Australia's City Food Bowls: Fertile Ground for Investigating Biomes and Food Security

Rachel Carey
Lecturer, Faculty of Veterinary and Agricultural Sciences, The University of Melbourne
Email: rachel.carey@unimelb.edu.au

Jen Sheridan
Research Assistant, Victorian Eco-Innovation Lab, The University of Melbourne
Email: jennifer.sheridan@unimelb.edu.au

Abstract

Australia's major state capitals are surrounded by highly productive food bowls, which are an important source of fresh foods for their growing populations. These food producing biomes are a rich resource for investigating key themes related to Biomes and food security, one of two Year 9 units of study in the Australian Curriculum: Geography. This paper draws on case studies of Melbourne and Sydney to explore challenges to food production in Australia's city food bowls. These challenges include population growth, urban sprawl, water scarcity and the impacts of climate change. We explore the implications of these challenges for the food security of Australia's urban populations, and we highlight the potential for emerging research findings about the significance of these food producing biomes to engage students with key themes of the Year 9 Biomes and food security unit.

Introduction

Biomes and food security is one of two units of study in the Year 9 Australian Curriculum: Geography (ACARA, 2017). This unit investigates the role of biomes around the world in food and fibre production, examining their significance as sources of food, the challenges of increasing food production to feed a growing population, and the emerging environmental limits to food production. This unit offers the opportunity to explore a key global challenge, which is addressed in goal 2 (Zero Hunger) of the United Nations Sustainable Development Goals – how to feed a growing population equitably and in a way that increases the sustainability and resilience of the global systems that underpin food production (United Nations, 2015). Core themes in the Biomes and food security unit can be explored through a wide range of global food producing biomes, from the rice fields of South-East Asia to the rainforests of the Amazon. Yet closer to home, there is a group of significant, but underexplored, food producing biomes, which offers students the opportunity to explore key themes in the unit as they relate to their own lives and sources of food: the food bowls of Australia's major cities.

Each of Australia's major state capitals is surrounded by farmland on its peri-urban fringe (Carey et al., 2016). These city food bowls are some of the most highly productive agricultural regions in Australia (Houston, 2005), and are important sources of fresh foods, but the rapid growth of Australia's capital cities places them at risk as regions of food production (Sheridan et al., 2015). However, if these city food bowls could be retained as Australia's cities grow, they have the potential to increase the resilience and sustainability of the population's food supply in the face of growing challenges from climate change and declining supplies of the natural resources that underpin food production (Carey et al., 2015).

This paper will draw on case studies of Melbourne and Sydney's city food bowls, explored through the findings of the Foodprint Melbourne project (Carey et al., 2016) and the Sydney Food Futures project (Institute of Sustainable Futures, 2015), to illustrate how key themes of the Year 9 Biomes and food security unit can be explored through investigation of Australia's city food bowls. Table 1 summarises how the findings of the Foodprint Melbourne project map on to key themes of this unit.

Curriculum resources to support the Year 9 Biomes and food security unit, based on the Foodprint Melbourne project, are currently under development by researchers at the University of Melbourne and the Geography Teachers' Association of Victoria.

Australia's City Food Bowls as Food Producing Biomes

We think of rural and regional areas of Australia as the nation's main regions of food production, but Australia's city food bowls are also important food producing biomes. Australia's city food bowls are the peri-urban regions on the fringes of the major state capitals (Carey et al., 2016).

Table 1: The relevance of the Foodprint Melbourne project to the Year 9 Biomes and food security unit

Aspect of Biomes and food security unit	Relevance of the Foodprint Melbourne project to the Biomes and food security unit
ACHGK061 The human alteration of biomes to produce food, industrial materials and fibres, and the use of systems thinking to analyse the environmental effects of these alterations	• Explores city fringe food bowls as significant food producing biomes. • Identifies types and quantities of food produced in Melbourne's food bowl. • Provides short case studies about Brisbane and Sydney's food bowls. • For data about Sydney's food bowl, also see the findings of the *Sydney Food Futures* project (Institute of Sustainable Futures, 2015).
ACHGK062 Environmental, economic and technological factors that influence crop yields in Australia and across the world	• Identifies the importance of irrigation for food production in Melbourne's food bowl. • Estimates the economic contribution of agricultural production and related industries in Melbourne's food bowl. • Models the potential economic impact of urban sprawl on loss of production capacity in Melbourne's food bowl. • Identifies economic pressures faced by farmers in Melbourne's food bowl.
ACHGK063 Challenges to food production, including land and water degradation, shortage of fresh water, competing land uses, and climate change, for Australia and other areas of the world	• Identifies challenges to food production in Melbourne's city food bowl from land degradation, water scarcity and climate change. • Identifies competing land uses. • Models the amount of land and water required to feed Greater Melbourne. • Provides per capita estimates of the amount of land and water required to feed the average Australian (estimates for the average Melbournian are based on national data and have national relevance). • Provides per capita estimates of the average Australian land and water footprint due to meat consumption. • Provides per capita estimates of the greenhouse gas emissions associated with producing food for Greater Melbourne. • Estimates the environmental impact of introducing *meat free* days to our diet. • Highlights the significance of recycled water for food production on the city fringe during times of water scarcity.
ACHGK064 The capacity of the world's environments to sustainably feed the projected future global population	• Estimates the capacity of Melbourne's food bowl to feed Greater Melbourne's current population and a future population of seven million (for similar estimates for Sydney see Institute of Sustainable Futures, 2015). • Models the potential to reduce urban sprawl through alternative city growth scenarios (for similar estimates for Sydney see Institute of Sustainable Futures, 2015). • Estimates Melbourne's food waste footprint now and with a population of seven million. • Models the potential environmental impact of reducing food waste. • Models scenarios for increasing the resilience and sustainability of Melbourne's food bowl. • Presents a vision of a resilient city food bowl for Melbourne and identifies policy approaches to achieve this vision

There is no widely agreed definition of peri-urban regions, but they are commonly understood as the transition zones between urban and rural areas, and they include areas of agricultural land that are subject to urban pressures (Opitz et al., 2016).

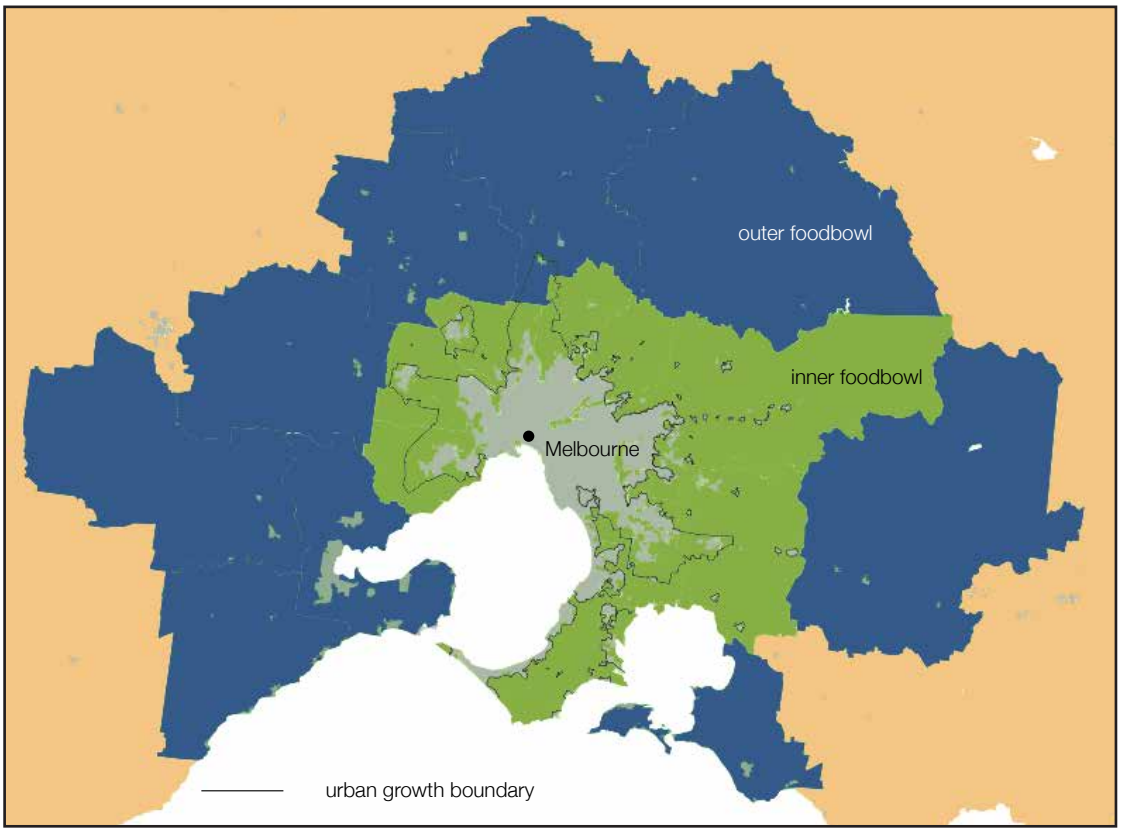
The fringes of cities around the world have historically been important to the production of fresh foods for their growing populations (Steel, 2009), and the food bowls of Australia's cities are still an important source of fresh foods. In 2010–2011, the peri-urban fringes of Australia's capital cities produced almost half of the nation's perishable vegetables, including broccoli, capsicum, cauliflower, coriander, herbs, lettuce, mushrooms and fresh tomatoes (Sinclair, 2015a), and they also produced a significant proportion of the nation's eggs and chicken meat (Sinclair 2015b). Emerging research has recently shed light on the significance of the food producing biomes around Melbourne (Sheridan et al., 2015) and Sydney (Institute of Sustainable Futures, 2015).

Melbourne's peri-urban food bowl (see figure 1) produces almost half of the vegetables grown in the state of Victoria, including around 66% of lettuce, 66% of broccoli and 92% of cauliflowers. It also produces over 80% of the state's chicken meat, 67% of eggs and 96% of the berries (Sheridan et al., 2015). Sydney's food bowl (see figure 2) produces a similar range of fresh foods, including 45% by value of vegetables produced in the state of New South Wales, around 45% of chicken meat and 50% of eggs (ABS, 2010). These are the types of fresh foods that gain most from being close to markets, sources of labour, and to processing and transportation infrastructure.

Capacity of Australia's City Food Bowls to Sustainably Feed City Populations

Research into the food bowls of Melbourne and Sydney has estimated the capacity of these food biomes to feed the cities' growing populations. Melbourne's food bowl currently produces enough food to meet around 41% of Greater Melbourne's food needs and around 82% of the city's vegetable needs (Sheridan et al., 2015), while Sydney's food bowl produces enough food to meet around 20% of that city's food needs, including 10% of its demand for vegetables and 40% of its demand for eggs (Institute of Sustainable Futures, 2015). It is unclear how much of the food produced in these city fringe food bowls is consumed in their respective cities, due to lack of data about food freight movements within and between the states. However, it is clear that the majority of the food needs of both cities are met from state, national and global sources of food outside of their city food bowl regions (Institute of Sustainable Futures, 2015; Sheridan

Figure 1: Melbourne's food bowl (source: Victorian Eco-Innovation Lab)



et al., 2015). It is also evident that the capacity of these city food bowls to sustainably feed their city populations is under pressure from a number of challenges that include population growth, climate change and water scarcity.

Challenges to Food Production in Australia's City Food Bowls

Population Growth

Australia's cities have some of the highest growth rates in the OECD (Department of Infrastructure and Regional Development, 2015). Melbourne is Australia's fastest growing city (ABS, 2016), and its current population of 4.5 million is expected to grow to a population of around seven or eight million by 2050 (Buxton, Phelan, & Hurley, 2015). By the time Melbourne reaches a population of seven million, it is likely to need around 60% more food than it does today. If the city continues to grow the way that it has in the past, with much of its growth on the city fringe at low rates of urban density, then by the time the city reaches a population of seven million, the capacity of its food bowl to feed the city could fall from 41% currently to around 18%, due to population growth and loss of farmland. The capacity of the food bowl to meet the city's vegetable needs is likely to be particularly affected, falling from 82% today to around 21%, as the majority of the vegetables grow in the inner food bowl close to the urban growth boundary (Sheridan et al., 2015).

Sydney is also experiencing rapid growth. If it continues on the path proposed in its current metropolitan plan (Department of Planning and Environment, 2014), then by 2031, the capacity of its food bowl to feed the city could reduce from 20% to just 6%, and it could lose over 90% of its remaining production of fresh vegetables and almost 90% of egg production (Institute of Sustainable Futures, 2015).

Loss of agricultural land around Australia's cities accelerated after the Second World War as a result of rapid population growth fuelled by post-war migration (ABS, 1996; James, 2016a). It is unclear exactly how much agricultural land has already been lost on the fringes of Australia's state capitals (James & O'Neill, 2016), but Ramsey and Gallegos (2011) estimate that the available area of fruit production around the cities of Sydney, Melbourne, Adelaide and Perth fell by between four and eleven per cent from 2000 to 2006, while the land available for vegetable production fell by around 14% in Perth and 28% in Brisbane over the same period.

The metropolitan plans and state planning policies governing land use around Australia's cities have failed to deal effectively with the ongoing loss of peri-urban farmland, although they have likely slowed the rate of loss (Buxton & Carey, 2014).

Figure 2: Sydney's food bowl (image courtesy of the Institute of Sustainable Futures)

It is becoming increasingly urgent, however, to develop more effective solutions to protect Australia's city food bowls, in order to address the growing challenges that food production faces from climate change, water scarcity and declining supplies of the natural resources that underpin food production, particularly fossil fuels.

Fossil Fuels

Fossil fuels underpin the entire food system to the extent that it is sometimes said that we "eat oil". They are a key source of nitrogen-based fertilisers, an input to pesticide manufacture, they fuel machines on farm, and provide the energy for manufacturing, cooling and transportation systems (Canning et al., 2017). As initiatives intensify to decouple the food system from its dependence on fossil fuels, alternative sources of energy and fertilisers will need to be found. City food bowls have access to a potential source of alternative fertilisers in the large amounts of organic waste and food waste generated by city populations. This waste could be processed into organic fertilisers for use on farm, and city food bowls could also play a role in reducing the energy demand for cooling and transportation by reducing the distance that highly perishable foods need to travel to market (Carey et al., 2016).

Climate Change

Climate change is likely to affect food production in Australia in multiple ways through impacts that include increasing temperatures, reduced water availability and more frequent and severe extreme weather events, such as heatwaves, droughts, storms and floods (Hughes et al., 2015). Climate change is also expected to reduce the yields of some food crops in Australia's major region of food production, the Murray-Darling Basin (Reisinger et al., 2014). Australia's city food bowls have the potential to increase the sustainability and resilience of the food system in the face of climate challenges by reducing the dependence of city populations on distant sources of food, so that local sources of fresh food are available if supplies from other regions are disrupted, or if major transportation routes into the city are cut off during extreme weather events (Carey et al., 2016). Retaining fresh food production around cities also enables waste water from city water treatment plants to be used to produce food. In a drying climate, recycled water from water treatment plants could become one of the most secure sources of water available for food production (Carey et al., 2015).

Water Scarcity

One of the main ways that climate change is likely to affect food production in southern Australia is through a reduction in the availability of water (Reisinger et al., 2014). The impacts of water scarcity on food production became evident during Australia's Millennium Drought (1996–2010), which led to significant reductions in agricultural production in the Murray-Darling Basin (ABS, 2014; Hughes et al., 2015), and sharp increases in food prices during the height of the drought, particularly for fresh fruit and vegetables. Between 2005 and 2007, food prices in Australia increased 12%, while the price of vegetables increased 33% and fruit prices rose 43% (Quiggin, 2007).

The importance of recycled water for food production became clear during the Millennium Drought, when some areas of food production around Melbourne and Adelaide became dependent on recycled water (Carey et al., 2016). Werribee Irrigation District is an area 30 kilometres to the West of Melbourne, which produces around 10% of Victoria's vegetables. At the height of the drought, producers in the region lost access to river water after river flows fell to unsustainable levels, and vegetable production in the district would have collapsed without access to recycled water from the nearby Western Treatment Plant (Sheridan et al., 2016). A relatively small amount of recycled water from Melbourne's two main water treatment plants is currently used for food production – just six per cent in 2014–2015 (Melbourne Water, 2015). Much of the recycled water from the water treatment plants is unused and disposed of at sea. Just 10% of the available recycled water would be enough to produce around half of the vegetables that Greater Melbourne eats (Carey et al., 2016). Expanding the use of recycled water to produce food in cities in southern Australia has the potential to increase the resilience of the food system to prolonged drought, but it would require greater investment in infrastructure to store recycled water outside the growing season and to deliver the water to farmers.

Economic Pressures

Australia's city food biomes make a valuable contribution to the regional economies of these cities. The peri-urban regions of Australia's five mainland states generate almost 25% of the gross value of agricultural production in those states from just three per cent of the agricultural land (Houston, 2005). Melbourne's food bowl has been estimated to contribute around $2.45 billion per annum to the city's regional economy and around 21,000 full time equivalent jobs (Deloitte Access Economics, 2016). However, the productive capacity and economic contribution of these regions is not only at risk from urban sprawl. It is also at risk from a combination of economic

pressures that undermines the viability of farming in these regions.

Farmers across Australia face ongoing challenges to farm viability from the rising costs of inputs (such as fuel, fertilisers and water) and from downward pressure on farmgate prices, particularly as a result of the growing power of the major supermarkets and competition from cheaper food imports (Carey et al., 2011; James, 2016b). The viability of farming in city food bowl regions is under added pressure from the high cost of land and property rates, and the difficulty of expanding farming operations in these regions to achieve economies of scale. Yet city food bowl regions also offer the potential for farmers to gain a greater share of the food dollar by selling direct to consumers and businesses in cities through farmers' markets, farmgate sales and other forms of direct marketing (Carey et al., 2016). Initiatives are needed to support city fringe farmers to gain access to local markets as part of planning for more sustainable and resilient city food bowls in Australia.

Planning Sustainable and Resilient City Food Bowls

The challenges faced by Australia's city food bowls raise fundamental questions about the future of these food biomes and the food security of urban populations. Could the way that we grow our cities alter these food biomes to the extent that we undermine the capacity for future generations to meet their own food needs? Will the populations of Australia's cities become dependent on more distant sources of food, and does this matter?

The capacity to source food from multiple sources – regional, national and global – is an important part of a resilient food supply. Indeed, as the case studies of Melbourne and Sydney illustrate, most of the food needs of these cities are met from outside their peri-urban regions. However, becoming entirely dependent on "somewhere else" to meet increasing deficits in fresh food supply is likely to become a risky strategy in future (Carey et al., 2016), because national and global food supplies are also under pressure from climate change and growing constraints on natural resources (Godfray et al., 2010; PMSEIC, 2010). As a result, global food supplies are likely to be subject to more frequent disruptions and greater volatility in food prices (UNEP Finance Initiative/Global Foodprint Network, 2016).

Retaining capacity for fresh food production close to cities is increasingly recognised as an important part of sustainable and resilient urban food systems (FAO/RUAF, 2015). However, if Australia's state capitals are to retain their city fringe food bowls as they grow, changes will be needed to metropolitan and state planning policy frameworks. Cities will need to plan for food as they plan for housing, transport and other basic needs. This is likely to require a range of measures that not only protect farmland on the peri-urban fringe, but encourage farmers to continue farming in these areas, and also harness the potential of city water and organic waste streams to increase the resilience of peri-urban farming to the growing environmental constraints on food production.

Conclusion

The food biomes of Australia's state capitals provide rich case studies for exploring the core themes of the Year 9 Biomes and food security unit. These significant regions of fresh food production have the capacity to make an important contribution to sustainably feeding Australia's city populations, yet they face a range of challenges that include population growth, urban sprawl, climate change and water scarcity. Study of these local food biomes offers an opportunity for students to connect to the core themes of this unit in a way that relates directly to their own lives. Moreover, investigation of these city food bowls also offers the potential for students to make a difference by contributing to increased public awareness of their significance, which may one day build the social and political licence for action to ensure their long-term protection.

Materials to support investigation of Australia's city food biomes within the Year 9 Biomes and food security unit will be available from the Foodprint Melbourne project at the University of Melbourne and the Geography Teachers' Association of Victoria at the start of the 2018 school year. The development of these resources has been supported through a grant from the Lord Mayor's Charitable Foundation. Reports, infographics and other resources from the Foodprint Melbourne project are available from http://research.unimelb.edu.au/foodprint-melbourne/school-resources/year-9-geography

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