

The Food Security of the Australian Capital Region

Rachael Wakefield-Rann and Robert Dyball

Fenner School of Environment and Society, The Australian National University

Abstract: Food security is becoming one of the most significant political, economic and environmental challenges faced by governments around the world. Despite Australia's wealth and abundant agricultural resources, this issue affects Australian cities. In order to develop effective strategies to decrease the vulnerability of Australian cities to food supply disturbances, the nature of food flows between cities and the agro-ecosystems upon which they depend must first be understood. Australia's urban populations tend to be affluent and have specific expectations regarding the types of food they believe should be available to them all year round. The corporations that supply these consumers draw on food sourced from remote agro-ecosystems with little regard for local or seasonal produce. The vulnerability of a city's food supply therefore no longer depends on local constraints affecting its immediate hinterlands, but on ecological and socio-political factors affecting the remote regions from which its food is sourced. Therefore, urban food security is largely contingent on the specific interrelationships, dependencies and constraints that have developed within the national and international food production system.

Through an examination of what is known about food flows in the Australian Capital Region, this paper argues that current ways of understanding and defining food security should be shifted and expanded to account for numerous factors that are presently neglected. This case study provides insights into the food security challenges that Australian cities may face and indicates a number of vulnerabilities associated with the current food supply system. Perhaps most importantly, it demonstrates that a comprehensive assessment of the food security of Australian cities cannot be made until identified data gaps have been filled.

Introduction

Food security has typically been framed as an issue that affects the rural poor in developing countries (Campbell 2009; Hoffman 2011). Although the literature has expanded somewhat to account for the food supply risks likely to affect the increasing urban populations in developing countries, and even the poorest members of wealthy nations, the scope and complexity of the issue is still largely unacknowledged.

The United Nations Food and Agriculture Organisation (FAO) defines Food Security as "...when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO 2006). However, given that consumers now source food globally and depend on agricultural systems worldwide, there are a number of other important factors that should be included in the criteria for assessing food security. These include regional food production capacity, the types and amounts of food imported and what is traded via exports. Moreover, increasing pressures on global primary food production, changes in diets, increasing population density in cities, and decreasing rural populations engaged in food production, will all impact how food is distributed and how much is available. Based on these broader criteria, cities that are currently considered to be food secure may still be vulnerable to a number of threats to their food supply.

With the exception of a few disadvantaged or marginalised groups, Australian cities are considered to be food secure according to the FAO definition. Australia produces enough food each year to feed 60 million people (National Food Plan 2013, p.7), and is the world's 16th largest food exporter (Rushdi 2012). Australia is listed as one of the world's top five countries for affordable food (Economist Intelligence Unit 2012), and for 90 per cent of Australians, food prices are within 10 per cent of those found in capital cities, meaning that people in remote areas generally have access to affordable food (BITRE unpublished). Taken together, these figures create an impression of invulnerability to food shortages.

However, Australia, and Australian cities in particular, are less food secure than these statements suggest. In order to highlight the shortcomings of the claims underpinning the argument that Australia is food secure, the first section of this paper will examine some of the key assumptions upon which these claims are based. The first is that the Australian population's nutritional requirements could be adequately met by the food currently produced in Australia. The second is the idea that the more places Australia sources its food from, the more food secure it is. The remainder of the paper will subsequently examine some of the issues that could potentially effect Australia's capacity to be food secure in the future. Finally, a case study of food flows in the Australian Capital Territory (ACT) is presented to emphasise some of the potential vulnerabilities associated with Australia's current food supply system, and the critical data gaps that must be filled in order to make a comprehensive assessment of a city's food security.

Determining Australia's future food security

Australia's capacity to produce enough food to feed 60million people has been used to support the claim that Australia is food secure. This argument is evident in Australia's National Food Plan, which claims that "Australia has a strong, safe and stable food system and high levels of food security. Every year Australian farmers and fishers produce enough food to feed around 60 million people—far more food than we consume" (National Food Plan 2013, p.7). However, Australia's capacity to produce this amount of food in calorific terms does not mean it has the capacity to meet the nutritional requirements for an adequate diet for that many people. Australia specialises in the production of specific types of food based on the history of its agricultural policies, international relations, availability of natural resources, and how they have been understood and valued, and other factors related to Australia's environment and development trajectory. This history has determined Australia's role in the current global food system and locked it into specific types of food production. Typically, production has been centred on undifferentiated bulk commodities, such as grains, meats and sugars, while higher value and luxury goods are imported. Consequently, Australia is a major exporter of wheat for example, yet it imports a considerable amount of the fresh and processed vegetables that enable the population to eat a nutritionally balanced diet (James 2012).

Australia's specialisation in these types of bulk commodities also has implications for the country's future food production capacity. At present, these products do not command high margins, meaning that increasingly more needs to be produced for the same return. The only way to do this is by increasing inputs, such as water and artificial nutrients. As a result, investment, and consequently risk, increases, perpetuating an unsustainable system based on high inputs and levels of resource extraction (Sustainability Institute 2003).

In addition to being locked into deteriorating terms of trade for these bulk commodities, the water and key nutrients required to produce them are being lost. Estimates from as long ago as 1983 showed that the Nitrogen, Phosphorous, and Potassium lost overseas in Australian wheat exports could not be recovered with the money from the sale of the wheat (Lipsett & Dann 1983). Thus, many Australian landscapes are simply drawing down their soil nutrient capital and exporting it. Furthermore, the pressure that food production places on landscapes should be calculated based on the gross amount that the landscape yields, not just the food products consumed. This means that the volumes of material being exported from productive landscapes are in excess of the reported figures for per capita consumption. Other materials include non-edible portions of both plant and animal products as well as edible material that is spoiled or lost before purchase, or purchased and not consumed. Key ecosystem services are also drawn upon for this gross volume of production, including water, nutrients and soil condition. Given the current pressure being put on Australian landscapes in terms of the total volume being extracted, it is unlikely that Australia will be able to maintain present levels of food production into the future without significantly increasing inputs (Deutsch et al, 2013).

Another common assumption underpinning food security claims is that more and stronger international trading relationships lead to greater food security. This is because strong trading relationships improve market access and the promotion of Australian interests overseas, and due to the idea underpinning the economic model of specialisation that if there is a disturbance in one location, food can still be sourced from others, ensuring continuity of food supply (Deutsch et al, 2013). The importance placed on strengthening and expanding trading networks for ensuring

Australia's future food security is evident in Section 3.2 of the National Food Plan, titled 'Building our food trade ties' (National Food Plan 2013). This model for ensuring food security in the future overlooks the considerable potential vulnerabilities associated with the complex and highly diversified system of accessing food that is currently dominant in Australian cities.

Due to their size, density and the productive capacity of their hinterlands, most cities in the world are dependent on external landscapes for their food. Prior to the development of complex food trading networks, and the technologies that enabled cities to develop, the size and complexity of urban areas were limited by the productivity of their surrounding landscapes (Boyden 1992). Various technological innovations gradually allowed cities to circumvent geographic constraints and expand, resulting in the modification of distant landscapes to provide specific types of food, the development of trade relationships, expanded food transport infrastructure, and the creation of other industries and services intended to ensure that there is a consistent inflow of food to urban populations. As a consequence, cities have become more dependent on complex food trading networks and distant productive landscapes over which they have no decision-making power or jurisdiction (Pinstrup-Anderson, 2009).

Like many wealthy urbanised countries, Australia's dependence on external food production systems is also linked to shifts in dietary preferences. Historically, urbanisation has generally correlated with a dietary shift away from a narrow range of starch-based staples to a broader range of food products, including meat, vegetables and a wide range of foreign and processed foodstuffs (Boyden 1992). This dietary transition has been enabled by the loosening of geographic restrictions on food production, in addition to increasing affluence, technological innovation and the expansion of trade networks (Cirera & Masset, 2010). The demand for more varied and high quality foods from within cities is, in turn, changing the way food systems make food available to urban populations. Locality and seasonality are consequently no longer the primary factors determining what food is available. Rather, price, preference, variety and convenience have become the dominant values driving demand (Boyden 1992). The normalisation of this dietary culture has reinforced Australia's dependency on food sourced from multiple sites across the continent and around the world.

Implications for the future of the Australian food system

Due to the complexity and high degree of interdependence that characterise current food production and distribution mechanisms, the ways in which these systems may change in the future are complex and largely unpredictable. However, there are some critically important factors which are likely to have an adverse effect on the food security of Australian cities, these include: global population growth; the depletion of arable land and fresh water sources; and climate change. The likely consequence of these probable future occurrences is that the global food system will be required to produce more food from fewer resources (Hoffman 2011). Moreover, increased production must occur in the context of global climatic change, meaning that food-producing landscapes are likely to be altered in many unpredictable ways. The ways in which these changes affect the external food producing landscapes which Australia relies upon for food imports represent future vulnerabilities for Australia's food supply, particularly if the nature of the food flows between Australia and such landscapes remains uninvestigated.

Australia's reliance on distant food producing landscapes also means that it has a significant dependency on fossil fuels. Because the way that food is sourced, processed, stored and distributed is primarily driven by economic expediency, food is often produced, processed, packaged and sold all in different locations, requiring a substantial amount of fuel (Ledgard et al 2011). This is problematic not only because fossil fuel use cannot continue indefinitely, but because it contributes significant amounts of greenhouse gasses (GHG) to the atmosphere.

The high GHG impact of Australia's most significant agricultural commodities, based on GHG flux calculations, is particularly problematic considering its pledge in the National Food Plan to produce food sustainably and assist other countries to build their capacity to cope with the disturbances likely to result from climate change. However, the strategies outlined in the plan to achieve this do not recognise the role of Australia's current approach to food production and sourcing in causing the problem. Rather, the Plan reduces Australia's food security responsibilities to four roles: providing technical and development assistance; reforming global markets and seizing the benefits of trade; helping with climate change and environmental degradation; helping in times of emergency (National Food Plan 2013). This framing indicates that the role of Australia is that of an external agent that will

help foreign populations adapt through the provision of aid and support to local initiatives. The impact of Australia's food consumption habits on the ability of other places to manage their resources sustainably, and GHGs emitted through food imports, are not acknowledged.

In addition to fossil fuel dependency, extensive national transport networks leave Australian cities dependent on events that can disrupt those networks, such as floods, transport disputes and blockades, and prolonged high fuel prices. Such events are not necessarily easily adapted to – for example where significant infrastructure, such as warehouses, abattoirs, mills and processing plants are located in just a few places. Furthermore, farmers that have specialised in one product, such as irrigated rice, potatoes or citrus fruits, cannot readily or rapidly convert to another product in response to changing local demand. Where Australian cities have become dependent on landscapes overseas, where they have no jurisdiction and where they have no authority over how that land is managed these vulnerabilities to disruption to national product supply are further compounded. Therefore, although the culinary needs and wants of affluent urban populations are largely being met at present, the food provisioning system that enables this will eventually be forced to change.

By investigating the nature of the food flows between cities and the agro-ecosystems that support them, avenues for systemic reform may be identified in advance. In order for this to be possible, the criteria used for assessing food security should be expanded and reframed to acknowledge how the interdependencies inherent in the global food system may cause future vulnerabilities. It is also critical that any new criteria accounts for significant regional variability, as the specific vulnerabilities and degree of resilience experienced by each city will be unique. Factors such as the ecological productivity of landscapes, transport infrastructure, ownership over and access to certain landscapes, the nature of interstate and international trade, what can be sustainably produced in each region, and other factors influencing regional land use planning all impact on food production potential, and play a role in determining how and from where a city sources its food.

The following overview of the food system in the ACT will be used as an example to analyse some of the dependencies that may exist for Australian cities, and indicate the types of data required to make such an assessment. Crucially, this case study reveals a number of knowledge gaps and demonstrates the importance of obtaining city specific data in order to conduct a comprehensive assessment of a city's food security. The parameters of this study and the data used are based on a project undertaken by the International Alliance of Research Universities on Global Food Flows and Urban Food Security (Deutsch et al 2009) and report compiled for the ACT Government on what is known about food production and consumption in the Territory (Turner et al 2012).

Case Study: Food in the ACT

Canberra is the largest city in the Australian Capital Region (ACR), an area encompassing the Australian Capital Territory and the surrounding 17 local government areas in the State of New South Wales (NSW), and covering 5.86M ha (Turner et al 2012). With a population of approximately 367,000, Canberra is Australia's largest inland city and eighth largest city overall.

In order to discover the external landscapes that the ACT population is dependant on it is necessary to obtain data related to: what is consumed and where it is purchased from; where the food is produced; how much regional demand is able to be met through regional production; how food is transported in and out of the ACT; and how much of the food produced in the ACT is actually consumed.

The following analysis provides an overview of what is currently known in each of these data categories, and how they are related to other significant variables and land use pressures that effect how food is and can be sourced in the region.

Food consumption

Due to a lack of research into the specific consumption habits of ACT residents, consumption data has been taken from national averages and divided by the ACT population. This is one of many areas

in which a lack of local data negates the specificity that can be achieved in the investigation of the city's dependencies on external landscapes and decision makers. The data collected at a national level does, however, provide an adequate amount of information to conduct a useful investigation into likely ACT consumption patterns.

The apparent consumption of 130 basic foodstuffs consumed by an average Australian resident was gathered at a national level by the ABS up until 1998-99 (ABS, 2000). Despite the discontinuation of the data set, the ABS did generate an update providing trend estimates up to 2010. This update suggests that there have not been significant changes in the per capita consumption of key food products and is therefore still potentially useful (Espinal & Innes-Hughes 2010).

Based on these statistics, Table 1 presents some of the main classes of food products consumed at a national level that are assumed to be consumed at equivalent rates in the ACT. It shows the total per capita volume of each product type consumed in 1998-99. The population of the ACT is taken to be 1.6% of the national figure of 22,620,554 when this data was collected (Turner et al 2012).

Main Product Class	Sub-category	Volumes p/c ^{yr}	Indicative total annual ACT consumption (tonnes)
Dairy Products	Butter	2.9kg	1060
	Margarine (table)	4.5kg	1644
	Cheese	10.7kg	3910
	Whole and skim milk powder	2.7kg	987
	Drinking milk	102.4L	37,419,000L
Meat and meat products	Beef and veal	36.4kg	13301
	Lamb and mutton	16.3kg	5956
	Pig meat (including bacon and ham)	28.3kg	10341
	Poultry meat	30.8kg	11255
Cane Sugars	As refined sugar	8.8kg~	3216
	In manufactured foods	33.9kg~	12388
Fresh Fruit (include fruit for fruit juice)	Citrus	56.4kg	20609
	Other	55.4kg	20244
Vegetables	Potatoes	68.0kg	24849
	Other root and bulb vegetables	24.4kg	8916
	Tomatoes	24.9kg	9099
	Leafy and green vegetables	20.6kg	7528
	Other vegetables	25.1	9172
Eggs and egg product		137 (equivalent number)	4,171,890 (dozen)
Grain Products	Wheaten flour (excluding bread)	16.3kg	5956
	Breakfast foods	7.9kg	2887
	Table rice	7.1kg	2594
	Bread	53.4kg	19513
Nuts	Peanuts	2.3kg	840
	Tree nuts	4.8	1754

Table 1: Consumption ~Figure is for 1988-89 due to unavailability of more recent data

Food purchasing

In terms of where food is purchased, ACT residents have access to the major national grocery retailers, including Coles, Woolworths, Aussie Farmers Direct and IGA, in addition to a number of alternative retail outlets, such as a regional farmers market and two farmers outlet stores. However, Coles and Woolworths account for over 70 per cent of all grocery sales in Australia (DAFF 2011), so it could be assumed that the majority of food consumed in the ACT is from these retailers.

Because the majority of food purchases made in the ACT are from Coles and Woolworths the precise origin of most food products is unable to be determined. This is because it is unknown how these companies currently maintain their inventories and there is no requirement for them to disclose where they purchase their products.

It might be assumed that a large percentage of produce arrives from its nearest central dispatching point (Turner et al 2012). However, there are a range of central corporate decisions concerning work load distribution, efficiencies and capacities of systems, and contractual arrangements that would also influence where products are sourced, processed and distributed (Delforce et al 2005). This means that a significant percentage of food consumed in the ACT may travel to various locations along the supply chain.

Moreover, demand for high product diversity and seasonal consistency mean that products are sourced from wherever in the world is most economically expedient. The key priorities influencing how and where Coles and Woolworths source their products are cost reduction, increased demand for wholesale and retail services, and maximisation shareholder values (Delforce et al 2005). These goals are largely determined by what is required to be competitive in an increasingly interdependent international food market. The complexity of global food supply chains and the pressures they generate must consequently be acknowledged in any assessment of Australia's food security and the options for reforming the food system.

Food production capacity

In order to determine the extent to which the city is dependent on external, and particularly international, landscapes for food, it is necessary to assess what can be produced and processed within the region, and whether this could provide a nutritionally adequate diet year round.

The 2011-12 Agricultural Commodities survey for the ACT recorded 58,286 hectares of agricultural land holding in the ACT and approximately 75 agricultural businesses (ABS 2012). However, based on the data that is currently available from the ABS, ABARES and the ACT government, it is not possible to specify the exact amount of food produced in the ACT, either from commercial and community agricultural production or processed food products (Turner et al 2012).

There is still insufficient data when the analysis is extended to examine the whole ACR. However, it is clear that agricultural land use is dominated by grazing sheep and cattle on relatively un-improved grasslands, most of which could not be put into alternative food production without significant human inputs, including water (Deutsch et al 2009).

Table 1 presents consumption figures for 10 key commodities consumed in Australia compared to the most applicable ACR production figures. These commodities account for over 85% of ACR agricultural land use by area and therefore fairly accurately represent the ACR's productive capacity (Turner et al 2012). The most recent period for which matching statistics for consumption and production could be found was the year 2000.

Product	ACR Production (Tonnes)	ACR Crude Consumption	ACR Production to ACR Consumption %
Apples	20,525	9,780	210%
Beef	36,576	18,384	199%
Cheese	12,000	5,922	203%
Chicken meat	5,607	19,874	28%
Grapes	5,893	29,213	20%
Wine	4,717	19,616	24%
Lettuce	109	4,336	3%
Milk - fresh	17,000	52,864	32%
Milk -all dairy	142,816	161,198	89%
Oranges	486	18,447	3%
Potatoes	544	34,221	2%
Rice	-	23,678	0%
Sheep meat	30,061	7,033	427%
Wheat	273,896	251,110	109%
Pork	13,656	12,987	105%

Table 2: Production to Consumption

*Data from Agstat 2005/2006

Table 2 demonstrates that the ACR could be self-sufficient in a number of food products. However, the products able to be produced in the ACT do not necessarily correspond with consumer demand.

For example, the data shows that the ACR could currently be self-sufficient in beef, lamb, and cheese. However, time-series analysis shows that these meats are declining in popularity in favour of meats such as pork and chicken, which are not grown locally, are typically intensively farmed, and require imported grain (Deutsch 2009; Turner et al 2012).

These figures also indicate that the ACR could be self-sufficient in fruit, but again, this would require a shift in consumption preferences away from imported exotics, such as bananas, to fruits such as apples and plums that readily grow in the region.

There are also a number of foodstuffs that are commonly consumed in the ACR that cannot grow in the region, or which could only grow there under highly artificial conditions. These include rice, most citrus, tea and coffee.

Moreover, there are a number of foodstuffs that were previously produced in the region but are now sourced elsewhere for economic reasons. For example, the ACT was previously more self-sufficient in potatoes, however the majority are now imported from other parts of Australia (Turner et al 2012).

The capacity of the region to produce such products again will depend on how land use has changed and the forms of alternative food production that can be implemented sustainably.

These findings suggest that although the localisation of food production represents a sustainable option in the categories of products that grow well in the region, other food products which make up a large percentage of average diets cannot be grown without a significant amount of inputs. In these

cases, local does not equate to sustainable and secure, highlighting the need to investigate dietary cultures, as well as the region's productive capacity, when attempting to determine a city's vulnerabilities and potential avenues for change towards more sustainable food sourcing options.

Other influences on food production and consumption

Aside from biophysical constraints and dietary cultures, alternative land use priorities also influence the productive capacity of the region. Of particular concern is the encroachment of urban development on potential sites for food production in urban and peri-urban areas. Over the period for 2011, 72% of residential development occurred in greenfield sites, with a projection for the 2011-2015 period of 55% of these developments occurring on greenfield land (Turner et al 2012). The Australian Institute of Architects ACT chapter's has stated that the loss of the most fertile agricultural land in the region is "a threat to Australia's capacity to feed ourselves" (Parker 2007). Therefore, prospective land use planning for food production must be assessed with respect to other land use values and pressures that will influence what land is actually available.

In addition to production restrictions, the ACT has limited infrastructure for processing food within its borders (Turner et al 2012). For some products, social and economic considerations largely determine whether production and processing occurs in the ACT. For example, the ACT now has no capacity for commercial processing of animals due to the closure of abattoirs. Similarly, dairying was previously a significant activity in Canberra, however there is now no commercial dairy produced in the Territory.

The lack of processing facilities in the region means that food produced in the region often still needs to be transported elsewhere for processing. This is the case for wheat. Around two-thirds of the flour that becomes bread for Canberra consumers is baked in the capital after having been grown in country NSW and milled in Sydney (Turner et al 2012).

Food Transport

The majority of the food consumed by ACT residents is transported on trucks via four main access roads (Turner et al 2012). This means that future road blockages and the rising cost of oil could potentially disrupt the ACT's food. In order to assess viable transport alternatives, it is necessary to know more about what food is being transported in and out of the ACT.

Food waste

The food consumption figures present refer to apparent consumption, that is, the amount that is purchased and therefore assumed to be consumed. This does not account for the amount of food wasted post-purchase. By reducing the amount of food wasted significantly less food would need to be produced. It is estimated that up to 50% of food produced, and 25% of food purchased in supermarkets, is wasted (Baker et al 2009). This translates to \$5-7.8 billion worth of food each year (Baker et al 2009). Although the exact reasons why the ACT is the most wasteful state are unknown, a likely reason is that Canberra's relatively high average household income means that people can afford to waste more food (Pearson et al 2013).

Conclusions and further research directions

This study has identified a number of significant knowledge gaps that must be addressed in order for a comprehensive understanding of the food security of Australian cities to be realised. These gaps are summarised in five points below:

First, the expectations, preferences and habits of consumers in each city significantly influence what food is made available, when, and for what price. It is therefore important to analyse what foods people are eating and where they are purchasing them.

It would also be beneficial to gather qualitative data on if and how consumers in each city would be willing to alter their food choices based on sustainability considerations.

Second, the highly concentrated and globally integrated system of food retailing in Australia, and the difficulty this creates for tracing the origins of foods products, creates significant challenges in terms of investigating the external ecosystems from which food is sourced. Greater transparency in food

sourcing and distribution channels will consequently be essential if holistic assessments are to be made of each city's food security.

Third, current forms of food production and the potential food production capacity of the region immediately surrounding a city provides important insights into what could be sourced regionally if food supply disturbances did occur.

As the ACT case demonstrated, assessments of the productive capacity of landscapes must account for other land use pressures that could prevent productive land being used for food production.

In addition, as a food exporting nation Australia has committed to supplying food to other nations. It is therefore important to assess the percentage of production in each region that is being exported and the potential implications these dependent populations if food exports changed.

Fourth, once information on each city's food dependencies has been obtained, it will be necessary to predict how these cities could potentially be impacted by climatic changes and limited fuel access. This includes changes related to the agricultural systems from which food is sourced, in addition to the shifting needs of the populations in those places and how their populations are likely to be affected.

Fifth, the amount of food required by each city could be dramatically decreased if avoidable food waste was reduced. It is therefore important to investigate the context specific drivers of food waste all the way along the food supply chain and post-purchase.

The identification of these data gaps provides a starting point for future research into the development of a broader, more encompassing understanding of urban food security that accounts for the interdependencies, vulnerabilities and complexities inherent in the current global food system.

References

- ABS (2012) '71210DO001. Agricultural Commodities, Australia 2010-11' Australian Bureau of Statistics., Canberra.
- Adler, Paul R, Grosso, Stephen J Del and Parton, William J (2007) 'Life-cycle assessment of net greenhouse-gas flux for bioenergy cropping systems', *Ecological Applications* 17:3, 675-691.
- Baker, David, Fear, Josh and Denniss, Richard (2009) 'What a waste-An analysis of household expenditure on food', *Policy Brief No 6*, 2009.
- BITRE (2009) 'Spatial patterns of household living costs: retail' Bureau of Infrastructure, Transport and Regional Economics, Canberra.
- Boyden, Stephen (1992) *Biohistory: the interplay between human society and the biosphere, past and present*, Unesco.
- Campbell, Bruce M (2009) 'Beyond Copenhagen: REDD+, agriculture, adaptation strategies and poverty', *Global Environmental Change* 19:4, 397-399.
- Cirera, Xavier and Masset, Edoardo (2010) 'Income distribution trends and future food demand', *Philosophical Transactions of the Royal Society B: Biological Sciences* 365:1554, 2821-2834.
- DAFF (2011) 'Australian food statistics 2009-10' Department of Agriculture Fisheries and Forestry, Canberra.
- Delforce, Robert, Dickson, Andrew and Hogan, John (2005) 'Australia's food industry', *Australian Commodities* 12:2, 379-390.
- Deutsch, Lisa, Dumaresq, D, Dyball, R, Matsuda, H, Porter, J, Reenberg, A and Takeuchi, K (2009) 'Global food flows and urban food security: Case studies from three IARU cities', in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 512004.
- Deutsch, Lisa, Dyball, R, and Steffen, W (2013) 'Feeding Cities: Food Security and Ecosystem Support in an Urbanizing World' in *Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities*, Springer Netherlands, 505-537
- Dey, Christopher (2010) *The 2008-09 Ecological Footprint of the Population of the Australian Capital Territory*, Integrated Sustainability Analysis Research Group, The University of Sydney.
- Economist Intelligence Unit (2012) 'Global Food Security Index 2012' foodsecurityindex.eiu.com [2013, 11 July]

- Espinal, P; Innes-Hughes, C (2010) *Apparent consumption of selected foods and household expenditure.*, PANORG, Sydney.
- FAO (2006) 'Food Security: Policy Brief' ftp://ftp.fao.org/es/ESA/policybriefs/pb_02.pdf [United Nations Food and Agriculture Organization]
- Hoffmann, Ulrich (2011) 'Assuring food security in developing countries under the challenges of climate change: Key trade and development issues of a fundamental transformation of agriculture', in, United Nations Conference on Trade and Development.
- James, Ian (2012) 'A discussion paper on vegetable import data and the implications for the Australian vegetable industry' <http://ausveg.businesscatalyst.com/resources/VegImportDataImplicationsDec2012.pdf> [2013, 13 July, AusVeg]
- Ledgard, Stewart F, Lieffering, Mark, Coup, Dan and O'Brien, Ben (2011) 'Carbon footprinting of New Zealand lamb from the perspective of an exporting nation', *Animal frontiers* 1:1, 40-45.
- Lipsett, J and Dann, PR (1983) 'Wheat: Australia's hidden mineral export', *Journal of the Australian Institute of Agricultural Science* 48, 81-89.
- National Farmers Federation (2012) 'Farm Facts 2012' National Farmers Federation <http://www.nff.org.au/farm-facts.html>
- Parker, Frances (2007) 'Making periurban farmers on the fringe matter', in *State of Australian Cities Conference, Adelaide, November, 28, 2007*.
- Pearson, David; Minehan, Michelle; Wakefield-Rann, Rachael (2013) 'Food waste in Australian households: Why does it occur?', *Locale: The Australasian-Pacific Journal of Regional Food Studies* In press.
- Pinstrup-Andersen, Per (2009) 'Food security: definition and measurement', *Food Security* 1:1, 5-7.
- Rushdi, Lisa (2012) 'Australian government report highlights Australian capabilities in global food crisis' <http://www.ausfoodnews.com.au/2012/07/19/australian-government-report-highlights-australian-capabilities-in-global-food-crisis.html> [2013, 11 June]
- Ryan, Sarah (2011) *Buying Choices for a More Sustainable Canberra*, ACT Commissioner for Sustainability and the Environment.
- Sustainability Institute (2003) 'Commodity Systems Challenges: Moving sustainability in to the mainstream of natural resource economics' Sustainability Institute, Hartland VT.
- Turner, Bethaney, Pearson, David and Dyball, Robert (2012) 'Food in the ACT: a preliminary study of issues for the ACT Government Environment and Sustainable Development Directorate' University of Canberra and Australian National University Canberra.