentrated in two areas of Melbourne

Left: stock.adobe.com/Scott Donkin

139 IPCC (2014) Summary for policymakers. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. C. B. Field, V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea and L. L. White, Cambridge University Press, Cambridge, UK & New York, USA

140 Brunori, G., Avermaete, T., Bartolini, F., Brzezina, N., Marsden, T., Mathijs, E., Moragues-Faus, A. and Sonnino, R. (2020) The Vulnerability of Food Systems. In Brunori, G. and Grando, S. (Ed.) *Innovation for Sustainability (Research in Rural Sociology and Development*, Vol. 25). Emerald Publishing Limited, Bingley, UK.

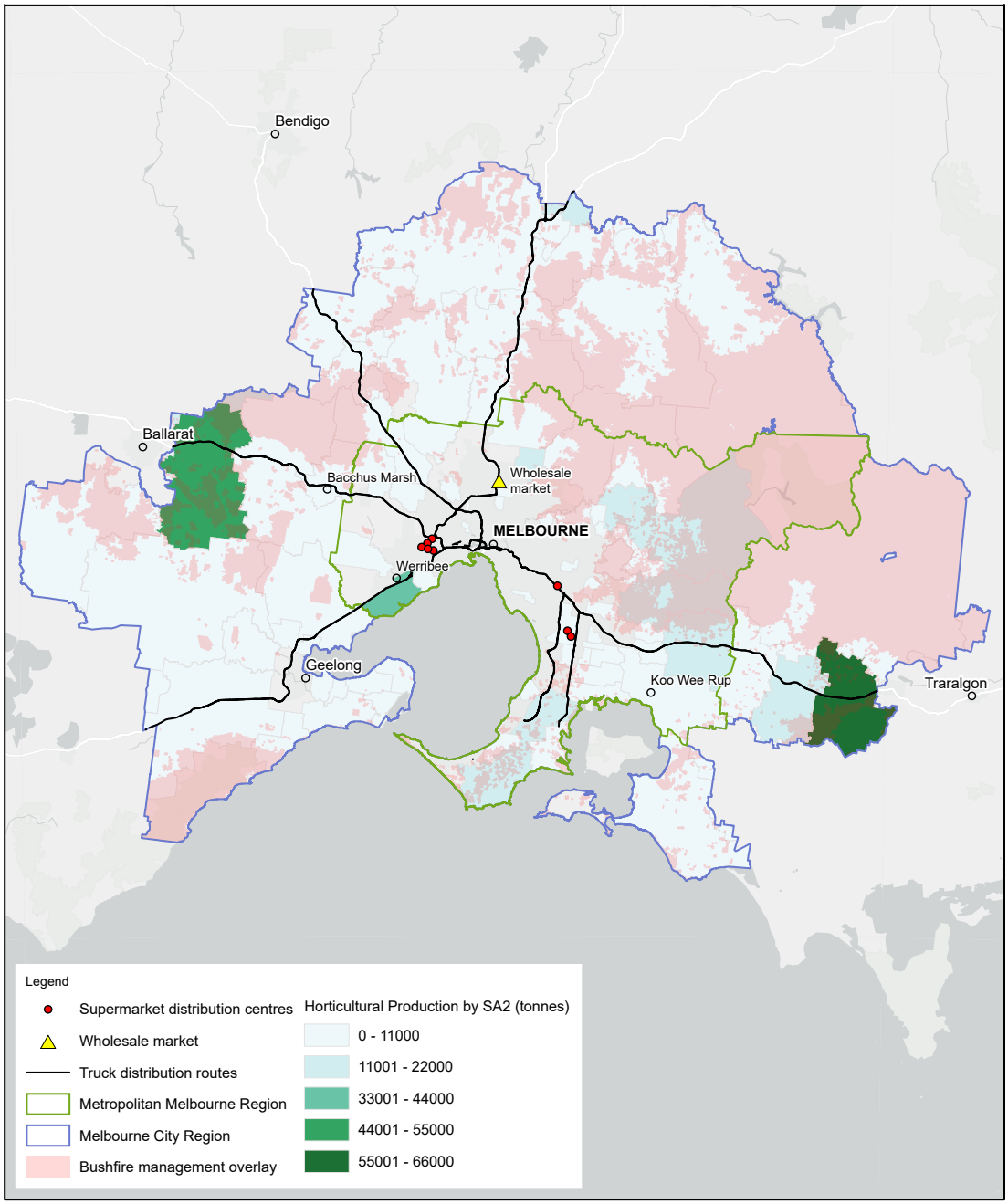
141 Clapp, J. (2021) The problem with growing corporate concentration and power in the food system. *Nature Food* 2: 404-408.

142 Hendrickson, M. (2015) Resilience in a concentrated and consolidated food system. *Journal of Environmental Studies of Science* 5: 418-431.

143 Australian Government (2021) *Food and grocery code: Independent reviewer. Annual report 2020-21*. Australian Government the Treasury. Canberra, Australia.

When food distribution centres or processing facilities are clustered in a geographic area, they are vulnerable to localised shocks, such as fire or flood, or road blockages that can prevent distribution of supplies. During the 2010-11 Queensland floods, the location of supermarket DCs in one area of Brisbane exacerbated the difficulties with distributing food.[144] Food distribution from supermarket DCs in Melbourne's western suburbs to the city centre and to the city's east is dependent on a key transport link, the West Gate Bridge. One interviewee highlighted the reliance of food distribution in Melbourne on this major transport route.

The West Gate Bridge in Melbourne's west is a key transport link for distribution of food



Data source: Bushfire management Planning Overlay, Vicmap, DELWP 2014; Horticultural Production, Agricultural commodities 2015-16, ABS 2017.

Figure 8. Areas of fire risk in Melbourne's city region

144 Smith, K., Lawrence, G., MacMahon, A. and Muller, J. (2016) The resilience of long and short food chains: a case study of flooding in Queensland, Australia. *Agriculture and Human Values* 33: 45-60.

If [the West Gate bridge] ever stopped, it would be horrendous….all our fuel is in the west of Melbourne, all our warehousing is in the west of Melbourne. How is it going to get to the east of Melbourne where half to two thirds of the population of Melbourne live? People in the west of Melbourne and north of Melbourne are fine. But then to get the volume and amount of vehicles over the river is huge. Huge. So, what's the contingency for the West Gate Bridge? **– Interview 17, Industry**

Figure 8 shows areas at risk of bushfires around Melbourne. Victoria is a highly fire-prone region, and Melbourne has many areas of fire risk on the fringe of the city.[145] A major bushfire event near transport routes into the city, particularly routes to supermarket distribution centres or the wholesale market, has the potential to disrupt food distribution.

Highly centralised supermarket distribution centres were vulnerable during the COVID-19 pandemic

Figure 8 also shows areas of horticultural production in Melbourne's foodbowl that are at risk of bushfire. In addition, some important areas of vegetable production around Melbourne are vulnerable to sea level rise and riverine flooding (see sections 2.4 and 2.5).

The highly centralised nature of supermarket distribution centres also became a vulnerability during the COVID-19 pandemic. Outbreaks in distribution centres in Victoria in 2020 led to government restrictions that reduced the capacity of their workforce by 33%, causing concerns about retailers' capacity to maintain food supply.[146] Later in the pandemic during the Omicron wave, the capacity of distribution centres was again significantly reduced because of the number of staff isolating.[147] When the operation of supermarket distribution centres is disrupted, there are flow on impacts through the food supply chain.

We are seen as critical infrastructure. If you lose a […] supermarket, people can go down the road to the other supermarket. But when you've got a distribution centre doing two and a half million cartons a week to 284 shops, you basically lose that distribution centre and you lose the product at every shop. **– Interview 34, Industry**

4.2.2. Chicken meat industry

Chicken meat production and processing in Victoria is highly concentrated.[148] Six companies supply 90% of the chicken meat in Australia and the two largest companies, Baiada Poultry and Inghams Enterprises, supply around 70% of chicken meat. These companies tend to be vertically integrated, owning all aspects of chicken production from hatcheries to processing plants.[149]

Chicken meat production generally occurs near cities (close to markets and sources of labour) and within 200 km of the abattoirs where birds are processed. In Victoria, chicken meat production and processing is concentrated in Geelong, the Mornington Peninsula, the northern suburbs of Melbourne and Bendigo (see Figure 9).[150,151] This geographic and corporate concentration of production and processing facilities leaves the chicken meat industry vulnerable to shocks (such as a major storm, flood or fire) occurring in those areas.

145 DELWP (2020) *Metropolitan bushfire management strategy 2020*. State of Victoria Department of Environment, Land, Water and Planning. Melbourne, Australia.

146 Towell, N., Powell, D., Gray, D., Bonyhady, N. and Harris, R. (2020) Supermarkets reach lockdown deal with state to keep Victoria fed. *The Age*, 6 August 2020. Available: www.theage.com.au/national/victoria/supermarkets-reach-lockdown-deal-with-state-to-keep-victoria-fed-20200806-p55jaq.html (accessed 24 February 2022)

147 Macau, F. (2022) Supermarket Shortages Are Different This Time: How to Respond and Avoid Panic. *The Conversation*, 10 January 2022.

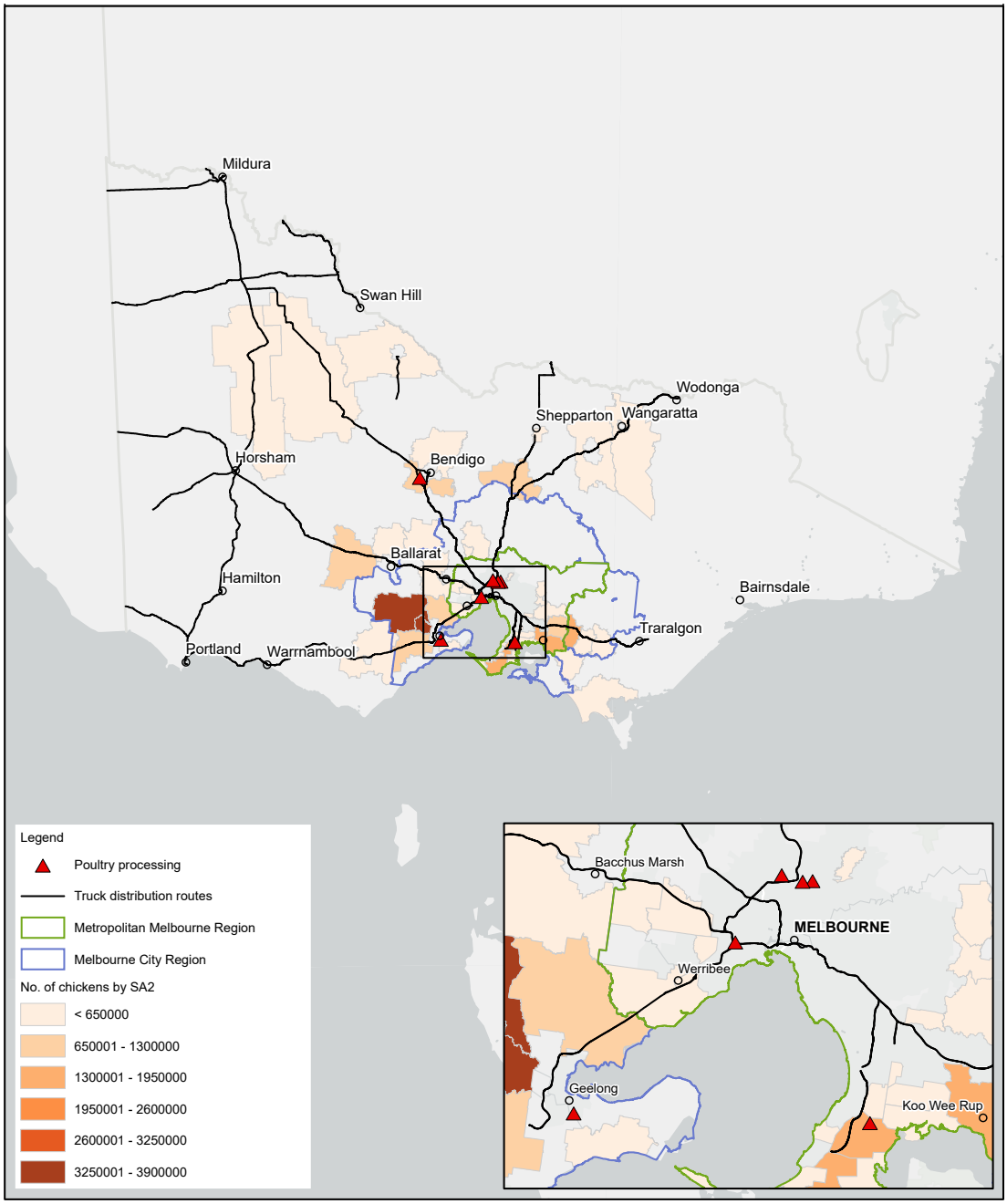
148 Agriculture Victoria (2021) *Victorian Poultry Industry Fast Facts*. Available: https://agriculture.vic.gov.au/__data/assets/pdf_file/0006/699288/Poultry-Fast-Facts-June-2021-Final.pdf (accessed 4 November 2021).

149 Australian Chicken Meat Federation (2020) *Structure of the Industry*. Available: www.chicken.org.au/structure-of-the-industry/#Vertically_Integrated_Chicken_Meat_Companies (accessed 4 November 2021).

150 Australian Chicken Meat Federation (2020) As above.

151 Agriculture Victoria (2021) As above.

The concentration of chicken meat processing in a small number of large processing facilities was a vulnerability during the COVID-19 pandemic. Some chicken processing facilities in Victoria were shut down early in the pandemic due to clusters of cases.[152] The Victorian Government also introduced restrictions in late 2020 which reduced the capacity of processing plants by a third[153], and during the Omicron wave in early 2022, their capacity was reduced because of the numbers of workers isolating, leading to shortages of chicken meat.[154]



Data source: Agricultural commodities 2015-16, ABS 2016.

Figure 9. Victoria's chicken meat industry

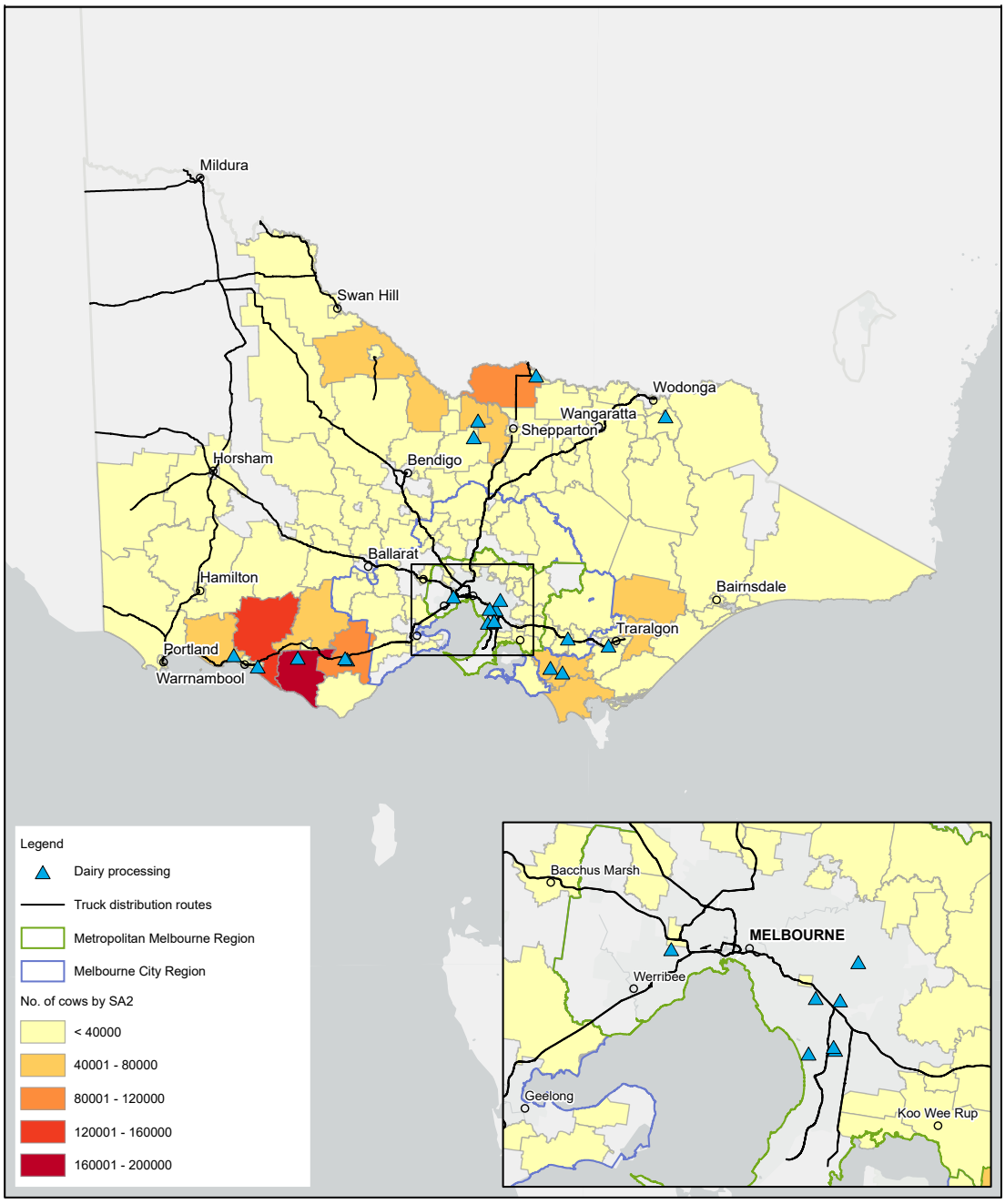
152 Marshall, A. (2020) COVID-19 infects Inghams workers and closes Thomastown plant. *Farm Online*, 23 July 2020. Available: https://www.farmonline.com.au/story/6846157/coronavirus-closes-inghams-site-but-wont-disrupt-poultry-supplies/ (accessed 17 April 2022).

153 Farrer, M. (2020) Pig and chicken cull possible as Victoria coronavirus lockdown hits abattoirs. *The Guardian*, 5 August 2020. Available: https://www.theguardian.com/australia-news/2020/aug/05/pig-and-chicken-cull-possible-as-victoria-coronavirus-lockdown-hits-abattoirs (accessed 11 April 2022).

154 Butler, B. and Hannam, P. (2022) Chicken out of stock: meat in short supply on Australian supermarket shelves and at KFC. *The Guardian*, 11 January 2022. Available: https://www.theguardian.com/australia-news/2022/jan/11/chicken-stock-omicron-shortages-australian-staple-off-supermarket-shelves (accessed 11 April 2022).

4.2.3. Dairy industry

Victoria is Australia's largest dairy producer.[155] The Australian dairy market is dominated by a small number of large (foreign-owned) dairy processors, but there are also a number of smaller processors. Dairy production in Victoria is concentrated in three key areas in Gippsland, northern Victoria and south-west Victoria (see Figure 10).[156]



Data source: Agricultural commodities 2015-16, ABS 2016.

Figure 10. Victoria's dairy industry

155 Agriculture Victoria (2021) *Victorian Dairy Industry Fast Facts*. Available https://agriculture.vic.gov.au/__data/assets/pdf_file/0011/698771/Dairy_Fast-Facts_June-2021_Final.pdf (accessed 4 November 2021).

156 ACCC (2018) *Dairy industry: final report*. Australian Competition and Consumer Commission. Canberra, Australia.

The supply of fresh milk tends to be state-based, because milk is a highly perishable product that is bulky and costly to transport, so most of Melbourne's fresh milk supply is likely to come from these regions of Victoria.[157,158]

A key issue for the Victorian dairy industry is its vulnerability to climate shocks and stresses, such as drought, heatwaves and bushfires. Around 800,000 litres of milk are estimated to have been wasted during the 2019-2020 bushfires in eastern Australia.[159] The bushfires followed a drought in 2018-2019, which increased feed and water prices in affected areas such as Gippsland and northern Victoria, leading to a decline in milk production.[160] The dairy industry was also significantly affected by the Millennium Drought, particularly farmers in Victoria's northern dairy region (in the Murray-Darling Basin) who rely on irrigation. From 2001-2006, the gross value of dairy in the Murray-Darling Basin fell by 5%.[161] Dairy cattle are also particularly sensitive to heatwaves, which can reduce milk production.[162] Drought, heatwaves and bushfires are all likely to occur with greater frequency and severity in Victoria in future due to climate change (see section 2).

The Victorian dairy industry is vulnerable to climate shocks and stresses

4.3. Long 'just in time' supply chains

Australia is often said to be 'food secure', because it exports a lot of food and has a high degree of self-sufficiency in its fresh food supply.[163] Over 90% of fresh foods such as fruit and vegetables, meat, milk and eggs sold by the major retailers are produced in Australia.[164] However, Melbourne's food supply relies on long and complex supply chains that source food from all over Australia and the world to maintain a consistent supply. During winter, Melbourne sources a significant proportion of its fruit and vegetables from the northern states, particularly Queensland.[165] Australia also imports many processed foods, such as canned and frozen fruit and vegetables, oils, bakery products and confectionary.[166] In addition to being long, food supply chains are also lean. Retailers hold relatively little stock in store to reduce costs and to keep food fresh.[167]

Melbourne's food supply relies on long and complex supply chains

[The retailers] run a very tight supply chain. There's not actually much in the supply chain, because the more volume there is in the supply chain, the more costly the supply chain is, for obvious reasons. So, they like their supply chains to be as lean as possible, for good reason, but in being lean, it means it has to be managed in real time. **– Interview 3, Industry**

157 Deloitte Access Economics (2016) As above.

158 ACCC (2018) As above.

159 Bishop, J., Bell, T., Huang, C. and Ward, M. (2021) As above

160 Dairy Australia (2019) In Focus 2019: *The Australian Dairy Industry.* Available: www.dairyaustralia.com.au/resource-repository/2020/07/09/australian-dairy-industry-in-focus-2019#.YbN3gr3MI0o (accessed 18 April 2022).

161 Kirkby, M., Connor, J., Bark, R., Qureshi, M. and Keyworth, S. (2012) The economic impact of water reductions during the Millennium Drought in the Murray-Darling Basin. Paper presented at the *56th AARES annual conference*, February 7-10, 2012. Fremantle, Western Australia.

162 Dairy Australia (2020) *Heat stress*. Available: https://www.dairyaustralia.com.au/animal-management-and-milk-quality/animal-health/heat-stress#.Ylyys-FByUk (accessed 18 April 2022).

163 ABARES (2020) *Australian food security and the Covid-19 pandemic*, Australian Bureau of Agricultural and Resource Economics and Sciences. Canberra, Australia. https://doi.org/10.25814/5e953830cb003.

164 Department of Agriculture, Water and the Environment (2020a) *Food*. Available https://www.awe.gov.au/agriculture-land/farm-food-drought/food (accessed 18 April 2022).

165 Deloitte Access Economics (2016) As above.

166 Hogan, L. (2018) *Food demand in Australia: Trend and issues*. Research report 18.10. Australian Bureau of Agricultural and Resource Economics and Sciences. Canberra, Australia.

167 Garnett, P., Doherty, B. and Heron, T. (2020) Vulnerability of the United Kingdom's food supply chains exposed by COVID-19. *Nature Food* 1: 315-318.

Sudden surges in consumer demand for food early in the COVID-19 pandemic highlighted the vulnerabilities of lean 'just in time' food supply chains as stocks of some staple foods ran out and there was a lag in the supply chain before shelves could be restocked.[168] Long supply chains that involve more people, organisations and border crossings also have more points for potential disruption.[169,170] When international borders closed during the COVID-19 pandemic, it reduced the availability of some imported foods and affected supplies of inputs important to food manufacturing, such as packaging and food additives.[171]

Sudden climate shocks elsewhere in Australia have also highlighted the vulnerability of long 'just in time' supply chains.[172] During the 2010-2011 Queensland floods, major transport routes into Brisbane and regional cities were cut off, leading to food shortages.[173] Flooding in 2022 in Queensland and northern New South Wales also cut food supply chains, resulting in empty supermarket shelves.[174]

4.4. Telecommunications and energy infrastructure

Food supply chains are dependent on critical infrastructure supplied by other sectors, such as energy, telecommunications and banking systems.[175] During climate shocks, such as fires, storms and floods, damage to other critical infrastructure can have a significant impact on food systems. During the 2019 – 2020 bushfires in New South Wales and south-east Victoria, power outages led to the loss of food stocks in stores and disruption to telecommunications affected payment systems and the ability to withdraw cash.

> *There were breakdowns in telecommunications and there was breakdown in power, so electricity, and breakdown in fuel. That manifested itself in people being unable to buy grocery products, because they only had credit cards and the internet wasn't working...some of the supermarkets had to close immediately…the tills weren't working, but also the freezers stopped working, the fridges stopped working, the fresh fruit and vegetables started to perish, as the air conditioning in the supermarkets went off.* **– Interview 3, Industry**

Sudden surges in consumer demand during COVID-19 highlighted the fragility of 'just in time' supply chains

The 2019-2020 bushfires impacted more than 300 telecommunications facilities in Victoria with an average 4.6 days of outage.[176] Similarly, the Victorian floods of 2011-2012 inundated power stations, affecting telecommunications and the food supply in regional towns.[177]

168 Carey, R., Murphy, M. and Alexandra, L. (2020) As above.

169 Productivity Commission (2021) *Vulnerable Supply Chains. Productivity Commission Study Report*. Commonwealth of Australia, Melbourne, Australia.

170 O'Meara, L., Turner, C., Coitinho, D. and Oenema, S. (2022) Consumer experiences of food environments during the Covid-19 pandemic: Global insights from a rapid online survey of individuals from 119 countries. *Global Food Security* 32: 100594.

171 AFGC (2020) As above.

172 Singh-Peterson, L. and Lawrence, G. (2015) Insights into community vulnerability and resilience following natural disasters: perspectives with food retailers in Northern NSW, Australia. *Local Environment* 20 (7): 782-795.

173 Smith, K., Lawrence, G., MacMahon, A., Muller, J. and Brady, M. (2016) The resilience of long and short food chains: a case study of flooding in Queensland, Australia. *Agriculture and Human Values* 33 (1): 45-60.

174 Carey, R., Alexandra, L. and Murphy, M. (2022) We can't keep relying on charities and the food industry to supply food after disasters – the government must lead. *The Conversation*, 4 March 2022.

175 DAFF (2012) As above.

176 Bushfire Recovery Victoria (2020) As above.

177 Comrie, N. (2011) As above.

4.5. Logistics and transportation

Melbourne is geographically isolated and food travels long distances to reach the city

Food in Australia is transported by road, rail, sea, and air. Melbourne and other major population centres are geographically isolated and food often travels long distances to reach the city. This increases the cost and complexity of transporting food. Other challenges for food freight in Australia include rising fuel costs, road congestion, maintenance of roads and rail freight corridors, and the reliance of air freight for food imports and exports on passenger air craft.[178]

Most food in Australia is transported by road.[179] Some of this food is highly perishable (e.g. dairy, meat and some fruit and vegetables) and must be kept refrigerated over long distances. This is energy-intensive and adds to the complexity of the food freight challenge.[180]

> *We have one of the most difficult tasks in Australia to supply goods over a long distance. We've got the longest distance. We've got separated entities. We've got long haul freight. We've got high ambient conditions and we've got a low population. It's one of the hardest things in the world to do. Some of the individuals that are involved in the cold chain in Australia are really trying their best.* **– Interview 31, Industry**

When major highways become blocked during extreme weather events, such as floods and fires, this can cause significant disruption to food supplies and increase food losses (see section 3.4). The closure of state borders during the COVID-19 pandemic also delayed interstate food freight and disrupted food supplies.

> *We have about 3000 trucks a night that go between Melbourne and Sydney one way and about 3000 a night come back the other way. The real issue with that is the fact that a major way of moving freight nowadays is by road…. the closure of borders was never anything we ever contemplated.* **– Interview 17, Industry**

4.6. Insecure employment in food and farming

Insecure employment in food and farming reduces the resilience of Australia's food system

The COVID-19 pandemic has highlighted how poor working conditions and insecure employment in the food and farming sectors reduce the resilience of Australia's food system.[181] The pandemic affected workers throughout the food system (see Figure 11). After the Australian Government closed international borders early in the pandemic, this led to labour shortages on farms[182] (see section 3.2). Farms in Victoria and other parts of Australia have long been dependent on working holiday makers and temporary migrant workers[183], particularly in labour-intensive sectors such as horticulture. It is estimated that less than half of the horticultural workforce is local.[184]

178 Infrastructure Australia (2019) *Australian Infrastructure Audit 2019. An Assessment of Australia's Future Infrastructure Needs*, Canberra, Australia.

179 Bureau of Infrastructure, Transport and Regional Economics (BITRE) (2019) *Australian aggregate freight forecasts – 2019 update, Research Report 152*. Canberra, Australia.

180 Infrastructure Australia (2019) As above.

181 Jones, N., Bellamy, J., Bellotti, W., Ross, H., van Bommel, S. and Lu, Y. (2022) As above.

182 Topsfield, J. (2020) Destroying spinach and sacrificing cabbages: The worker drought wasting Australia's produce. *The Age*, 29 September 2020. Available: https://www.smh.com.au/national/destroying-spinach-and-sacrificing-cabbages-the-worker-drought-wasting-australia-s-produce-20200929-p560es.html (accessed 18 April 2022).

183 Fair Work Commission (2021) As above.

184 Fair Work Commission (2021) As above.

During the COVID-19 pandemic, the lack of a local farm workforce became a risk to food supply.[185] It is also a risk for worker exploitation. Temporary migrant workers are less likely to report non-compliance with labour laws because they don't have secure residency.[186] COVID-19 also highlighted poor working conditions in other sectors of the food system. Meat processing plants were high risk sites of COVID-19 transmission, with large numbers of people working in close proximity in sites with poor air quality (see section 3.3).[187] The casualised nature of the workforce and limited access to sick pay may also deter workers from reporting symptoms of illness.[188]

The hospitality industry was hit hard during the COVID-19 pandemic.[189] The closure of the sector during lockdowns in Victoria highlighted the casualisation of the hospitality workforce and the precarious nature of employment. Hospitality workers in Melbourne were particularly affected due to the number of lockdowns in the city and their long duration. There was rising demand for food relief from people who had lost employment in the sector, particularly international students and temporary visa holders, who were ineligible for government support (see section 3.6).[190] Low rates of pay and insecure employment throughout food supply chains undermine the resilience of the food system.[191,192]

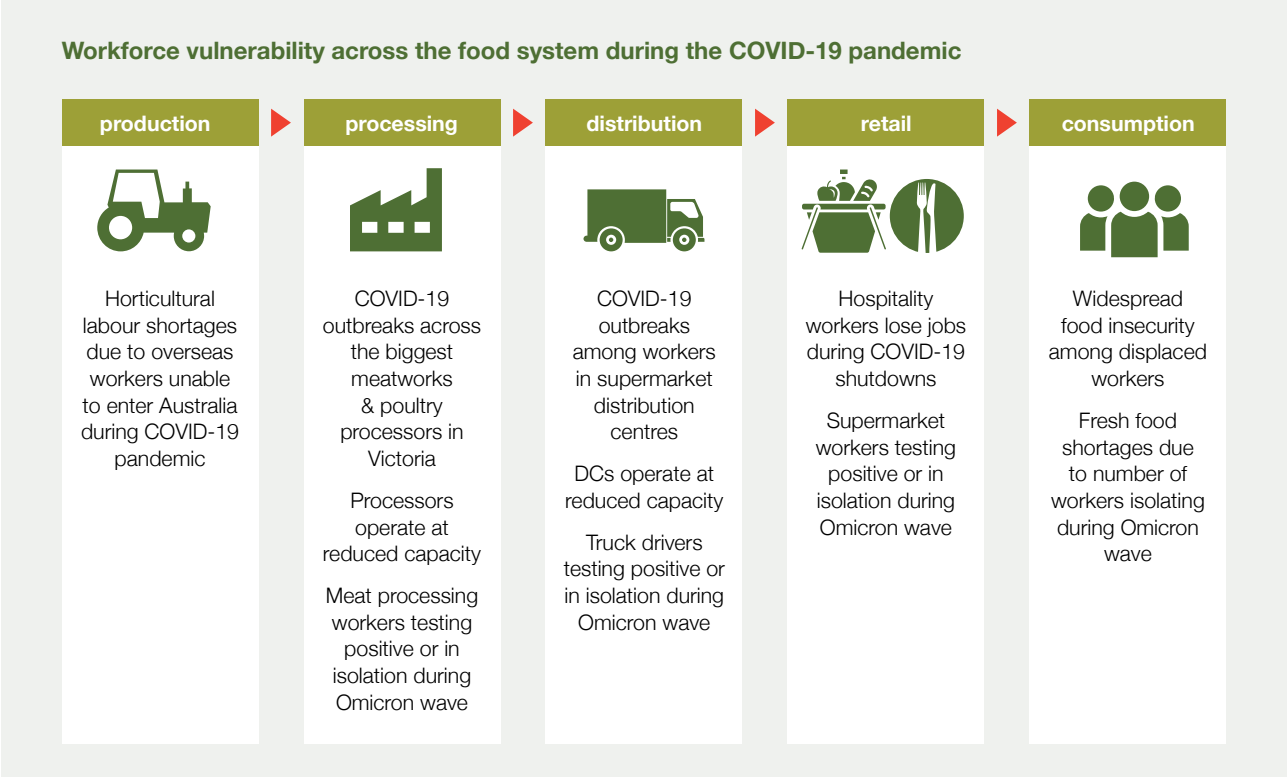


Figure 11. Workforce vulnerability across the food system during the COVID-19 pandemic

185 May, N. (2021) Australia's farmers set for record $70 billion year, but labour shortage and Covid rules threaten harvest. *The Guardian*, 15 September 2021. Available: https://www.theguardian.com/australia-news/2021/sep/15/australias-farmers-set-for-record-70bn-year-but-labour-shortages-and-covid-rules-threaten-harvest (accessed 18 April 2022).

186 Howe, J., Clibborn, S., Reilly, A., Broek, D. and Wright, C. (2019) *Towards a durable future: tackling labour challenges in the Australian horticulture industry.* University of Adelaide, South Australia.

187 Moolchand, E. and Marshall, S. (2022) Where's the meat? Employers and governments should have seen this supply crisis coming and done something. *The Conversation*, 24 January 2022.

188 Jones, N., Bellamy, J., Bellotti, W., Ross, H., van Bommel, S. and Lu, Y. (2022) As above.

189 Gilfillan, G. (2020) Covid-19: Impacts on Casual Workers in Australia– a Statistical Snapshot. *Statistical Snapshot Research Paper Series, 2019–20*. Parliament of Australia. Canberra, Australia.

190 Sakkal, P. (2020) "'We Don't Have Jobs': Unprecedented Demand for Emergency Food Relief." *The Age*, 12 April 2020. Available: https://www.theage.com.au/national/victoria/we-don-t-have-jobs-unprecedented-demand-for-emergency-food-relief-20200412-p54j6a.html (accessed 1 April 2022).

191 Underhill, E. and M. Rimmer (2015) Itinerant Foreign Harvest Workers in Australia: The Impact of Precarious Employment on Occupational Safety and Health. *Policy and Practice in Health and Safety* 13 (2): 25-46.

192 Jones, N., Bellamy, J., Bellotti, W., Ross, H., van Bommel, S. and Lu, Y. (2022) As above.

4.7. Food loss and waste

High levels of food waste generated in feeding Melbourne undermine the resilience of the city's food system. Around 200 kilograms of food waste is generated per capita per year throughout the food system (from production to consumption) in feeding the city. Around 60% of this waste occurs before food reaches consumers at earlier stages of the food supply chain.[193] Losses and waste through the food system are now widely recognised as a key factor affecting the sustainability of food systems.[194] A Sustainable Development Goal target (target 12.3) has therefore been set to halve global food waste by 2030, which has been widely adopted by governments, including the Australian and Victorian Governments.[195,196] However, food waste also undermines the resilience of food systems.[197]

Food waste is a waste of all the natural resources used to produce food, including land, water, phosphate rock (used in fertilisers) and fossil fuels (used to produce fertilisers and for energy throughout the food system).[198] These non-renewable resources are in limited supply and wasting them undermines the long-term resilience of the food system.[199] Food waste generates methane gas, a powerful GHG, when it decomposes in landfill, contributing to climate change. GHG emissions are also generated in producing the wasted food. Food waste in Victoria accounts for 15% of the state's (non-energy) GHG emissions.[200] This fuels climate change, which further undermines the resilience of the food system (see section 2).

Food waste is a waste of all the natural resources used to produce food

Food production also has adverse impacts on natural ecosystems. Production of food which is wasted exacerbates these impacts, further undermining the long-term resilience of food systems.[201] These ecosystems maintain the natural resources (such as land and water) on which food production depends, and provide vital ecosystem services to food production, such as pollination and maintaining soil fertility (see section 2.7).

4.8. Food insecurity

The resilience of Melbourne's food system is undermined by ongoing food insecurity in the region[202], which is exacerbated by shocks and stresses to the city's food system (see section 3.6). It is also undermined by weaknesses in the region's responses to food insecurity, which focus mainly on delivery of emergency food relief, rather than ongoing dignified access to adequate food.

In 2020, 5.9 % of Victorian adults ran out of money to buy enough food in the previous 12 months.[203] Figure 12 shows the percentage of the population who ran out of food and couldn't afford to buy more in different local government areas within Melbourne's city region during 2020. Although the proportion of the population who actually ran out of food in 2020 was relatively low, many more people experience other forms of food insecurity. They worry about running out of food or need to take steps to avoid running out of food, such as skipping meals. In 2014, around 13% of Victorians were worried about running out of money to buy food.[204]

193 Sheridan, J., Carey, R. and Candy, S. (2016) *Melbourne's Foodprint: What does it take to feed a city?* Victorian Eco-Innovation Lab, The University of Melbourne.

194 HLPE (2014) *Food losses and waste in the context of sustainable food systems*. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. Rome, Italy.

195 Commonwealth of Australia (2017) *National Food Waste Strategy: Halving Australia's food waste by 2030*. Canberra, Australia.

196 Sustainability Victoria (2020) *The Path to Half: Solutions to halve Victoria's food waste by 2030*. Melbourne, Australia.

197 Bajželj, B., Quested, T., Röös, E. and Swannell, R. (2020) The role of reducing food waste for resilient food systems. *Ecosystem Services* 45: 101140.

198 Wunderlich, S. and Martinez, N. (2018) Conserving natural resources through food loss reduction: Production and consumption stages of the food supply chain. *International Soil and Water Conservation Research* 6 (4): 331-339.

199 Bajželj, B., Quested, T., Röös, E. and Swannell, R. (2020) As above.

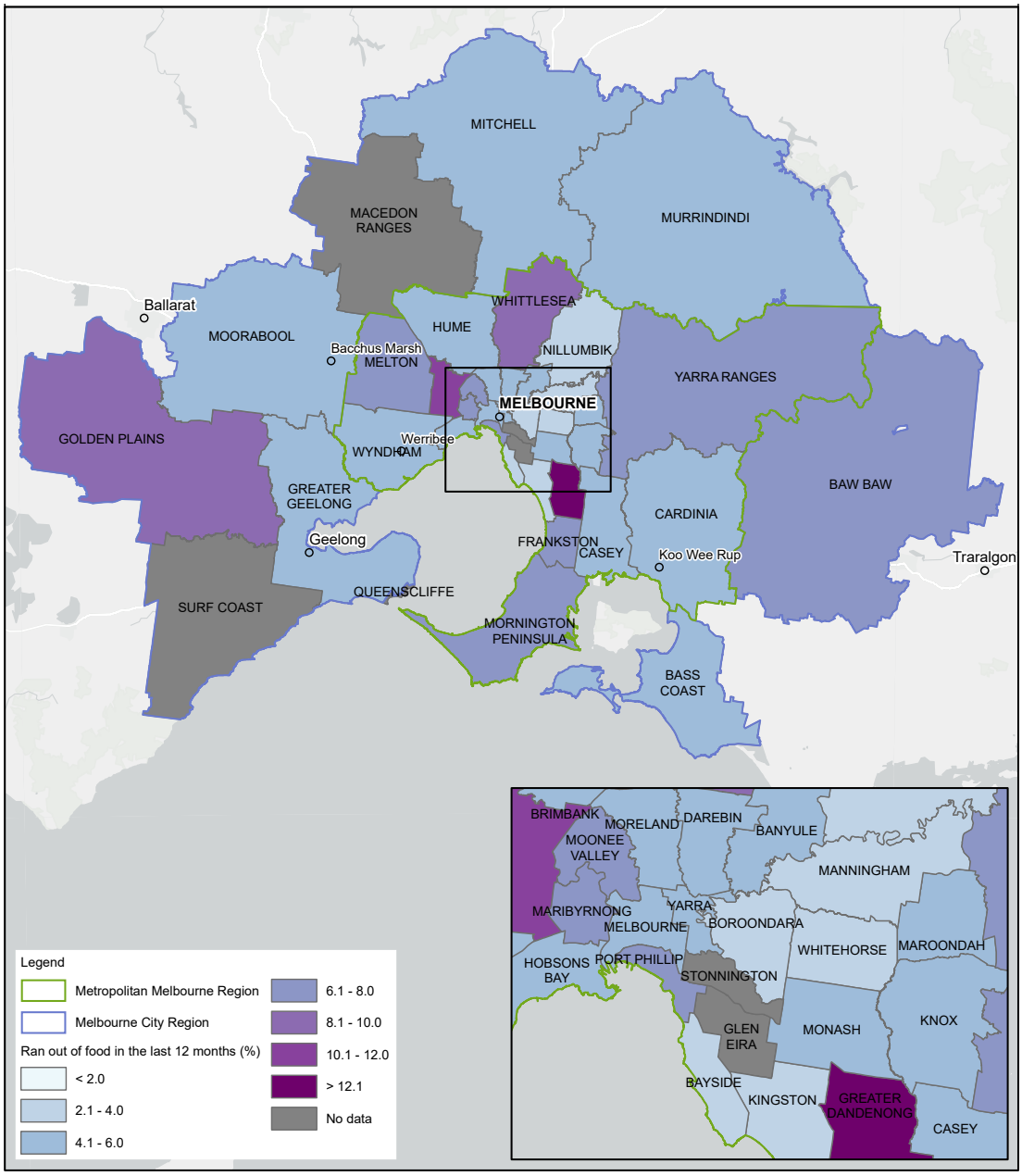
200 Sustainability Victoria (2020) As above.

201 Bajželj, B., Quested, T., Röös, E. and Swannell, R. (2020) As above.

202 City of Melbourne (2021) As above.

203 VAHI (2021) *Victorian Population Health Survey 2020 – Dashboard*. Victorian Agency for Health Information. Available https://vahi.vic.gov.au/report/population-health/victorian-population-health-survey-2020-dashboards (accessed 12 April 2022).

204 Victorian Agency for Health Information (2017) *Challenges to healthy eating – food insecurity in Victoria: findings from the 2014 Victorian Population Health Survey*, State of Victoria, Melbourne.



Data source: Food insecurity in Victoria, VAHI, 2021.

Figure 12. Food insecurity in Melbourne's city region by local government area

Food insecurity in the City of Melbourne local government area (which includes Melbourne's CBD and inner Melbourne suburbs, such as Carlton, North Melbourne and Flemington) is higher than the Victorian average and increased during the COVID-19 pandemic. Prior to the pandemic in 2019, around 26% of people surveyed by the City of Melbourne said that they either ran out of food and couldn't afford to buy more, skipped meals or worried about running out of food. Two years later in 2021, one in three households surveyed by the City of Melbourne reported experiencing one of these forms of food insecurity.[205] Food relief agencies have also seen a significant increase in the number of people in Australia relying on food relief during COVID-19, and new cohorts of people have sought food relief.[206]

Demand for food relief increased significantly during the COVID-19 pandemic

> *Demand is coming from a number of areas, one is young people, another is asylum seekers and international students, and the third one is entirely new cohorts of people that have never … sought help in the past.* **– Interview 7, Civil society**

The causes of food insecurity are complex. However, a key driver is low income. People on low incomes spend a higher proportion of their income on food[207] and are vulnerable to rising food prices and the impacts of shocks and stresses on food systems. Food insecurity increased during the pandemic among those already experiencing disadvantage, particularly First Nations Australians, single parent households, the elderly and other low-income groups.[208,209] People who lost employment during the pandemic, such as those working in the hospitality sector (including international students) were particularly vulnerable.[210]

A key driver of food insecurity is low income

The main response to rising food insecurity in Victoria during the COVID-19 pandemic was to expand provision of emergency food relief. The food relief sector is largely run by charitable organisations and includes food banks that source and distribute food, food rescue organisations and community-based organisations that provide food boxes, meals and vouchers.[211] The sector relies on donations of surplus and 'rescued' food from food manufacturers and retailers.[212,213] Early in the pandemic food donations into the sector fell as consumer demand rose, putting the system of food relief at risk.[214]

> *The panic buying saw all additional surplus food being taken by the supermarkets… what that did was essentially it dried up the donation side of the supply chain. So, we were down to two weeks' worth of food [relief] for the whole state.* **– Interview 4, Civil society**

> *With COVID, it has been the biggest impact for us at a national level with so many people impacted and needing support and our supply channels impacted by the panic buying in stores… overnight we saw a 50% increase in demand and also saw a decline in product donations.* **– Interview 9, Civil society**

205 In the City of Melbourne survey of over 3000 people conducted in May/June 2021, 19% of people had run out of food and been unable to afford to buy more in the last 12 months, 27% had worried about running out of food and being unable to afford to buy more and 21% had used strategies such as skipping meals to cope with not having enough food. See City of Melbourne (2021) As above.

206 Foodbank Australia (2020) *Foodbank Hunger Report 2020*. Sydney, Australia.

207 McKay, F., Bastian, A. and Lindberg, R. (2021) Exploring the response of the Victorian emergency and community food sector to the COVID-19 pandemic. *Journal of Hunger and Environmental Nutrition* 16 (4): 447-446.

208 Kent, K., Murray, S., Penrose, B., Auckland, S., Visentin, D., Godrich, S. and Lester, E. (2020) Prevalence and Socio-Demographic Predictors of Food Insecurity in Australia during the COVID-19 Pandemic. *Nutrients* 12 (9): 2682.

209 Louie, S., Shi, Y. and Allman-Farinelli, M. (2022) The effects of the COVID-19 pandemic on food security in Australia: A scoping review. *Nutrition & Dietetics* 79 (1): 28-47.

210 Jones, N., Bellamy, J., Bellotti, W., Ross, H., van Bommel, S. and Lu, Y. (2022) As above.

211 Lindberg, R., Whelan, J., Lawrence, M., Gold, L. and Friel, S. (2015) Still serving hot soup? Two hundred years of a charitable food sector in Australia: a narrative review. *Australian and New Zealand Journal of Public Health* 39 (4): 358-365.

212 Lindberg, R., Whelan, J., Lawrence, M., Gold, L. and Friel, S. (2015) As above.

213 CISVic and VCOSS (2021) *More than a band-aid: Emergency Relief in Victoria*. Community Information & Support Victoria, Victorian Council of Social Service. Melbourne, Australia.

214 CISVic and VCOSS (2021) As above.

Another vulnerability during the COVID-19 pandemic was the reliance of the sector on a volunteer workforce, which it lost almost overnight.

> *It was highlighted during COVID how vulnerable that charity sector is because it's predominately run, especially in regional Victoria, by people in their seventies. They were the key morbidity demographic and didn't want to do face-to-face contact with the community.* **– Interview 4, civil society**

> *One of the fault lines of the emergency relief sector that was exposed really early on in this pandemic was the fact that it is a sector that's delivered by volunteers primarily…almost overnight, we lost our volunteer workforce.* **– Interview 12, Civil society**

Emergency food relief is run by charitable organisations using food donated by the food industry

During the COVID-19 pandemic, government increased its investment in food relief at the federal, state and local government level.[215] However, at its core emergency food relief is a system run by civil society organisations using food donated by food industry enterprises, and therein lies the vulnerability revealed during the pandemic. Emergency food relief is also unable to meet people's personal and cultural food preferences and does not ensure the human right to adequate food.[216] The key role of civil society organisations and the private sector in the governance of food relief is discussed further in section 5.

4.9. Summary

In this chapter, we identified vulnerabilities in Melbourne's food system to shocks and stresses, particularly vulnerabilities revealed during the 2019-2020 bushfires and the COVID-19 pandemic. These vulnerabilities point to areas of the city's food system that could be strengthened to build its resilience to future shocks and stresses.

215 Victorian Government (2021) *Boosting food relief for Victorian communities.* Media release, 13 January 2021. Available: https://www.premier.vic.gov.au/boosting-food-relief-victorian-communities (accessed 20 April 2022).

216 Lindberg, R., Barbour, L. and Godrich, S. (2021) A rights-based approach to food security in Australia. *Health Promotion Journal of Australia* 32: 6-12.

SECTION 5

Policy and governance

5.1. Introduction

This chapter provides an overview of policies and governance arrangements that influence the resilience of Melbourne's food system to shocks and stresses. Multiple policy portfolios and stakeholders are involved in governance of the food system from production through to the management of food waste resources. The chapter concludes with a focus on the governance of the food supply and of food relief during sudden shocks to the food system.

Multiple policy portfolios and stakeholders influence the resilience of the food system

5.2. Policy influences on the resilience of Melbourne's food system

A range of federal, state and local government policies influence the resilience of Melbourne's food system to shocks and stresses. They include policies and regulation relating to management of natural resources, land use, climate change, public health, emergencies, critical infrastructure, labour and the economy. Figure 13 shows some of the key policy portfolios that influence the resilience of the food system.

Policies and regulation relating to the management of natural resources (such as land and water) and the environment influence the long-term underlying resilience of Melbourne's food system. Environmental legislation[217] influences the food system by establishing frameworks for conserving the natural ecosystems on which food production depends and for preventing and reusing waste (including food waste). Land use planning legislation[218,219] can promote the resilience of Melbourne's food system through strong protection for agricultural land in Melbourne's peri-urban areas.

Climate legislation in Victoria influences the resilience of Melbourne's food system by establishing emissions reduction targets and identifying actions to address the impacts of climate change across sectors that are important to the food system. Under the legislation, adaptation action plans must be developed every five years for seven 'systems'[220], which include the natural environment, primary production, transport and the water cycle.[221]

Public health legislation and policies also support long term planning for the resilience of food systems. State and municipal public health and wellbeing plans identify actions to increase access to healthy food in communities and to reduce the impacts of climate change on health.[222] Public health legislation plays an important role in protecting public health during shocks, such as bushfires, floods and pandemic.[223]

Emergency management legislation and policy across state and local government guides mitigation, response and recovery from shocks such as fire, flood and pandemic, including provision of food relief following emergencies.[224,225] State and federal critical infrastructure policy aims to ensure the continued operation of infrastructure, including the food and grocery supply, following a threat or hazard, such as a natural disaster.[226,227]

Left: stock.adobe.com/Daniel Morton

217 Victorian Government (2017) *Environment Protection Act 2017.*

218 Victorian Government (1987) *Planning and Environment Action 1987.*

219 Department of Environment, Land, Water and Planning (2017) *Plan Melbourne 2017-2050*. Melbourne, Australia.

220 Victorian Government (2017) *Climate Change Act 2017*. Melbourne, Australia.

221 Victorian Government (2022) *Victorian Government action on climate change*. Available www.climatechange.vic.gov.au/victorian-government-action-on-climate-change (accessed 14 April 2022).

222 Victorian Government (2019) *Victorian public health and wellbeing plan 2019-2023*. Melbourne, Australia.

223 Victorian Government (2008) *Public Health and Wellbeing Act 2008*. Melbourne, Australia.

224 Victorian Government (2013) *Emergency Management Act 2013.* Melbourne, Australia.

225 Emergency Management Victoria (2021) *Victorian State Emergency Management Plan*. Melbourne, Australia.

226 Australian Government (2015) *Critical infrastructure resilience strategy: Plan*. Canberra, Australia.

227 Victorian Government (2015) *Critical infrastructure resilience strategy*. Melbourne, Australia.

Figure 13. Key policy portfolios that influence the resilience of the food system

5.2.1. The challenge of policy silos

The policies outlined above represent just some (not all) of the policies that influence the resilience of Melbourne's food system, and therein lies one of the challenges of food system governance. The food system includes multiple sectors and stakeholders involved in the production, processing, distribution and sale of food and management of food waste (e.g. farmers, food manufacturers, transport operators, food wholesalers and retailers). Each of these sectors and stakeholders has specific policies and governance arrangements that influence the resilience of the food system. However, the interconnectedness of the food system calls for 'joined up' policy approaches.[228] The lack of co-ordination between policy portfolios and food system stakeholders undermines food system resilience. This was identified in our research as a governance challenge.

> *Part of the challenge is it's a really diverse system and there's lots of actors…they tend to talk to their own little groups and not necessarily always reach outside those groups…you can't talk to the system as a whole. You're always and only ever talking to part of the system.* **– Interview 30, Government**

A key barrier is that within the Victorian Government, there is no one minister or department that has responsibility for the food system.

> *One of the problems is…the fragmentation in Victoria... without having a whole food authority like you might have in New South Wales where you all sit in the same umbrella and have that conversation, we cannot have [the conversation] here without it coming from this minister's point of view, or coming from that minister's point of view and the conversation is not cohesive and all on the same page. So to get anything really done in that space we have to change to…one food governance body in Victoria.* **– Interview 10, Government**

Responsibility for the food system is distributed across government

> *The thing about food is that it's not really just owned by one area, responsibility is really distributed across government.* **– Interview 8, Government**

This section has highlighted that multiple policy portfolios and stakeholders influence the resilience of food systems. The challenge is to develop integrated governance arrangements that recognise the connections and interdependencies between policies, processes and stakeholders within the food system (see section 6.4.7).

5.3. Governance of the food supply

Governance of the food supply during a shock (such as bushfire or pandemic) involves both federal and state government (see Figure 14). At the federal level, governance is shared across government and industry under the guidance of the Australian Government's *Critical Infrastructure Resilience* Strategy, which aims to ensure the continued operation of critical infrastructure, including the food supply, in the face of a threat or hazard.[229] Government and industry collaborate to manage risks to Australia's food supply through the Food and Grocery Sector Group of the Trusted Information Sharing Network (TISN), which is chaired by the Chief Executive Officer of the Australian Food and Grocery Council, with secretariat support from the Department of Agriculture, Water and the Environment.[230]

228 Hawkes, C., Parsons, K. and Wells, R. (2019) *Brief 2: Understanding the food system: Why it matters for food policy*. Centre for Food Policy. London, UK.

229 Australian Government (2015) As above.

230 Department of Agriculture, Water and Environment (2022) *Critical Infrastructure Resilience Strategy*. Available www.awe.gov.au/agriculture-land/farm-food-drought/food/food-chain-resilience/critical-infrastructure-resilience-strategy (accessed 14 April 2022).

A Supermarket Taskforce was also established in March 2020 to address food and grocery supply risks that arose at the start of the COVID-19 pandemic. It has representation from federal, state and territory governments, major supermarket retailers and distributors, food industry and logistic associations and food relief organisations.[231,232]

Victoria has a similar critical infrastructure strategy and framework (see Figure 14). The Victorian Food and Grocery Sector Resilience Network includes the major retailers and distributors, freight and logistics operators, industry associations and unions, food manufacturers, food relief charities, and state and federal government agencies and regulators.[233]

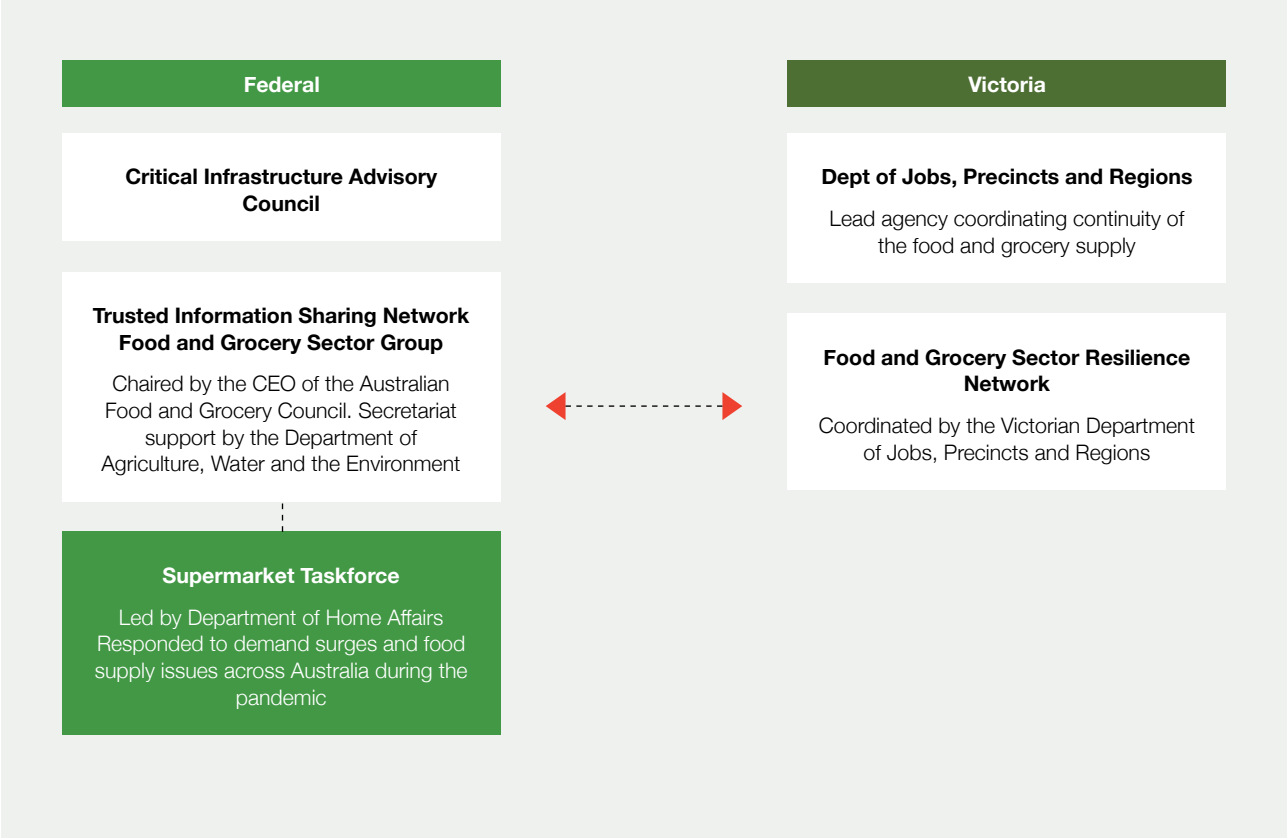


Figure 14. Governance of the food and grocery supply during a shock

The food industry plays a key role nationally and in the state of Victoria in ensuring the continuity of the food and grocery supply during a shock.

> *Private industry in the food and grocery sector are the primary responders. So, it's their emergency and government just looks at ways that they can support them…industry really is the primary responder and they're primarily responsible for getting the supermarket shelves stocked again.* **– Interview 8, Government**

231 Australian Public Service Academy (2021) *Supermarket Taskforce Case Study*, Australian Government Available https://www.apsacademy.gov.au/news-events/news/supermarket-taskforce-case-study (accessed 14 April 2022).

232 Parliament of Australia (2020) *Parliamentary Inquiry Written Question on Notice, Select Committee on COVID-19*, QoN Number: CV19-81 Available at www.aph.gov.au/DocumentStore.ashx?id=05c811f4-6789-4c53-a78b-836bd18a7d7f (accessed 14 April 2022).

233 Victorian Government (2022) *Victoria's Critical Infrastructure All Sectors Resilience Report 2021*. Melbourne, Australia.

I think the barrier is having quite an industry-based food system, as I said, so the risks are managed by them, the supply is managed by them, the profits are managed by them. Other countries do have within their legislation that we will provide our citizens with food. **– Interview 10, Government**

The leading role of the private sector in managing food supplies in the event of a shock in Australia was evident in the way that supplies were managed during the COVID-19 pandemic. When there were temporary shortages of some staple foods, the major supermarkets managed those shortages by putting limits on the quantities that consumers were able to buy and introducing special opening hours for vulnerable consumers.[234]

The critical infrastructure policy framework establishes the leading role of the private sector, and particularly major supermarkets, in the governance of the food and grocery supply during a shock to the food system in Victoria. However, the focus is on keeping supermarket supply chains operating, with little focus on other retailers or localised food supply chains. Most farmers markets were able to continue operating in Victoria during the COVID-19 pandemic, but at times it was unclear whether they would be able to continue under COVID-19 restrictions.[235]

The uncertainty around which farmers' markets are open and which ones are closed, and different councils doing different things - that was really quite damaging for a lot of farmers who rely on farmers' markets and also for the community to understand what was safe and what wasn't. **– Interview 13, Civil society**

5.4. Governance of food relief

Food relief in Australia is primarily managed at the state and local level. In Victoria, the governance of food relief is mainly the responsibility of charities and civil society organisations (see Figure 15). The Red Cross has the primary responsibility for ensuring access to food and water during emergencies under Victoria's emergency management framework, supported by Foodbank Victoria and the Salvation Army. Foodbank is the largest provider of food and groceries to food relief charities in Australia.[236]

The Red Cross has primary responsibility for ensuring access to food during an emergency in Victoria

There has historically been little government funding for food relief services in Australia. However, during the COVID-19 pandemic, more funding has been provided by federal, state and local governments.[237] In 2021, the Victorian Government established a Food Relief Taskforce to strengthen the state's system of food relief.[238] However, the charitable sector continues to play the lead role in providing food relief with a workforce that is mainly made up of volunteers.

234 AAP (2020) Australian supermarkets limit sale of essentials to prevent coronavirus panic buying. *The Guardian*, 24 March 2020. Available: https://www.theguardian.com/world/2020/mar/14/coronavirus-australian-supermarkets-limit-sales-of-essentials-to-prevent-panic-buying (accessed 20 April 2022).

235 Preiss, B. and Mannix, L. (2020) Farmers cling to city lifeline as DHHS backflips on COVID-19 market ban. *The Age*, 21 August 2020. Available: https://www.theage.com.au/national/victoria/absolutely-blindsided-farmers-markets-forced-to-close-amid-covid-19-rule-confusion-20200821-p55ny4.html (accessed 20 April 2022).

236 Foodbank Australia (2020) *Foodbank Hunger Report 2020*. Sydney, Australia.

237 Victorian Government (2021) *Boosting food relief for Victorian communities*. Media release, 13 January 2021. Available: https://www.premier.vic.gov.au/boosting-food-relief-victorian-communities (accessed 20 April 2022).

238 See https://providers.dffh.vic.gov.au/food-relief-taskforce

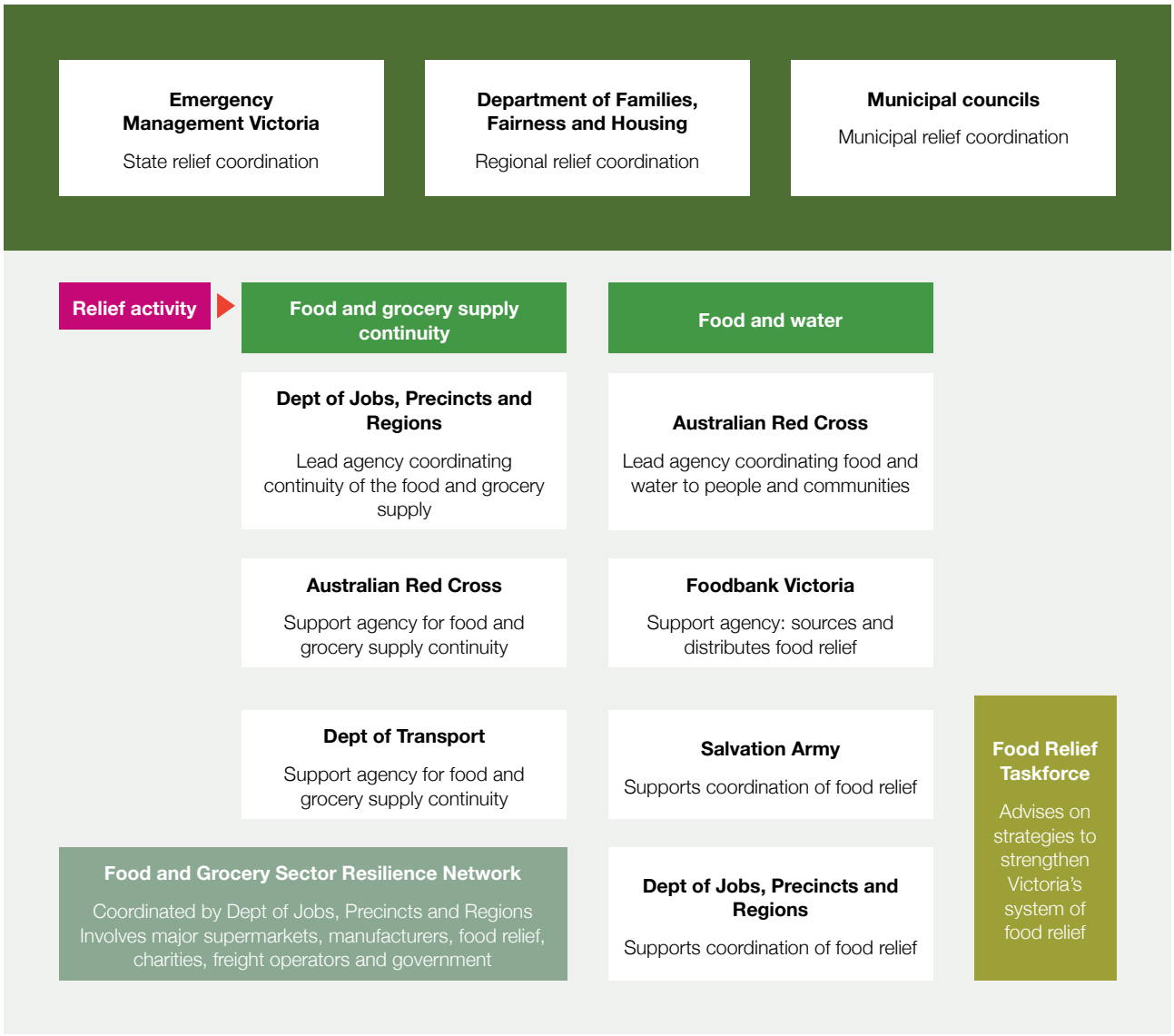


Figure 15. Governance of food relief during a shock in Victoria

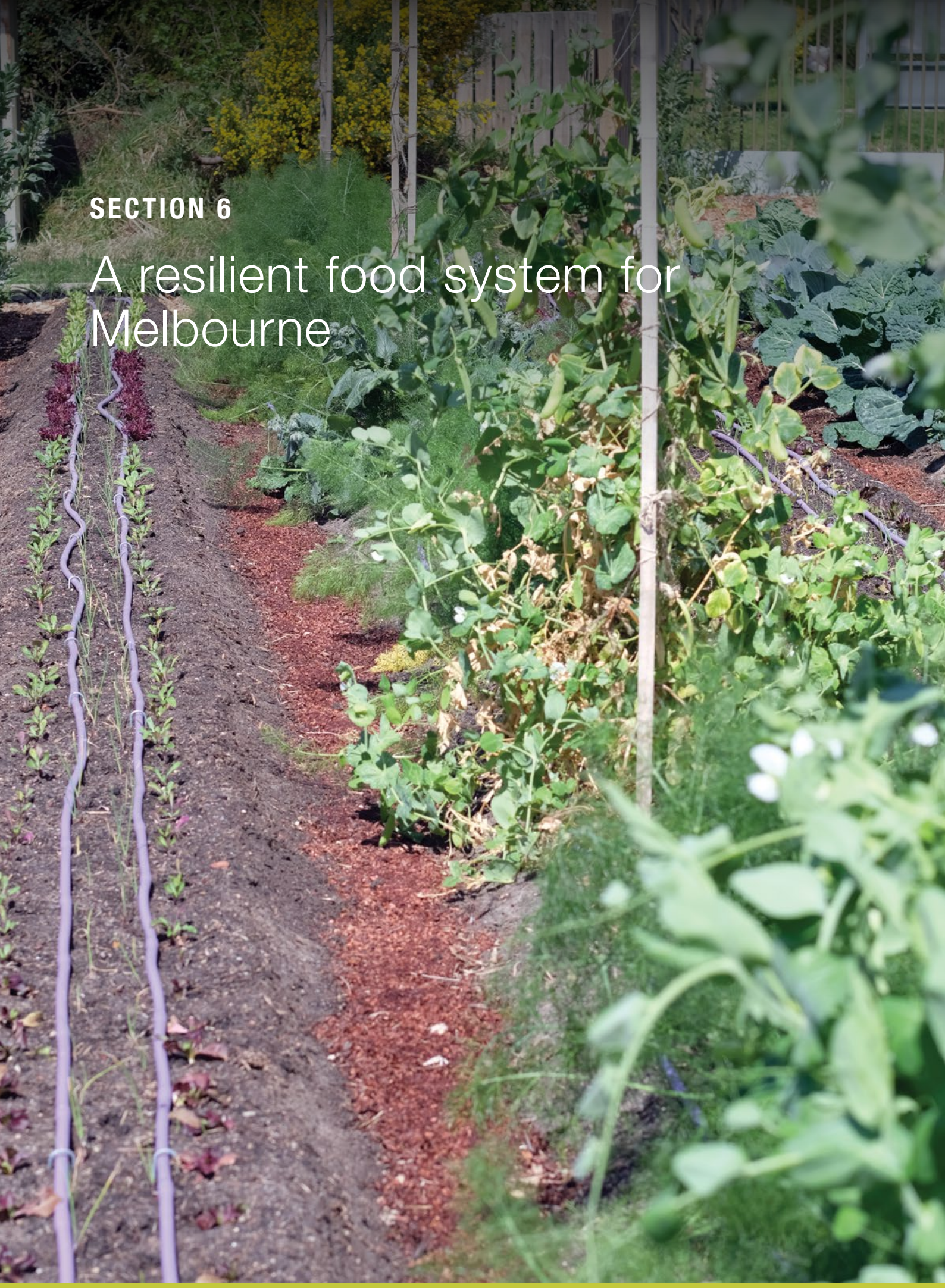
The experience of the COVID-19 pandemic has raised fundamental questions about Victoria's system of food relief and the role of government in ensuring that all Australians have access to a nutritious and culturally appropriate diet. The state's system of food relief is dependent on supplies of surplus food from the private sector and on a workforce of volunteers. This system came under significant strain during the COVID-19 pandemic. Demand for food relief increased rapidly at the same time as donations of food from the private sector fell and as the sector lost its volunteer workforce (see section 4.8). Criticism of the current system of food relief is also growing, because it does not provide recipients with food choices that meet their personal and cultural food preferences and it does not ensure the human right to adequate food.[239]

5.5. Summary

This chapter has discussed the policies and governance arrangements that influence the resilience of Melbourne's food system. A key challenge is that responsibility for food systems resilience is dispersed across multiple policy portfolios and there is a need for a more integrated policy approach. Government could take a more significant leadership role in the governance of food supply and emergency food relief during food system disruptions to strengthen the resilience of the food system.

239 Lindberg, R., Barbour, L. and Godrich, S. (2021) As above.

Image Lilly Murphy



SECTION 6

A resilient food system for Melbourne

6.1. Introduction

This chapter identifies opportunities to build the resilience of Melbourne's food system to future shocks and stresses. It draws on the lessons from recent climate and pandemic shocks to the city's food system. The COVID-19 pandemic came in the wake of major bushfires in south-east Australia in 2019 – 2020. Drought and flooding events have also impacted food systems in Australia in recent times. Building a resilient food system requires preparedness and planning for *any* potential shock or stress. This chapter highlights the features of a resilient food system and outlines seven strategies to build the resilience of Melbourne's food system to future shocks and stresses.

6.2. Planning for long-term resilience of the food system

The potential risks of disruption to food supply during a pandemic have been under consideration in Australia for over a decade.[240] While policy and governance frameworks are in place at both federal and state level for managing disruption to food supply chains (see section 5.3), some participants in our research suggested that Australia was not as well prepared for the impacts of the COVID-19 pandemic on food supplies as it might have been.

> *Not wanting to beat all the people up who did the pandemic scenarios over the last 10 to 15 years, I think it's probably fair to say that it may not have set us up for the current pandemic in a way that we would have expected.* **– Interview 16, Industry**

Several participants suggested that there is a need for better long-term planning for the resilience of food supplies that draws on the lessons learned from recent shocks to the food system.

> *I think [government] need to think strategically and do long-term planning and not just look at the next two to three years, but look at 5 to 10 years. Because if you take the bushfires and floods, we see it on a regular basis … we had SARS. We had [the COVID-19 pandemic] but nobody expected the panic buying. We can't say that in the future something like COVID-19 is not going to happen again. The pandemic can happen again. I think we need to start thinking longer term.* **– Interview 21, Industry**

Melbourne and Victoria will experience more frequent and more severe extreme weather events in future due to climate change.[241,242] These events are likely to have impacts throughout the food system (see section 3). The region is also likely to experience the compounding effects of multiple shocks and stresses that co-occur or follow shortly on each other (see section 2.8).

Long term planning is needed to strengthen the resilience of Melbourne's food system to any future shock

Participants in our research highlighted that there are many possible shocks and stresses that could affect Melbourne's food system in future including ecological, geopolitical, energy and cybersecurity shocks. There is uncertainty about which shocks Melbourne's food system will face next and in what combination. Given this uncertainty, several participants emphasised the importance of building the long-term resilience of the city's food system to *any* potential future shock.

Left: Image Leila Alexandra

240 DAFF (2012) As above.

241 Grose, M., et al. (2015) As above.

242 Timbal, B. et al. (2016) As above.

A key part of resilience and adaptation is the ability of a system to cope with shock, whatever that shock may be. **– Interview 19, Government**

What is the thing that is going to strengthen us to better prepare for any of those things happening…what is the common denominator for helping us be better prepared for anything that might come our way? **– Interview 1, Government**

6.3. Features of a resilient food system

Resilience is a relatively new concept in food systems (see section 1.3), and little is known about what makes food systems resilient.[243] This section discusses the features of resilient food systems with a focus on building the long term resilience of Melbourne's food system to any future shock or stress. It draws particularly on the lessons learned from the experience of the COVID-19 pandemic in Victoria and the 2019-2020 bushfires in south-east Australia.

6.3.1. Diversity

Resilient food systems source food from global, national, regional and local areas

Resilient food systems that can continue supplying healthy food through shocks and stresses are likely to be *diverse* – diverse in the geographic locations that food is sourced from (global, national, regional and local), the scale of food and farming enterprises (small-medium scale as well as large), the types of enterprises that supply food (social and community enterprises as well as commercial), the types of crops that are grown and the transport routes to get food to consumers.

I think one of the strongest things is to increase the diversity of… food systems so that we are having a much bigger proportion of our investment in agriculture systems focusing on decentralising the food supply and the distribution chains. **– Interview 13, Civil society**

From a transport side of things we have a diversified network to support major disruptions, which can switch between rail, road, coastal shipping and air freight to ensure adequate supply is available… when you look at the floods in far north Queensland, for example… we generally use rail. But we've got backup carriers that provide road service, which means we are still able to service remote communities. **– Interview 21, Industry**

Resilient food systems are diverse

Increasing the diversity of food systems can also support *redundancy* – having multiple or interchangeable ways of sourcing or transporting food, so that when one source or route is affected by a disturbance to the food system, other options are available.

One of the things that makes the sector resilient is the fact that it's very diverse and so there's a lot of redundancy built into that. **– Interview 8, Government**

I think we need to have contingencies and redundancy built into the system so that when things inevitably go wrong as they will more in climate change, we can bounce back from that. **– Interview 30, Government**

243 Fanzo, J. et al. (2021) Viewpoint: Rigorous monitoring is necessary to guide food system transformation in the countdown to the 2030 global goals. *Food Policy* 104, 102163.

Diversity in food production

Diversity in food production can enhance the resilience of food systems in multiple ways. Biodiversity in agricultural production systems can improve the functioning of ecosystem services important to food production, such as pollination, biological pest control and soil quality.[244] Diversity in the types of crops that are grown and the types of livestock that are reared can reduce vulnerability to pest and disease outbreaks.[245] Growing indigenous foods that are well adapted to local ecosystems can also enhance the resilience of food production.[246]

Sourcing food produced in diverse regions can extend the seasonal availability of fresh foods and strengthen the resilience of the food system to the impacts of extreme weather events. Food imports can help to cushion the impacts of food price rises when domestic food supplies are affected, during Australia's 13-year Millennium Drought, for example. However, several participants in our research emphasised the importance of growing and manufacturing as much food as possible in Australia.

> *A resilient food supply would be one that's potentially as local as possible, so reducing the risk of the impact of stresses. So that could be say adverse weather events, roads being blocked…or air freight, international trade, things like that. So, I think a resilient food supply in Australia would be growing as much of what we want to eat in Australia within Australia.* **– Interview 28, Industry**

> *How do we make sure that…through the next COVID-19 or something more serious, we are more resilient? The first thing is, to make sure that manufacturing stays in Australia, and ideally, would be improved in Australia, and we need industry policies that encourage, not just the manufacture of food and grocery products here in Australia, but manufacturing systems which are perhaps more flexible.* **– Interview 3, Industry**

The ability to draw on food supplies from other states in Australia is important to Melbourne's food system. Victoria sources many fruits and vegetables from the northern states of Australia, particularly Queensland, during the winter months.[247] However, many participants in our research also stressed the importance of local and regional food production in strengthening the resilience of Melbourne's food system to climate and pandemic shocks.

> *[A resilient food system is one] where there's food produced in a community and feeding the community around it. So, it's that you're not critically reliant on food coming from another country or from the other side of Australia. It's where, predominantly, your community is fed by the farm bowl that's nearest to you and you're importing extra things.* **– Interview 13, Civil society**

> *I just know that the pandemic has forced these re-evaluations and shifts in how we localise our economies and there's genuine headway being made. That's going to make us more resilient in the face of whatever the next shock is.* **– Interview 25, Civil society**

Local and regional food production can strengthen food supplies when an extreme weather event, such as a flood or bushfire, cuts major interstate transport routes or highways into the city. Community food production in backyards and community gardens can also strengthen access to fresh foods when conventional supply chains are disrupted.[248]

244 Dardonville, M., Bockstaller, C., Villerd, J. and Therond, O. (2022) Resilience of agricultural systems: biodiversity-based systems are stable, while intensified ones are resistant and high-yielding. *Agricultural Systems* 197, 103365.

245 Schipanski, M., MacDonald, G., Rosenzweig, S., Chappell, J., Bennett, E., Bezner Kerr, R., Blesh, J., Crews, T., Drinkwater, L., Lundgren, J., and, C. (2016) Realizing resilient food systems. *Bioscience* 66 (7); 600-610.

246 FAO (2019) *The State of the World's Biodiversity for Food and Agriculture.* J. Bélanger & D. Pilling (eds.). FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome, Italy.

247 Deloitte Access Economics (2016) As above.

248 Vieira, L., Serrao-Neumann, S., Howes, M. and Mackey, B. (2018) Unpacking components of sustainable and resilient urban food systems. *Journal of Cleaner Production* 200: 318-330.

Diversity in food supply chains

Sourcing food from enterprises at different scales can enhance the resilience of food systems. Large scale enterprises, such as major supermarkets, have significant resources at their disposal to help them get back up and running quickly after a disaster. They also have good links to government and other major players in food supply chains to help them adapt to disruptions. Smaller scale organisations may have better links to local food producers and local knowledge of alternative suppliers or supply routes that can help them to quickly fill gaps in supply.[249] Smaller scale enterprises can often be nimble and flexible in their responses.

> *Rather than having a large system…thinly spread both profit margin and margin for error and disruption, a small-scale autonomous business is able to duck and weave, to protect itself, to represent itself, to tell its story, to change course if necessary and have strong relationships, both with customers and its peers and its cohort. I think it makes for a very robust group of people and businesses.* **– Interview 5, Civil society**

> *To ensure that we have got greater food security into the future, because the pandemic has revealed the fault lines in supply chains, we want to make sure that we've got a range of supply chains, not just relying on the bigger, traditional chains that we need to look at. I guess, armouring ourselves with as many sources of food as we can.* **– Interview 12, Civil society**

During the Omicron wave of the COVID-19 pandemic, small independent grocers and food markets often had good supplies of fresh foods, particularly fruit and vegetables, when supermarkets were experiencing shortages due to the number of workers isolating through the supply chain.[250] Small independent food stores, community gardens and orchards, backyard food production, farmers markets and other food markets all contribute to resilient food systems.

6.3.2. Adaptation and innovation

The capacity to not only recover from a disturbance, but to adapt to the changing conditions, is also central to resilient food systems. Producers are constantly adapting to the impacts of climate change in Victoria. Adaptations include water efficiency improvements and the use of recycled water to increase resilience to drought, moving production to areas of higher rainfall and the use of protected cropping to create climate-controlled environments and reduce the impacts of extreme weather events on production.

> *We could easily grow a lot of food - and may have to because of the heat outside – in glasshouses, in controlled environment settings. They could be back near the cities.* **– Interview 27, Industry**

Supermarket supply chains adapted to the 2019-2020 bushfires by rerouting food freight between Victoria, NSW and Queensland away from affected areas of the major coastal highway, the Princes Highway, to alternative transport routes. Similarly, food freight into the Northern Territory was rerouted through Queensland after floods in South Australia cut the usual supply routes in early 2022.[251]

249 Smith, K., Lawrence, G., MacMahon, A., Muller, J. and Brady, M. (2016). The resilience of long and short food chains: a case study of flooding in Queensland, Australia. *Agriculture and Human Values* 33 (1): 45-60.

250 Butler, B. (2022) How fresh food markets are avoiding Australia's supply chain crisis. *The Guardian*, 15 January 2022. Available: https://www.theguardian.com/business/2022/jan/14/how-fresh-food-markets-are-avoiding-australias-crippling-supply-chain-crisis (accessed 22 April 2022).

251 Towie, N. (2022) 'A logistical nightmare': flooding takes out sole rail link sparking West Australian food shortage. *The Guardian*, 4 February 2022. Available: https://www.theguardian.com/australia-news/2022/feb/04/a-logistical-nightmare-flooding-takes-out-sole-rail-link-sparking-west-australian-food-shortage (accessed 22 April 2022).

Both long and short food supply chains in Victoria adapted to the COVID-19 pandemic. The major supermarkets responded to the surge in food demand by establishing additional 'pop up' distribution centres and some trucks by-passed the usual distribution centres altogether, delivering supplies straight to stores.

> *The supply chain had to adapt…the classic distribution is manufacturer, distribution centre… and out to supermarkets. They were circumventing that by sending trucks straight from the manufacturer directly to supermarkets, to keep the supply up.* **– Interview 3, Industry**

Short food supply chains, that connect farmers directly to consumers, also adapted and innovated. Many farmers who sold via farm gates moved their businesses online early in the pandemic, using platforms like the Open Food Network.[252]

> *In stage 4 [COVID-19 restrictions], with people not being able to shop more than five kilometres from home that had a massive impact on the farm gate. Within a week all of the major farm gates moved to online and home delivery in some way or form.* **– Interview 24, Government**

> *A lot of organisations are incredibly…adaptable and flexible. We've certainly seen that during this COVID-19 period where organisations have really pivoted…they have absolutely proved themselves to be able to continue to deliver services no matter what. They've just switched the service delivery from face to face to on the phone to online.* **– Interview 7, Civil society**

Some communities established virtual farmers markets or 'food hubs', aggregating online orders from multiple producers in a region.[253] Civil society organisations also came together to form new enterprises like Moving Feast[254], a collaboration of over twenty organisations that created new systems of food relief for Victorians during the pandemic, using produce from local farmers and from networks of community gardens across the city.

6.3.3. Decentralisation

The COVID-19 pandemic highlighted the risk of centralised supermarket distribution centres and food processing facilities, where just a few facilities exist for a city or supply chain. Sometimes facilities are also concentrated in a specific geographic area, posing a risk if the area is affected by an extreme weather event, such as a flood or fire (see section 4.2). Some participants in our research suggested that food supply chains should be more decentralised, with a greater number of smaller distribution centres and processing facilities.

> *I would think as a result of [COVID-19], we would see probably smaller distribution centres with a bit of spare capacity. So whether it's a workforce shutdown, a pandemic, a bushfire, or whatever else, you've got multiple [nodes] that are carrying 10 per cent of volume each rather than two big nodes which are 50/50 and then one goes over and you're in a spot of bother.* **– Interview 16, Industry**

Greater decentralisation of food supply chains could have additional benefits. More food processing facilities could be located in regional areas, growing regional food economies. Less concentrated supply chains (see section 4.2) could also facilitate a fairer distribution of power across actors in the food system.

252 See https://about.openfoodnetwork.org.au/

253 Schultz, I., Freeman, C. Kelly, L. and Sheridan, J. (2021) *Recipes for resilience: The impacts of COVID-19 on values-based food supply networks in Australia and the sector's response.* Open Food Network Australia.

254 See https://movingfeast.net/

6.3.4. Collaboration and networks

Networks and collaborative relationships across food system stakeholders (industry, government and civil society) and within communities are central to resilience.[255] Existing relationships and trust between stakeholders can support a rapid response in the event of an emergency.

> *The point of these networks is that when you get a call in the middle of the night, it's from somebody that you know and trust…so, when you come together, there's not that necessary storming piece. You've already formed.* **– Interview 8, Government**

> *It's really important for us to foster collaboration and collaborative policy responses across organizations … shocks and stresses, especially to the food system, won't stop at municipal boundaries.* **– Interview 1, Government**

Some areas of Melbourne's city region which had put networks in place to respond to bushfire events were able to draw on those stakeholder networks to respond quickly to the impacts of the pandemic on food security.

Community networks, like neighbourhood mutual aid groups, were also important in promoting food security across Melbourne during the COVID-19 pandemic.[256] Self-governance at community level can build adaptive capacity by promoting local solutions.[257]

> *I think we're going to need to move to a place of local networks and network solutions and resilience systems, rather than try to go macro.* **– Interview 6, Civil society**

6.3.5. Transformation

The need for a transformation to sustainable, resilient, healthy and equitable food systems is widely recognised.[258] Food system shocks can create opportunities for transformative change.[259]

> *The tip of the iceberg is just getting by from cycle to cycle, from disaster to disaster and keeping your head above water. The next level down is systemic change, changing how you do things to better respond to be better prepared. Then there's a whole iceberg of transformational adaptation where you're fundamentally re-imagining your objectives in the first place…those sorts of really big questions, sometimes space is created for them off the back of a disaster.* **– Interview 19, Government**

Many interviewees in our research highlighted that the COVID-19 pandemic has created an opportunity to transform food systems in Australia. This significant shock to the food system has focused attention on the prevalence of food insecurity (see section 4.8), revealed vulnerabilities in supply chains (see section 4) and highlighted the need to increase the resilience of food systems. It has also demonstrated that rapid and meaningful change is possible.

255 Smith, K. and Lawrence, G. (2014) Flooding and food security: A case study of community resilience in Rockhampton. *Rural Society* 23 (3): 216-228.

256 Carey, R., Larsen, K., and Clarke, J. (2020) As above.

257 Schipanski, M., MacDonald, G., Rosenzweig, S., Chappell, J., Bennett, E., Bezner Kerr, R., Blesh, J., Crews, T., Drinkwater, L., Lundgren, J., and Schnarr, C. (2016) Realizing resilient food systems. *Bioscience* 66 (7); 600-610.

258 HLPE (2020) As above.

259 Prosperi, P., Allen, T., Cogill, B., Padilla, M. and Peri, I. (2016) Towards metrics of sustainable food systems: a review of the resilience and vulnerability literature. *Environmental Systems and Decisions* 36: 3-19.

I suppose for us COVID has had its positives. Now people can more relate…every man and woman can relate now to the issue of food insecurity because of COVID. **– Interview 9, Civil society**

People are making a lot of comparisons I think between the current pandemic and climate change, and really, I think what this has shown us is that big system, rapid, cross-portfolio change is possible. **– Interview 10, Government**

The COVID-19 pandemic has opened up a transformational moment with the potential for deep systemic change in food systems as in many other areas of our lives.

To me, it's one of these sort of periods in world history that's going to just completely change everything I think. **– Interview 27, Industry**

6.4. Strategies to build food system resilience

This section outlines seven strategies to build the resilience of Melbourne's food system to future shocks and stresses. There is uncertainty about which shocks and stresses the city will face and in what combination, so this section focuses on actions that will build the long-term resilience of the city's food system to a range of shocks and stresses.

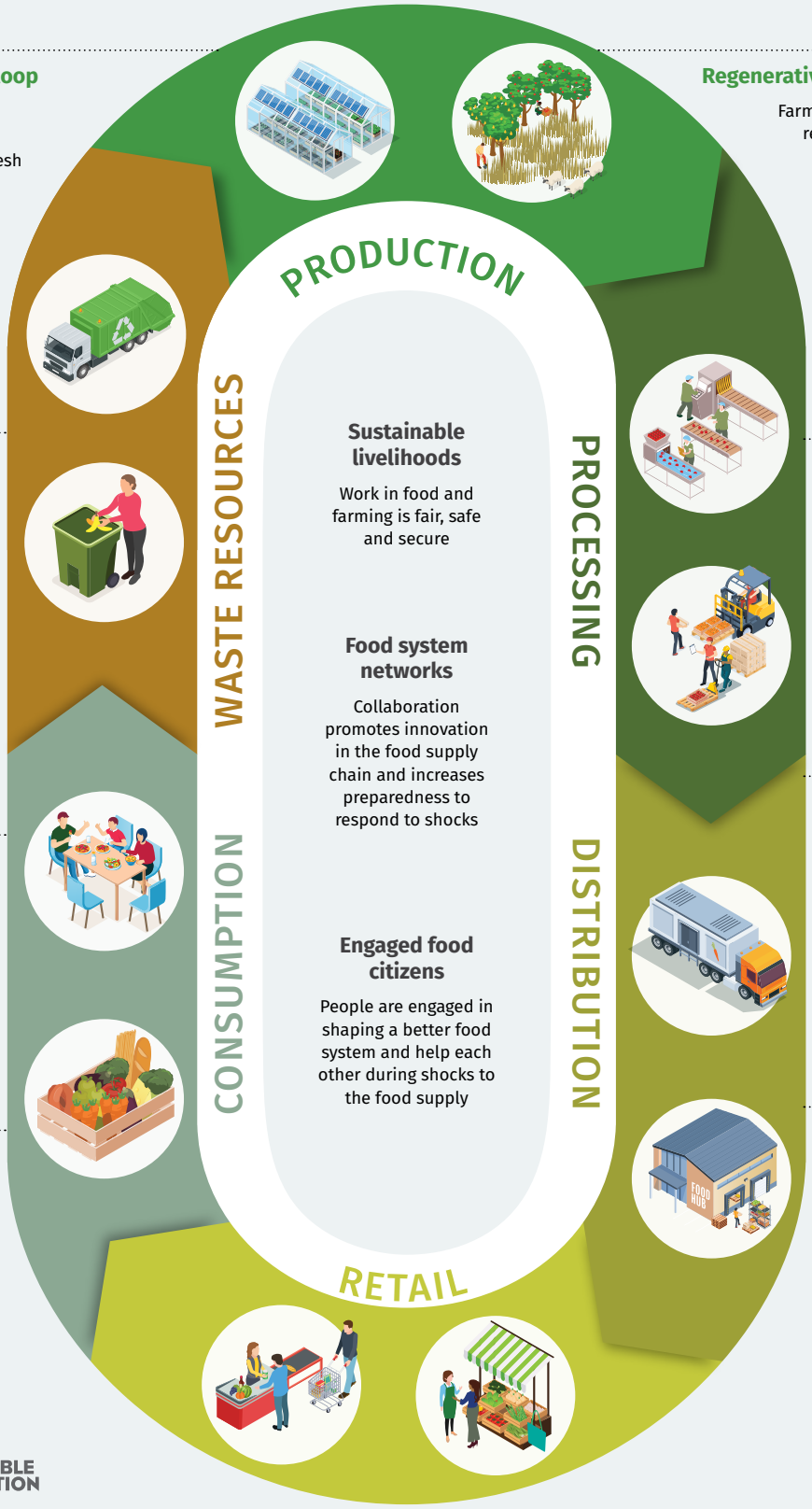
It considers strategies that will build the resilience of the food system to underlying ecosystem stresses (such as degradation of the natural resources and systems on which food production depends), as well as strategies that will build the resilience of the food system to sudden shocks related to climate change, pandemic or geopolitical shifts.

The strategies outlined in this section emerged from our research, which included a series of five co-design workshops with stakeholders (see section 1.4). Recommendations and actions related to these strategies are described in detail in a companion report, *Building the resilience of Melbourne's food system – a roadmap*.[260]

260 Carey, R., Murphy, M., Alexandra, L., Sheridan, J., Larsen, K. and McGill, E. (2022) *Building the resilience of Melbourne's food system – a roadmap*. University of Melbourne, Australia.

Resilient Food Supply Chain

Increasing the resilience of our food supply to shocks and stresses



Protected closed-loop agriculture

Climate-controlled production provides fresh food year round, using renewable energy, recycled nutrients and wastewater

Regenerative food production

Farmers produce food using regenerative approaches that build soils, store carbon and regenerate natural ecosystems

Circular food economy

Waste is prevented and recycled, and wastewater and organic waste are reused on farms

Decentralised food supply chains

Food processing, distribution and retail is spread across many locations and organisations

Ensuring the right to food

Governments ensure that all citizens can realise their human right to food

Local and regional food supply chains

Local food producers are connected directly to people and businesses through short supply chains

Equitable access to food

Everyone has access to a sustainable and healthy diet at all times

Diverse food supply chains

Food is supplied in diverse ways – from large *and small* farms, supermarkets *and farmers markets*, global *and local* supply

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Figure 16. A resilient food supply chain

6.4.1. Equitable access to nutritious food

Food system shocks have the greatest impacts on people who are already at risk of food insecurity. The COVID-19 pandemic led to rising food insecurity in Melbourne and Victoria, exacerbating an existing problem. The pandemic also revealed the inadequacies of the system of emergency food relief which aims to address the issue (see section 4.8).

Ensuring ongoing access to sufficient nutritious food for all is a basic goal of any food system, enshrined in target 2.1 of Sustainable Development Goal 2, Zero Hunger.[261]

> *By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.*

New approaches are needed to ensure adequate access to nutritious food for everyone in Melbourne's city region. Approaches should aim to ensure ongoing access to nutritious and culturally appropriate food in a dignified manner that meets people's human right to adequate food. Clear government responsibility should also be established in Victoria for ensuring the food security of citizens.

6.4.2. Regenerative and agroecological production systems

The underlying stresses on Melbourne's food system include the adverse impacts of intensive agriculture on the natural ecosystems that underpin food production (see section 2.7). These long-term stresses interact with other shocks and stresses related to climate change and high levels of food waste, magnifying their impacts (see section 2.8).

Diverse approaches to sustainable agriculture can enhance the resilience of food systems (also see section 6.3). Regenerative and agroecological approaches to food production work with natural ecosystems. They aim to eliminate the degradation of land and water systems that has been associated with conventional agriculture and to restore the natural ecosystems on which food production depends. They minimise the use of external inputs, such as synthetic fertilisers and pesticides, and focus on building soil organic matter, diversifying production and integrating livestock into mixed farming systems.[262,263,264]

The evidence base for regenerative and agroecological approaches to food production is still emerging in an Australian context. However, recent reports from the Intergovernmental Panel on Climate Change have highlighted the potential of these approaches to improve the resilience of agricultural systems[265] and to support food security and ecosystem services to food production.[266]

Policy support and funding is needed for Victorian farmers to adopt regenerative and agroecological farming approaches, including support to develop an evidence base for the approaches in a Victorian context. Funding and policy support is also needed for Victorian Traditional Owners to develop food and farming enterprises and to restore their knowledge and practices of traditional systems of food production. This includes access to land, resources and capital to support self-determination in establishing Indigenous-led food and farming enterprises and to restore their leadership of the Victorian native foods industry.

261 See https://www.un.org/sustainabledevelopment/hunger/

262 Schreefel, L., Schulte, R., de Boer, I., Schrijver, A. and van Zanten, H. (2020) Regenerative agriculture – the soil is the base. *Global Food Security* 26 100404;

263 Gosell, H., Gill, N. and Voyer, M. (2019) Transformational adaptation on the farm: processes of change and persistence in transitions to 'climate smart' regenerative agriculture. *Global Environmental Change* 59: 101965

264 Altieri, M. and Nicholls, C. (2020) Agroecology and the reconstruction of a post-COVID-19 agriculture. *The Journal of Peasant Studies* 47 (5): 881-898.

265 Olsson, L., H. Barbosa, S. Bhadwal, A. Cowie, K. Delusca, D. Flores-Renteria, K. Hermans, E. Jobbagy, W. Kurz, D. Li, D., Sonwa, L., Stringer, (2019): Land Degradation. In: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)].

266 IPCC (2022) As above.

6.4.3. Protected closed-loop and urban agriculture

Protected closed-loop and urban agriculture can build the resilience of city food systems as part of a diverse set of approaches to sustainable food production. Protected agriculture takes place in indoor environments (e.g. glasshouses and high tech vertical farms) where it is protected from pests, disease and climate extremes.[267] Protected agriculture systems can 'close the loop' by using recycled nutrients and energy as part of circular food economies (see section 4.7). Urban agriculture in and around cities includes growing fruit and vegetables and raising animals on urban farms, community gardens, vacant lots, backyards, verges, rooftops, and in high-yield protected cropping systems.[268] Increasing food growing in and around Melbourne could strengthen the resilience of the city's food system to disruptions in food supply.

Integrated policy frameworks are required to promote protected closed-loop and urban agriculture, including land use planning, water and energy policy. Investment is needed in infrastructure, technology and training to support these forms of agriculture. Underutilised public land and buildings in Melbourne's city region could be made available as sites for protected closed-loop and urban agriculture.

6.4.4. Circular food economies

Food systems are generally linear. They use limited natural resources to produce food and discard important nutrients, such as phosphorous and nitrogen, in disposing of food waste. This undermines the long-term resilience of food systems. Circular food economies design out waste and pollution and re-use natural resources efficiently, aiming to regenerate natural ecosystems.[269] Cities have advantages as places to build circular food economies. Melbourne generates large amounts of food and organic waste resources that can be processed into compost to build soils on nearby farms, recycling valuable nutrients. It also produces vast amounts of wastewater that can be recycled to grow food (see section 4.7).

Victoria has introduced a circular economies policy[270], but more support is required to develop a circular food economy. A 'joined up' policy approach is needed to promote the development of a circular food economy, including agriculture, energy, water and waste policy. Investment is needed in infrastructure to support circular food economies, such as infrastructure to deliver more recycled water to farmers. 'Fit for purpose' compost products also need to be developed that meet the requirements of farmers.

6.4.5. Local and regional food supply chains

Local and regional food supply chains are an important part of resilient food systems that draw on diverse sources of food – global, national and local. Regional food supply chains that connect local producers directly to consumers and businesses have fewer potential points for disruption and can act as a buffer when food supply routes into a city are disrupted by an extreme weather event, such as a flood or fire (see section 4.3). Strong local and regional food supply chains can also enhance resilience by increasing the diversity of food systems and by decentralising food systems (see sections 6.3.1 and 6.3.3).

Melbourne is surrounded by a highly productive foodbowl with long growing seasons that can support strong local and regional food supply chains. However, the primary policy focus in Victoria has been on food exports, and local and regional food systems have received little policy attention.[271] Greater investment is needed in local and regional food supply chains in Victoria. Investment is needed in regional infrastructure for local food processing and distribution, decentralised logistics and marketing schemes and provenance labelling to promote local and regional food products.

267 Future Food Systems (2021) Protected cropping: current technologies and target crops. Australian Government Department of Industry, Science, Energy and Resources. Available: https://www.futurefoodsystems.com.au/wp-content/uploads/2021/04/P2-004-Protected-cropping.pdf (accessed 31 March 2022).

268 Sarker, A., Bornman, J. and Marinova, D. (2019) A Framework for Integrating Agriculture in Urban Sustainability in Australia. *Urban Science* 3 (2): 50.

269 Ellen MacArthur Foundation (2019) *Cities and Circular Economy for Food,* Cowes, UK.

270 Department of Environment, Land, Water and Planning (2020) *Recycling Victoria. A new economy*. State of Victoria, Melbourne, Australia.

271 Carey, R., Larsen, K. and Sheridan, J. (2019) *Roadmap for a resilient and sustainable Melbourne foodbowl.* University of Melbourne.

6.4.6. Sustainable livelihoods

The resilience of Melbourne's food system depends on farmers and workers throughout the food system having secure and sustainable livelihoods. The COVID-19 pandemic highlighted how poor working conditions and insecure employment in the food and farming sectors reduce food system resilience (see section 4.6). To strengthen the resilience of food systems, farmers need to receive a farmgate price that supports a sustainable living, and food industry workers need a living wage and safe and secure working conditions.

Policy support for sustainable livelihoods in the food and farming sectors should include promoting compliance with fair and safe work conditions and providing adequate housing in regional areas. Social enterprises should be funded to provide training and employment services in food and farming, and new farmers should be supported with access to land, training and capital to overcome barriers to entering the industry.

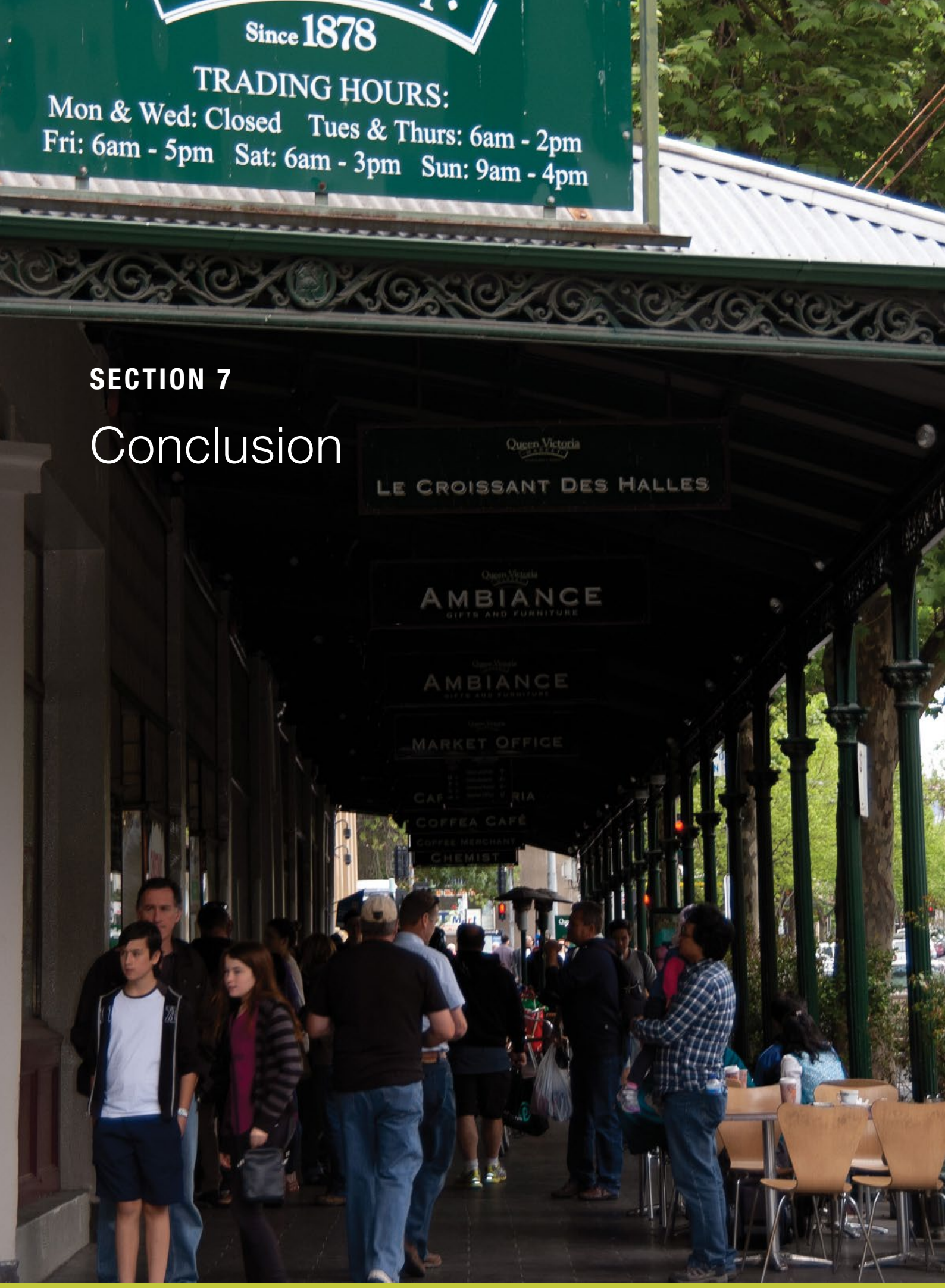
6.4.7. An integrated 'food systems' approach

The COVID-19 pandemic has created an opportunity to transform food systems so that they are resilient, sustainable, healthy and equitable. This will require an integrated 'food systems' approach that includes all relevant policy portfolios that influence the resilience of the food system (see section 5.2).

Food resilience planning should take place at all levels of government. This planning should aim to increase the resilience of food systems to shocks and stresses, with a focus on the food security of those who are most vulnerable to the impacts of shocks and stresses (see section 4.8). It should also aim to strengthen the stakeholder and community networks that promote food system resilience and to build the food literacy of Victorians, empowering them to shape their food system.

SECTION 7

Conclusion



Melbourne will face more frequent and severe shocks to its food system in future, particularly related to climate change. It will also experience the compounding impacts of multiple shocks and stresses co-occurring or following closely on each other. The impacts of these shocks and stresses will be felt throughout the food system from food production to consumption and the generation of waste. However, the greatest impacts will be felt by the people and communities who are most vulnerable and already at risk of food insecurity.

This research highlighted vulnerabilities in Melbourne's food system related to geographic and corporate concentration in the food industry and centralised food processing. It revealed vulnerabilities in centralised supermarket distribution centres, which are geographically concentrated in just a couple of areas of the city.

The 2019-2020 bushfires in south-east Victoria and the COVID-19 pandemic exposed vulnerabilities in long 'just in time' food supply chains and insecure employment across the food system from farming to retail. Large numbers of people lost their jobs and became food insecure, adding to the many Australians already experiencing food insecurity. The pandemic also revealed fragilities in systems of emergency food relief. As demand for food relief rose, food donations fell and the network of volunteers that underpins charitable food relief disappeared almost overnight. These vulnerabilities point to opportunities to build the resilience of Melbourne's food system to future shocks and stresses.

Resilient food systems are diverse in the geographic locations that food is sourced from - global, national, regional and local. They are also diverse in the scale of food and farming enterprises (small-medium scale as well as large) and the types of enterprises that supply food (social and community enterprises as well as commercial). Resilient food systems are adaptive and innovative with inbuilt contingencies so that if one part of the system is disrupted, another can fill the gap. Resilient food systems are decentralised to disperse risk and to build regional food economies. They are also underpinned by collaboration, trust and networks.

As the frequency and severity of shocks and stresses increases, there is a need for greater government leadership to build the resilience of Melbourne's food system. Food resilience planning is needed at all levels of government. It is uncertain which particular shocks and stresses Melbourne's food system will face in future and in what combination, so actions should focus on building the long-term resilience of the city's food system to any future shock or stress.

The COVID-19 pandemic has put food system resilience on the policy agenda. There are multiple potential co-benefits of food resilience planning, including synergies with many of the Sustainable Development Goals. The COVID-19 pandemic has also created an opportunity for a more significant transformation to resilient, sustainable, healthy and equitable food systems. This research provides a foundation for a roadmap towards a resilient, sustainable, healthy and equitable food system for Melbourne.[272]

272 Carey, R., Murphy, M., Alexandra, L., Sheridan, J., Larsen, K. and McGill, E. (2022) *Building the resilience of Melbourne's food system – a roadmap*. University of Melbourne, Australia.

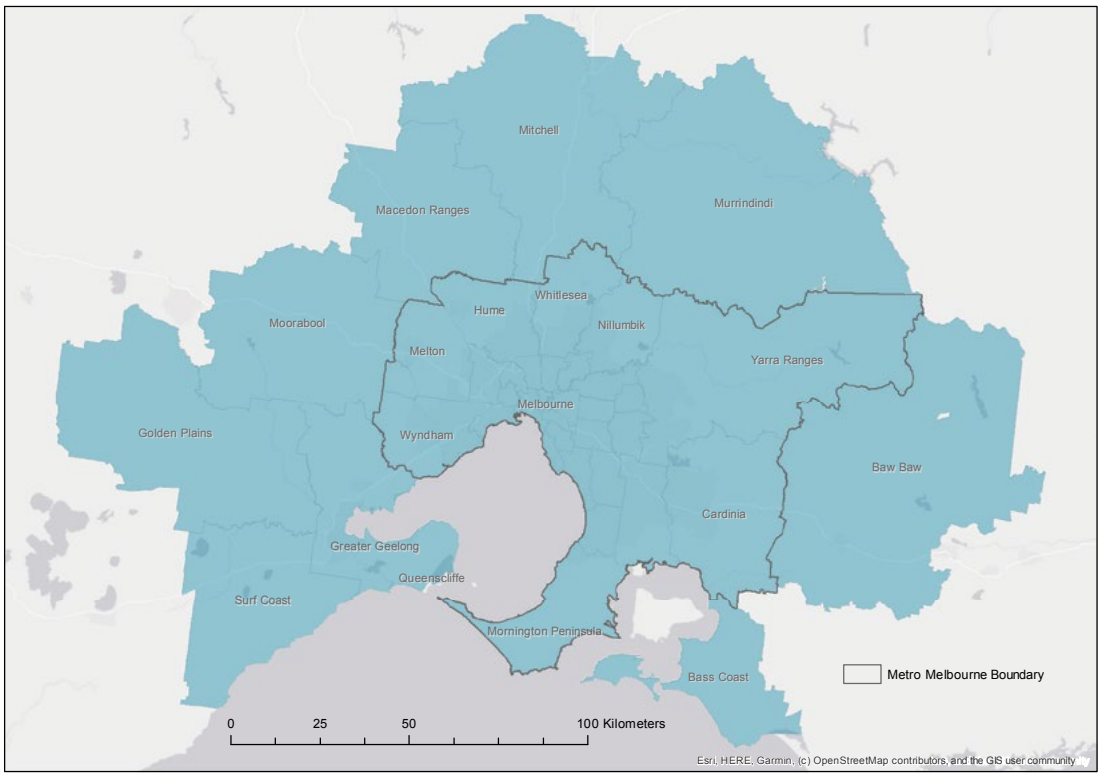
Appendix A

Local government areas included in Melbourne's city region

Melbourne's city region food comprises 40 local government areas of Greater Melbourne and the surrounding peri-urban areas within approximately 100 km of central Melbourne. The municipalities are:

Banyule City Council
Bass Coast Shire Council
Baw Baw Shire Council
Bayside City Council
City of Boroondara
Brimbank City Council
Cardinia Shire Council
City of Casey
City of Darebin
Frankston City Council
City of Greater Geelong
Glen Eira City Council
Golden Plains Shire Council
City of Greater Dandenong
Hobsons Bay City Council
Hume City Council
City of Kingston
Knox City Council
Macedon Ranges Shire Council
Manningham Council
Maribyrnong City Council
Maroondah City Council
City of Melbourne
City of Melton
Mitchell Shire Council
City of Monash
City of Moonee Valley
Moorabool Shire Council
Moreland City Council
Mornington Peninsula Shire
Murrindindi Shire Council
Nillumbik Shire Council
City of Port Phillip
Stonnington City Council
Surf Coast Shire
Whitehorse City Council
City of Whittlesea
Wyndham City
City of Yarra
Yarra Ranges Council

Map of Melbourne's city region



Appendix B

Foodprint Melbourne project partners

The Foodprint Melbourne project partners are:

University of Melbourne

Lord Mayor's Charitable Foundation

Cardinia Shire Council

City of Melbourne

City of Whittlesea

Interface Councils

Foodbank Victoria

Mornington Peninsula Shire

Moreland City Council

Open Food Network

Peri-urban Group of Rural Councils

Port Phillip and Westernport Catchment Management Authority

Victorian Council of Social Service

Wyndham City

LORD MAYOR'S CHARITABLE FOUNDATION

THE UNIVERSITY OF MELBOURNE