

In 30 years, how might climate change affect what Australians eat and drink?

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Abstract

In this article, we analyse the current Australian diet and discuss how climate change might influence the foods we eat and consumer behaviour in coming decades. As climate change proceeds, one likely outcome is that key Australian agricultural regions will experience warmer, drier conditions with more frequent and intense drought and extreme events. These conditions will place pressure on Australia's ability to maintain the quality and quantity of the food it now produces. Amongst other pressures, reduced agricultural supply may contribute to higher prices for grains, red meat, fresh fruit and vegetables; reduced quality of produce due to an increase in pests and disease; and for water, increased costs of treatment. The risks from changes to diet correlate with socioeconomic disadvantage. Wealthier groups tend to spend more on quality produce. For most Australians, but particularly those that are vulnerable and food insecure, increased prices will lead to the consumption of cheaper and lower quality foods, changing diet composition away from healthy options, and exacerbating health issues. The interplay between climate, agriculture, economics and human health is complex. To improve, or even maintain, the health of Australians will likely cost more in the future for individuals and for our health system. Now is the time to explore and better understand these relationships in order to prepare for the near future.

Introduction

Availability and access to high quality fresh food and safe drinking water in Australia will be challenged in coming decades as climate change continues (Karoly et al., 2015). In this article we bring together experts in climate, agriculture, and health to explore what this means for the Australian diet. We argue that for the wealthy, choices in diet may be morally driven by attempts to reduce carbon emissions or willingness to pay more for higher quality and scarcer foods. We will also discuss how communities that are marginalised socially and economically may feel greater pressure from increased costs of water, quality

fruit, vegetables and meat with decreased water and reduced agricultural productivity.

Food security and health are already a significant concern for Australia's socioeconomically disadvantaged groups, such as Indigenous, homeless, unemployed, aged and disabled groups (Rosier, 2011). Food insecurity occurs whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable food in socially acceptable ways is limited or uncertain (Radimer, 2002). At any one time, around five percent of Australians are food insecure and around 40 percent of these are severely food insecure (Temple, 2008). Even for those not under threat of food insecurity, experience shows that when food prices rise, people will adjust their diet based on both availability and affordability, to lower quality food (Lake, 2012).

Anthropogenic (human-induced) climate change has been declared "unequivocal" and climate change will persist for centuries even if we substantially reduced greenhouse gas emissions today (IPCC, 2013). Across Australia's key food producing regions, extreme events may become more frequent, water will likely become scarcer and temperatures higher (CSIRO and BoM, 2015), changing the price, quality and quantity of food that is able to be supplied to the nation and the rest of the globe (Reisinger et al., 2014). Therefore it is critical to think about, and prepare for, the potential impacts of climate change on the Australian diet.

Here we explore how climate change may affect the typical Australian diet, and consider its potential to increase nutritional disparities associated with social disadvantage. We assess the components of the current contemporary Australian diet and discuss how the pressures of climate change may affect each components' availability, cost, access, and hence consumption. While the interplay between climate, agriculture, economics and human health is complex, now is the time to explore and better understand these relationships in order to prepare for the coming decades.

Breakfast	Wheat-based cereal, banana and milk with sugar
	White bread toasted with butter. Glass of orange juice
	Mug of tea or coffee
Lunch	
Weekdays	Sandwich on white bread with margarine. Chicken and salad Ham and cheese
Weekends	Meat pie and tomato sauce Can of soft drink
Dinner	
Weekdays	Lasagne with green salad, avocado and dressing Roast beef with mashed potatoes, frozen peas and corn.
Weekends	Burger and chips Pizza Glass of wine or beer
Snacks	Sweet biscuits with a tea or coffee Plain cake Savoury biscuits with cheese Milk chocolate Almonds Apple Orange

Table 1: Typical Australian diet in 2011–12. Meals derived from the Australian Bureau of Statistics Health Survey (2014)¹ which indicated the most popular foods in the Australian diet. This diet was derived purely to be indicative of the typical meals that might be eaten by an Australian adult and is not intended to represent a “healthy” diet.

The Australian diet

Australia is a multicultural society which is reflected in the large array of foods we eat, although a “typical” Australian diet remains firmly rooted in western Europe, as shown by the recent Australian Health Survey¹ conducted by the Australian Bureau of Statistics on our eating and drinking patterns. By analysing consumption patterns, we have distilled this information down into a few popular and typical meals eaten in Australia (see Table 1). For the purposes of discussion, this table was generated as a broad representation of the food types that are most commonly eaten as determined by the Australian Health Survey.

It is important to note that this diet does not represent all Australians and the food we eat is often dependant on socioeconomic and cultural factors. The impact of change in food prices and availability will affect socioeconomic groups differently (Figure 1). In this discussion we focus on the “typical” Australian family (outlined in Table 1) whose food choices in relation to healthy eating are often influenced by time available to prepare food, perceptions of a healthy diet, relative cost of fresh foods compared to processed foods (cheap calories), lack of awareness on how to prepare fresh food, locations of fast food restaurants in outer suburbs, and lack of public transport.

At the wealthier end of the scale, people have the capacity to spend more on food. While increasing food prices will have less influence on this group, there will be pressure to consume a less greenhouse intensive diet (McMichael et al., 2007). Such a diet would lead to a lower consumption of red meat and dairy products that could also have a beneficial effect on cardiovascular health (Westhoek et al., 2014).

Potential effects of climate change on food production

Australia, with its large, export-oriented agricultural sector, is already experiencing the impacts of climate change, over and above its natural variability and predisposition to extended drought (Turrall, Burke and Faures, 2011). There is still much uncertainty around how the climate will evolve and further research needs to be done so we can adapt in the most effective and efficient manner. Early indications, however, suggest that continued warming across the country is expected over this century with an increase of 0.6 to 1.3°C by 2030 (CSIRO and BoM, 2015) relative to the base period of 1986–2005. Hotter days, more frequent heat waves and fewer summer frosts are projected for many regions. The nature, timing and reliability of rainfall and water supply for irrigation is critical for food crop production (Turrall et al., 2011). Changes to intensity and frequency of extreme events (floods and heat waves) can have sudden and disastrous impacts on entire crops as well as on drinking water (Bambrick and Burton, 2012). Heavy rainfall events are expected to become more frequent in the tropical regions and east coast. More frequent and intense droughts, and associated bushfires are predicted for the south, putting pressure on water resources, particularly in the ‘food bowl’ of Australia—the Murray-Darling Basin (see review in Karoly et al., 2015)

1. Grains and pulses

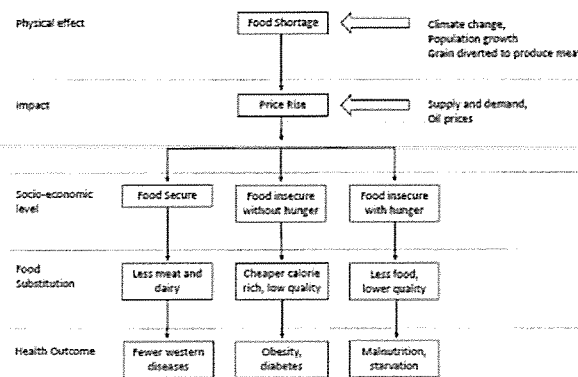
Wheat is one of the major components of the Australian diet. It is present in our breakfast cereals, our breads and our snack food. To a lesser extent, our diet includes other grains such as barley, corn, canola, pulses and rice. Cropping of wheat and other grains is the major agricultural activity² in Australia occurring over some 24 million hectares in an arc around eastern, southern and western Australia (Howden et al., 2010).

Wheat production is highly sensitive to climate variations with higher temperatures leading to lower yields (White and Edwards, 2007). Irrigation for crops of wheat, barley, corn, and rice can be exposed to climate risks through reduced rainfall and reduction in water allocations during prolonged dry periods. With a projected drier and warmer climate into 2030 and beyond, the dry margins of the cropping boundary are estimated to be shifting southwards and likely to constrict the grain belt area (Nidumolu et al., 2012).

¹ <http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4364.0.55.0.07main+features12011-12>

² <http://www.grdc.com.au/About-Us/Our-Grains-Industry>

Figure 1: Climate change impacts on food supply may result in price rises and food substitution with varying outcomes for different socio-economic groups.



Growth of these crops is expected to benefit from increased atmospheric carbon dioxide (CO₂) levels. However, this growth can come at the cost of decreased protein levels and micronutrients (Müller et al., 2014), thus reducing the minerals in the typical Australian diet. Increased CO₂ may also encourage growth of weeds that reduce crop yields (Fuhrer, 2003).

One potential benefit of the drier climate is a reduction in natural habitats for insect pests that migrate into crops (Hoffmann et al., 2008). In contrast, elevated temperatures may increase growth rates of mites and beetles that attack crops and stored grains, respectively (Driscoll et al., 2000; Hoffmann et al., 2008).

2. Fruits, vegetables and nuts

For many, consuming sufficient fruits and vegetables is challenging due to the availability and affordability of convenience foods, which are highly processed, energy-dense, and nutrient poor. Favourite fruits consumed are bananas, apples and oranges. For vegetables, Australians are still keen on mashed or chipped potato (Table 1). An increasing variety of cheaper exotic vegetables and fruits is becoming available.

Despite our abundance of fruit growing regions, Australia still imports substantial amounts of fruit, particularly when it is out of season. As the climate changes, the suitability of areas where crops are grown will change; for example, the apple chilling requirements of current production areas may not be met forcing production areas to move further south where water availability may be problematic. Similarly the areas suitable for sub-tropical crops will expand (Webb and Whetton, 2010). Climate change will pose challenges to some horticulture when thermal maxima are exceeded, changes in the timing of flowering and fruiting, and water availability.

Climate change may also affect fruit and nut production that is mediated by pollinators as it is generally expected to influence pollinator abundance and population dynamics. Fruit and nut yields are generally tightly coupled with the abundance of both honeybees and native pollinators (Garibaldi et al., 2013) that are being reduced by climate change (Potts et al., 2010).

3. Meat, poultry and dairy

Australians have access to high quality, relatively affordable meat and so not surprisingly this food group also forms a large part of the typical Australian diet. It is not uncommon for red meat (beef, lamb) to be eaten several times a week. Milk also appears in the Australian diet in many forms (Table 1) including with breakfast cereals and in coffee. Cheese is also popular for sandwiches, pasta and pizza and as a snack.

Many animals are susceptible to heat stress. Heat stress affects the quality of the meat and weight gain; for chickens the quality of eggs; and in dairy cattle, reduced milk yields (Nidumolu et al., 2014). Increased temperature may also indirectly reduce meat availability by increasing the abundance of animal parasites (White et al., 2003). The quality and availability of our beef, lamb and poultry also depends on the quality and availability of pasture and grains for feed. Similarly, lower quality diets in dairy cattle reduce proteins in milk that affect cheese yield and quality. Feed supplies are generally under threat from climate change due to shorter growing seasons and reduced rainfall. Dairy output is expected to decline in all regions of Australia, except Tasmania, by 2030 (Reisinger et al., 2014).

Alternatives to beef and lamb in the Australian diet may grow due to financial pressures in the family budget, changing perceptions of a healthy diet or of "green choices" (e.g. greenhouse gas emissions and water requirements). There may also be incentives to farmers to move away from greenhouse gas intensive production. These influences may drive increased preferences towards white meat, such as chicken or pork, or a switch to potentially more sustainable meats such as kangaroo.

4. Fish and seafood

Seafood is less common than poultry and beef in the everyday Australian diet, but forms a notable part of Australian cuisine (Danenberg and Mueller, 2011) and popularity is increasing (Stephan and Hobsbawn, 2014). Canned tuna, prawns, crumbed and battered white fish, and canned and fresh salmon are popular choices¹. Sixty-six percent (by weight) of seafood consumed in Australia

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are low-value products imported from Asia, New Zealand and elsewhere (Stephan and Hobsbawn, 2014).

Climate change is already affecting our oceans through changes in temperature and ocean chemistry and will affect the availability and price of seafood (Hoegh-Guldberg et al., 2014). Frozen and thawed basa (catfish) from Vietnam are now the most commonly eaten import, its low cost, white flesh and neutral flavour makes this attractive to a large cross-section of Australians (Department of Agriculture, 2013). Seafood could provide an increasing proportion of protein to the Australian diet, particularly if consumers choose fish as a “healthy choice” or cost is reasonable compared to other meat. Aquaculture industries, both domestic and overseas, are considered to have high capacity to cope with climate change and to increase production and diversify over the coming decades (Hobday and Poloczanska, 2010; Department of Agriculture 2013).

5. Potable water

Access to safe and sufficient (potable) drinking water is taken for granted by most Australians. There is increasing concern that extreme weather-related events can affect drinking water quantity and quality through their impacts on treatability and infrastructure integrity, and are also likely to increase the overall costs of providing safe drinking water (Stanford et al., 2014). While Australian water utilities are generally designed and operated to reduce the impacts of weather events to acceptable levels, public health advisories may be needed to protect public health. Even with otherwise safe drinking water, consumers may face aesthetic (taste, odour, colour and turbidity) issues with their drinking water. As a result, consumers may turn to less sustainable and more expensive bottled water.

Future Australian diet and the impact on human health

The typical contemporary Australian diet is not especially healthy, as evidenced by our increasing obesity rates (Australian Institute of Health and Welfare, 2012). The Australian diet, comprised as it is with a high proportion of processed and convenience foods, is typically too high in fats, salt, sugar and refined carbohydrates while lacking in sufficient fresh fruits, vegetables and plain water (Table 1). Convenient, energy-dense foods are usually more cost effective in terms of meeting energy requirements, but do not meet other nutritional requirements.

Promoting a healthy diet underpins prevention efforts in obesity and cardiovascular disease, two National Health Priority Areas³. Nevertheless, pressure from climate change on Australia’s agricultural productivity and the associated food price increases may drive the goal to have a healthier diet by consuming more fresh produce farther out of reach for many people. Shifting dietary attitudes and behaviours towards those that are healthier to prevent obesity and related chronic disease, will become increasingly difficult as the cost of fresh food increases.

3 <http://www.aihw.gov.au/national-health-priority-areas/>

Wheat, meat, fruits and vegetables and dairy are likely to remain dominant in our diet, but farming practices will need to adapt to our changing climate, in particular in increasing water efficiency and pressure to produce fewer greenhouse gas emissions. As an alternative it may become more common to eat our fruits and vegetables after they have been tinned or frozen and imported from more climatically favourable regions and countries. Nonetheless, transport could attract an emissions price that will also drive up food prices.

The growing consumption and availability of seafood, both as a high-quality product and as a nutritious food source, will have positive implications for the Australian diet, given the high content of Omega-3 in some fish such as salmon, and the wider health benefits of lower calorie content of white fish compared to other meat. Nevertheless, the way we eat the fish—whether it’s grilled or battered and deep fried—will affect how healthy this option truly is.

Encouraging people to drink sufficient quantities of plain water is also a public health imperative as we face increasing temperatures and heatwaves. Plain water is the preferred source of fluids for health and may be complemented with fruit juices.

Adapting to climate change and mitigating the health risks requires a trans-disciplinary approach across many sectors (research, policy and advocacy) and disciplines (climate, agriculture, health and technology). Nutrition and diet is just one small aspect of our health that is affected. It is possible—with good planning and an approach to food and agricultural policies that accepts the evidence—to adapt our diet to suit our climate and make us healthier.

Reducing food waste is one obvious avenue to improving food security so that we can make better use of potentially dwindling supply. There is a large amount of edible food that is lost or wasted along the food supply chain, from production to consumption. The Food and Agriculture Organisation of the United Nations (FAO) estimates that up to one-third of all food produced is not consumed (FAO, 2011). Recently campaigns have begun to encourage the purchase of “ugly” food which is usually thrown out as it does not meet cosmetic requirements⁴.

Another source of food wastage occurs once the food reaches the home. Household wastage is estimated to be around AU\$5 billion per year and is linked to improper consumer behaviour such as insufficient purchase planning, exceeding shopping needs, cooking more than the required amount, being too sensitive to food safety, inappropriate food storage techniques and a deficiency of kitchen skills (Pearson et al., 2013). A parallel consumer education campaign regarding the current massive food waste can lead to a change in consumer behaviour and

4 <http://www.news.com.au/lifestyle/food/ugly-fruit-and-vegetables-sold-at-discount-prices-in-odd-bunch-campaign-by-woolworths/story-fneuz8wn-1227143733738>

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overall optimisation of our food resources from paddock to plate.

Ultimately the solutions need to come from broader concerted efforts and will need to consider a range of options targeting both supply of produce and consumer demand. Changing farming practices will become essential to adapt to individual location changes such as reduced water supply and more extreme droughts and floods. Some solutions to food production may in future arise through biotechnological advances given the appropriate scientific investment, but better, more efficient farming practices are needed now.

Conclusions

Keeping healthy food in the “typical” Australian diet will come under increasing pressure from a number of sources over coming decades including climate change. Food supply and distribution is a complex system with many competing market factors that are difficult to predict. Further, the specific changes to our climate, the response of crops and pests, and potential technological advances have levels of uncertainty associated with them. Nevertheless, we can begin to understand how our diet may vary in the future.

Broadly it is likely that the cost of food and water will increase as supply becomes less reliable and once productive areas are subject to increasingly uncertain rainfall. Changing market dynamics are likely to encourage people to eat less of the fresh Australian crops impacted by increased droughts and extreme events, such as fruit, vegetables, wheat products, and meat.

With Australia's climate becoming less favourable to food production, the consumption of fresh produce will be compromised. It is likely these will be replaced by processed or frozen foods, which are lower in quality. The consequences for health are serious, as this poorer diet will augment the already increasing prevalence of chronic disease related to obesity. Through its impact on what we eat and drink, climate change may cause the numbers of people with diabetes, cancer, cardiovascular and kidney disease to rise. These nutrition related diseases will increasingly occur disproportionately among the disadvantaged, reducing life expectancy and increasing chronic disease and associated costs to the Australian healthcare system.

The interplay of climate on food security and health is a complex system. Nevertheless, it is clear that there is likely to be a negative impact on health with increasing costs to individuals and the health system. We should be addressing these health issues urgently through multi-sectoral policies and planning, before climate change impacts our diet much further. For example, investment in alternative farming techniques, preservation of our most productive land, programs to encourage more fish consumption from sustainable fisheries; and the

development of better fruit and vegetable preservation for greater acceptance as a snack food.

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