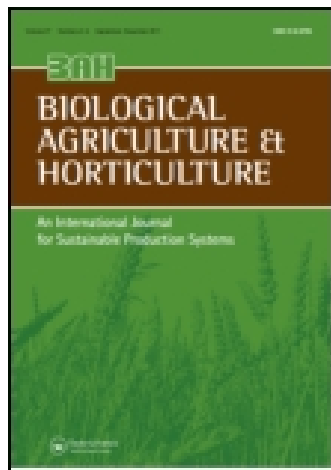


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### Building environmentally sustainable food systems on informed citizen choices: evidence from Australia

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## Building environmentally sustainable food systems on informed citizen choices: evidence from Australia

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To address imminent concerns of global food security and agricultural sustainability, international research activities are increasingly focusing on ways of improving the food system's efficiency and effectiveness at providing nutritious food for all in an environmentally sustainable manner. A significant component of this will involve understanding and ultimately influencing people's dietary choices. However, for people-oriented intervention strategies to be effective, the gaps between existing behaviour and what is required for environmentally sustainable and healthy food choices must be specified. This paper identifies priority areas for behavioural change in relation to the types of food purchased, how they have been produced and the individual's food provisioning behaviour. In order to determine the most effective ways to influence people's consumption behaviour in light of these priority areas, the authors conducted a pilot study on a group of 163 Australians who would be expected to be 'early adopters' of a sustainable diet. Results show that only around 1 in 10 are presently actively engaged in reducing the environmental impact of their diets in these priority areas. Hence, there is a significant need to engage many more people in sustainable dietary behaviours. Furthermore, it was found that areas where interventions are most likely to have the largest impact, based on high cost to the environment and likelihood of citizens changing their behaviour, are reducing the amount of food waste generated in the household and lowering the amount of junk food eaten.

**Keywords:** diets; environmental sustainability; food system; citizens

### Introduction

The global food system, which encompasses agricultural production, food processing, distribution, retailing and consumption, is expected to experience an unprecedented confluence of pressures over coming decades (GOS 2011). On the demand side, global population size is anticipated to increase from seven billion today to nine billion by 2050 (UNGC 2012). Many of these individuals are expected to be wealthier than ever before and are predicted to create demand for a more varied, high-quality diet which requires additional resources to produce.

On the production side, competition for land, water and energy will intensify. The effects of climate change will become increasingly apparent, resulting in an imperative to reduce greenhouse gas emissions and adapt to a changing climate. This is particularly significant considering that the agriculture industry is one of the greatest emitters of

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greenhouse gases globally (Macdiarmid et al. 2012). Food production already dominates much of the global land surface and water bodies. Maintaining biodiversity, therefore, is an imperative for the Earth's environmental systems. These stresses are placing the global food system under pressure to produce more food using less natural resources (Lang 2009; Beddington et al. 2012).

International research activities are consequently prioritizing areas for improving the food system's efficiency and effectiveness at providing nutritious food for all in a sustainable manner (Edwards et al. 2011). This portfolio of activities is occurring at all stages of the food supply chain. Thus, it include understanding and influencing the behaviour of individuals (Godfray et al. 2010; Garnett 2011; Friel et al. 2013) in order to harness the collective power of their food choices and hence cause changes further up the supply chain.

The importance of citizen engagement and its contribution to food security has been emphasized in recent prominent food policy documents (e.g. GOS 2011; UNGC 2012) and include statements such as 'the most important food security issue relates to the ways in which we consume and use food' (PMSEIC 2010). In addition, research (Pretty et al. 2010) has confirmed that whilst an increasing number of individuals seek information, there is a paucity of knowledge about 'what is most useful to citizens wishing to make informed decisions about the environmental and social impacts of their food choices'.

### Background information

Collectively, individual dietary decisions form the main source of demand within the dynamic and multifaceted food system. Individual desires, such as for readily available, affordable, convenient, safe and arguably sustainable food, shape the food system (e.g. GOS 2011; DAFF 2013). The following conceptual framework (Figure 1) links dietary choices with environmental sustainability by showing how, over time, a more environmentally sustainable food system may be created by citizens changing their dietary behaviour.

Existing evidence for healthy diets encourages modest intakes of a diversity of healthy foods to ensure, inter alia, an adequate supply of nutrients (NHMRC 2013). The challenge now is to specify changes in behaviours required to enact sustainability components of healthy diets (FAO 2010; Friel et al. 2013). This has been referred to as a transformative change for society which will require re-establishing widespread recognition amongst citizens of the dependence of their food on the natural environment (Kickbusch 2011).

An individual's food-related choices are a complex area of enquiry. Research has identified numerous different factors that influence these choices (Furst et al. 1996). The environmental impact of these choices is influenced by composition of diets, such as the amount of beef and dairy, production systems (organic vs. conventional), level of processing and distance between production and consumption (Thøgersen 2010).

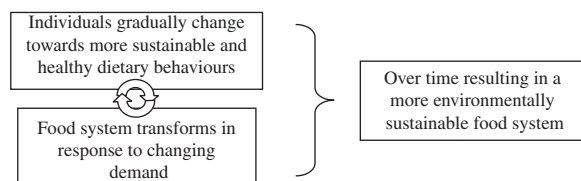


Figure 1. Linking dietary choices with environment sustainability.

The Sustainable Development Commission in the UK (SDC 2009) developed a list of priority actions, at the household level, for improving sustainability of the food system. This study used a very broad definition of sustainability based around the UK Government's principles of sustainable development. These principles aim to ensure 'a strong, healthy and just society and living within environmental limits' and are explicitly aimed at integration (rather than trade-offs) between environmental, social and economic outcomes. As such, these recommendations are consistent with health guidelines (Owen et al. 2007). These recommendations have been reorganized by the authors into groups of related actions for individuals.

Food product (e.g. protein from meat or other sources):

- reducing consumption of meat,
- reducing consumption of dairy products,
- reducing consumption of junk food,
- reducing consumption of bottled water.

Source of food product (e.g. conventional vs. seasonal or organic):

- reducing consumption of non-seasonal produce.
- reducing consumption of non-sustainable fish,
- reducing consumption of non-organic food.

Behaviours around food provisioning (e.g. food shopping, storage, cooking and waste)

- reducing food waste,
- reducing energy use in food purchasing, storage and cooking.

In the original report (SDC 2009), the highest priority areas for change, lowering consumption of meat, lowering consumption of dairy products, consuming less low nutritional value products, for example 'junk food', and reducing food waste, were based on those considered 'likely to have the most significant and immediate impact on making our diets more sustainable, in which health, environmental, economic and social impacts are more likely to complement each other' (p. 4). The following discussion considers issues for citizens, and those in the wider food system, for these priority areas to reduce the environmental impact of their diets.

### ***Food product***

#### *Meat and dairy*

Some research has focused on the relative amount of plant versus meat products and has suggested that eating more plants, less meat and less processed food would contribute to a diet that is good for both people and the planet (World Wildlife Fund for Nature 2011). Implementation of these aspirational changes would result in a diet that is similar to what is currently consumed in some countries and has been referred to by some as the Mediterranean diet (Burlingame & Dernini 2011).

The primary reason for these recommendations is that the production of livestock for human food has a large negative impact on the natural environment as well as having some negative impacts on human nutrition when consumed above recommended amounts (Walker et al. 2005). Livestock production accounts for a very significant portion of global greenhouse gas emissions with estimates that meat and dairy consumption in developed countries accounts for around 50% of the climate change impact of a typical diet (FSA 2010). The main causes of this are methane from enteric fermentation, nitrous oxide from

manure and fertilizer, carbon dioxide from land-use change and use of energy in agricultural activities (FAO 2006).

The environmental impact of red meat production varies according to the specific climate and farming systems used. For example, obtaining calories directly from cereals would support more people than the current food system where about one third of the world's cereal production is fed to animals prior to their consumption by humans (Godfray et al. 2010). Hence, although it is possible to reduce environmental impact per unit of meat or milk produced, reducing consumption of these products will have a bigger and more immediate benefit. This is particularly important in many developed countries, such as Australia, where consumption of meat is above recommended dietary requirements (McMichael et al. 2007).

Another approach would be to move away from farming beef towards producing meat from animals that do not produce methane. An example for Australia would be the commercial farming of kangaroos (Wilson and Edwards 2008). This challenges many culturally constructed norms related to acceptable sources of animal protein. Interestingly, most of the kangaroo meat that is currently harvested in Australia for human consumption is exported to Europe (RIRDC 2008).

### *Junk food*

Although there is widespread concern about consuming large amounts of junk foods, these being those that are high in salts, sugars and fats, from a health perspective, less attention has been paid to their environmental impact. In a comprehensive Life Cycle Assessment in a developed country, these products were found to account for one third of total climate change impact in the food sector (Carlsson-Kanyama et al. 2003).

### *Bottled water*

The reduction of bottled water purchases, which has been estimated to have an environmental impact of 100 times that of water from a tap (Jungbluth 2006), is an additional area in which the sustainability of diets could be improved.

## ***Source of food product***

### *Fresh produce*

Whilst there are many health led initiatives aiming to increase consumption of fresh fruits and vegetables, such as the Australian Government's recommendation of two servings of fruit and five of vegetables everyday (Go for 2&5 2011), inclusion of environmental impact leads to emphasis on seasonal outdoor production, as opposed to indoor glass or greenhouse methods. Citizens tend to relate seasonality to fresh fruits and vegetables, and occasionally some meat products. Research shows that concern for the environment tends to be low for these products where taste and freshness are important drivers of consumer demand (Brooks et al. 2011).

An inevitable consequence of seasonal purchases is a more localized diet. However, in addition to issues associated with changing what is produced where, increasing local food purchases may lead to nutritional deficiencies and even be less environmentally sustainable due to reduced opportunities for benefiting from comparative advantages of production as well as economies of scale and scope (Pearson, Henryks, Trott et al. 2011). The appropriateness of using a narrow surrogate measure, such as 'food miles', in the area

of environmental impact has been questioned (Edwards-Jones et al. 2008; Australian Bureau of Agriculture and Resource Economics 2009). An example of low food miles creating a higher environmental impact is found with in-season apples being transported half way around the world (from New Zealand to the UK), which were found to have a lower impact than within country production that was stored for six months to allow for out-of-season consumption (Saunders & Barber 2007).

### *Fish*

Whilst the consumption of fish is supported by a number of health initiatives, such as Government dietary guidelines in Australia (NHMRC 2013), it is recognized that some fish species are susceptible to exploitation (Mitchell 2011). With this in mind sustainable seafood guidelines are available in many countries, such as the Australian Marine Conservation Society which provides a 'traffic light' system for 60 commonly purchased seafood species (Australia's Sustainable Seafood Guide 2012).

### *Organic food*

The superior environmental credentials of the organic food industry are supported by many influential organizations (United Nations 2006; Organisation for Economic Cooperation and Development 2008; United Nations Environment Program 2008). This includes the United Nations, which uses it as an exemplar of a more sustainable food production method. Furthermore, with widespread distribution in most developed countries, including many organic products in supermarkets, and global sales of over US \$55 billion (Willer and Kilcher 2011), it is now a viable choice for many citizens. However, higher prices when combined with a smaller range of products in supermarkets and limited availability in the food service sector make it difficult for some citizens to purchase these products (Dixon et al. 2007; Pearson & Henryks 2008).

## **Food provisioning**

### *Food waste*

A large amount of food produced is lost whilst in transit along the supply chain towards human consumption due to degradation by aging, poor handling or pests. A recent United Nations Food and Agriculture Organisation study (Gustavsson et al. 2011) suggests that about one third of food produced for human consumption is lost due to waste. The reasons for this vary. In developing countries, major losses occur post-harvest due to low technology storage and transport conditions, whilst in developed countries, large amounts of food is wasted by citizens in their homes (Pearson et al. 2013) and at food service outlets.

Reducing the amount of food wasted in the household also presents an opportunity for increasing the environmental sustainability of diets. It has been reported that perishable products, such as fresh fruits and vegetables, and meat, are most vulnerable to waste. Whilst some waste is unavoidable, better management within households could reduce this (Quested et al. 2011). For example, it has been suggested that a reduction of food waste from 22% to around 10% is feasible in the UK (FSA 2010, Waste and Resources Action Programme 2011). Current dietary trends are contributing to a context in which it is easy to waste food. For example, citizens are being encouraged to eat more fresh products for health purposes; however, these are generally the products that are most susceptible to 'use by dates' and hence likely to be wasted. Moreover, only limited opportunities exist for

recycling food waste in many countries, such as Australia, resulting in high proportions of food waste going to landfill (Baker et al. 2009). Another significant aspect of 'food waste' is that of over-consumption, which contributes to dietary-related health disorders including obesity.

### ***Energy***

And finally, reducing the amount of energy used in purchasing and cooking foods offers an additional area in which the sustainability of diets could be improved.

### ***Summary***

It is recognized that diets and their associated food systems are hugely complex, that there are many areas in which environmental sustainability may be improved (Collins and Fairchild 2007) and to date scientific evidence is not sufficiently well developed to enable specification of requirements for a sustainable diet (Riley and Buttriss 2011; NHMRC 2013). Furthermore, an individual's purchasing decisions are a result of many factors, with environmental impact being just one of them. This research continues by exploring citizen's knowledge and willingness to change, in the priority areas for behavioural changes that will improve the environmental sustainability of their diets.

This paper adds to the growing body of knowledge by providing information about individual choices in relation to the environmental sustainability of their diet. The following sections describe the methodology used and results from a pilot study on a group of Australians who would be expected to be early adopters of a sustainable diet.

### ***Methodology***

In detailing the methodology selected for collection of empirical data for this research it is vital to have an awareness of the agronomic, cultural and economic context within which individuals in the population make their food-related choices. The recommendations for a more environmentally sustainable diet previously discussed (SDC 2009) were created for the UK context. These are seen as being relevant to many other developed countries where there are similarities in both diets (relatively high levels of protein sourced mainly from beef, wheat and potatoes being the main sources of carbohydrates, and an abundance of fruits and vegetables) and food system that supplies them (dominated by an intensely competitive chain of supermarkets, and food service sector that is increasing its market share, both of which use global sourcing of products). Most individuals in developed countries have become accustomed to year round availability of an abundant range of products that are supplied by supermarkets and the food service sector at relatively low prices. Furthermore, it is recognized that whilst many developed countries benefit from a bounty of food products, their consumption is unevenly spread across the population.

Owing to the similarities in diets and food system that supplies them between developed countries in general, and the UK and Australia in particular, it was felt that the latter was a relevant context for the collection of empirical information. In brief, at a national level, Australia is classified as being 'food secure' with domestic production currently exceeding consumption by a large amount (Edwards et al. 2011). Australia produces enough to feed almost three times its population when measured in dollar terms. Major surpluses exist for wheat and beef, both of which are exported into global markets. Australia also exports and imports many packaged food products and undertakes trade



'swaps' of perishable products, such as importing fresh oranges from the northern hemisphere to allow for out-of-season consumption before reversing the flow when they are in-season in Australia. Furthermore, many Australians suffer from 'over-nutrition'. Over half of the adult population (63%) are classified as being overweight or obese (ABS 2012). Obesity emerges from a nutritional imbalance with excess consumption of discretionary energy-dense and nutrient-poor foods (NHMRC 2013), such as those with high salt, sugar and fat (HSSF) levels which are commonly referred to as 'junk' foods. These are consumed at the expense of fresh fruits and vegetables, and relatively unprocessed complex carbohydrates such as those found in grains, e.g. pasta, breads and rice.

The nature of the research question led to the use of focus group discussions followed by an online questionnaire. This is a very common approach for exploratory market research (e.g. Pearson, Henryks J & Jones 2011; Pearson, Henryks, Trott et al. 2011). Two focus group discussions were completed with a total of 28 respondents enrolled in a second-year undergraduate marketing unit (Advertising Strategy) at the University of Canberra. There was an almost equal split across the genders (13 male and 15 female). Their living arrangements varied from renting with unrelated adults (16), living at home (7) or living in catered college rooms (5). The majority (23) classified themselves as Australians. The majority (26) were aged between 19 and 21 years, with a small number (2) of mature-age students. To create a relevant frame of reference for respondents, whilst avoiding directing their thoughts, they were asked to think about sustainable food consumption. Then the two main prompt questions were 'What comes to mind when someone asks you what an environmentally sustainable diet is?' and 'How could you make your own diet more environmentally sustainable?' The sole purpose of undertaking these focus groups was to provide information for development of a questionnaire.

Owing to the absence of a suitable questionnaire in the literature, one was developed from first principles. Results from the focus groups were utilized to identify issues relevant to individuals and the language used by them. The online questionnaire contained mainly fixed response questions, with a limited number of opportunities for respondents to record open text comments. Minor modifications were made to improve clarity after a pilot test with another 20 undergraduate students.

The questionnaire was made available to 623 participants in an email-based staff 'chat room' at the University of Canberra. It is located in the Australian Capital Territory (ACT) which has a predominantly urban population of almost 400,000. Hence, respondents are drawn from a population where the main employment opportunities focus around white-collar government jobs.

The questionnaire explored respondent's interest and knowledge about an environmentally friendly lifestyle and in particular whether they thought about the environment when making food-related choices. It then investigated from where they purchased food, either for consumption 'at home' or 'away from home'. The final section collected information about their self-reported behaviour, and on how likely they were to change their behaviour, in relation to the most important areas that would make their diet more sustainable as previously discussed. The survey responses were collected and collated using an online survey tool (Survey Monkey) and the data was analysed using descriptive statistics (SPSS software).

## Results

A total of 163 completed questionnaires were received, representing a 26% response rate. The majority of respondents (75%) were female. They represented all age groups and

living arrangements, ranging from unrelated single adults through the various stages of having children living at home to the largest group which were empty nesters (73%). They had relatively high levels of household income, with an average of almost AU \$100,000 compared with AU\$75,000 for the ACT and AU\$55,000 for Australia (ABS 2011), and education, 78% having a bachelor degree compared with ACT (30%) and Australia (19%).

With this higher level of education and purchasing power, these respondents, on average, are likely to be leaders or ‘early adopters’, in terms of their behaviour with respect to reducing the environmental impact of their diets (Owen et al. 2007). In addition, these respondents would be expected to be more aware and engaged in proactive measures to improve their health. Evidence for this is found in the low proportion of respondents who were in an unhealthy weight range, with only 32% being overweight or obese, almost half that of the 63% in the Australian population (ABS 2012).

The results indicate that effectively all respondents (96%) would like to lead a more environmentally friendly lifestyle and most (77%) knew what they could do to be more environmentally friendly. Furthermore, over half (53%) think about the environment when they are making food-related choices. These percentages are based on the sum of respondents who ‘strongly agree’ or ‘agree’ on a five-point scale through to ‘strongly disagree’ in response to the specific questions: ‘I would like to lead a more environmentally friendly lifestyle’, ‘I don’t know how to be more environmentally friendly’ and ‘I think about the environment when making food choices’ ( $n = 163$ ).

The results show that individuals differ according to their attitude towards sustainable food. As shown in Figure 2, the majority of respondents (66%) think that sustainable food is a good thing, whilst only a few are either passionate about it (11%) or don’t know what it is (17%). Many respondents expressed a desire to know more about the sustainability of their diets to allow them to make informed decisions; ‘I don’t know how to tell if food is sustainable or not in order to make better purchasing choices’ was a free-text comment from a questionnaire respondent. Product labels were identified as a potential site for this information. The general support for consideration of environmental impact when making food purchases was tempered with recognition of trade-offs associated with dietary choices, including the free-text comment ‘[Sustainable food is a] good thing, but other things impact more at most times’.

Having an awareness of the context where food purchases are made is vital in gaining an understanding of how to encourage more environmentally sustainable dietary choices.

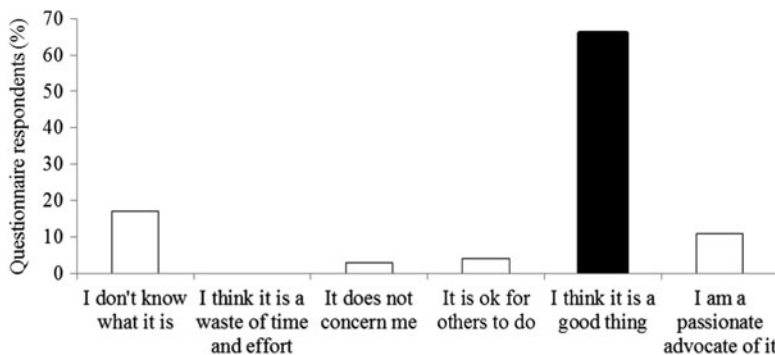


Figure 2. Individual attitude to sustainable food ( $n = 163$ ).

Individuals have a range of choices in terms of food outlets, these maybe classified according to whether they are for food ‘at home’ and food ‘away from home’.

Supermarkets are the dominant source of food for purchases that are subsequently eaten ‘at home’ with only a small number of respondents (10%) either choosing not to use them or being unable to access them. Other less popular retail outlets include markets, cooperatives and convenience stores.

Not all food is purchased, with ‘home grown’ products being an obvious example. At a national level in Australia it has been estimated that around 5% of all fresh fruits and vegetables eaten are ‘home grown’ (ABS 1992). Just over half of the respondents (52%) grow some of their own food, with vegetables (44%) and herbs (38%) being the most popular. The vast majority of these gardeners used their backyard (83%) whilst ‘pots’ were less commonly used (12%), and a few used a community garden (5%).

The potential production from ‘home grown’ is significant, e.g. the free-text comment, ‘In summer, I purchase very little in the way of fresh vegies [vegetables] from the markets. I also produce almost all the fruit I can eat in summer and preserve large amounts for off season eating.’ However, this opportunity must be tempered with recognition of constraints from time required, access to suitable growing spaces and benefits from having appropriate knowledge.

Another important aspect of understanding food ‘at home’ is consideration of who cooks the meals. As shown in Figure 3, the majority of interview respondents prepared their own food. For example, 96% cook their own meals ‘always’ or ‘sometimes’. Eating food prepared by others, or heating ‘ready-made’ meals was much less common.

In many developed countries more people are eating ‘away from home’ more often. Whilst this is an area of growth, in Australia food sales are still dominated by purchases for ‘food at home’. The dollar value of sales from the food ‘away from home’ sector is only one third of supermarket sales which account for an estimated 80% of food ‘at home sales’ (DAFF 2011). It is possible to estimate that approximately 10% of dietary intake is from food ‘away from home’, based on the preceding figure and a prepared meal mark-up of say 200% on the ingredient cost. It would be valuable for further research to gather more accurate information about the ratio of ‘food at home’ to that eaten ‘away from home’.

With food purchased for consumption ‘away from home’ becoming more significant it is important to understand where this occurs. As shown in Figure 4, food purchased for

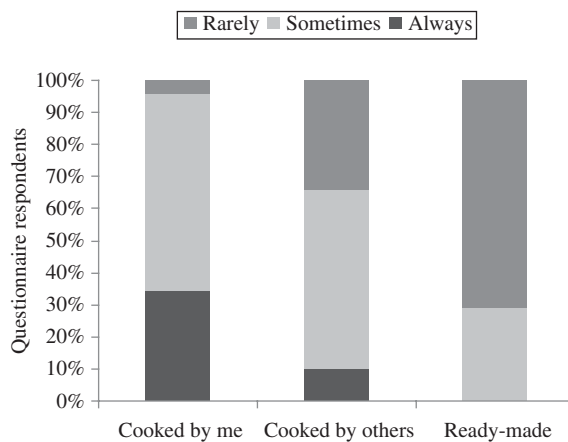


Figure 3. Who cooks food eaten ‘at home’? ( $n = 163$ ).

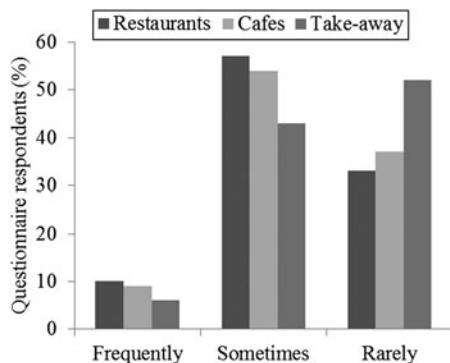


Figure 4. Where food for consumption 'away from home' is purchased ( $n = 163$ ).

consumption 'away from home' is an occasional event, with only a small number of respondents (less than 10%) frequently choosing it. Although restaurants are most commonly used by respondents for 'food away from home' purchases, patronage is fairly evenly spread across all three types of food outlets.

The following results have been presented in relation to the behavioural changes that support a more environmentally sustainable diet. The specific actions for investigation were those identified by the Sustainable Development Commission in the UK (SDC 2009) and previously discussed. These were developed into the following specific questions by the lead author.

The following are the nine most important areas in which you could improve the environmental sustainability of your diet. Given this information, how likely are you to:

- Reduce consumption of meat (e.g. beef, lamb, pork, chicken)
- Reduce consumption of dairy products (e.g. milk, yoghurt, cheese)
- Reduce consumption of food and drink of low nutritional value (e.g. junk food such as sweets, soft drinks, take-away food and other HSSF foods)
- Reduce food waste
- Increase consumption of fruit and vegetables
- Eat only fish from sustainable stocks
- Increase consumption of food produced with respect for the environment (e.g. organic food)
- Reduce energy input (e.g. by shopping on foot or over the Internet, and cooking and storing food in energy conserving ways)
- Drink only tap water instead of bottled water

Results are first given for those who believe that they have already adopted the specified behavioural change and followed by results in relation to those who would consider making the change. As shown in Figure 5, some respondents are already contributing to reducing the environmental impact of their diet. The four high-priority areas for changing behaviours, as previously discussed (SDC 2009), are considered prior to a brief review of the less important ones.

Around 1 in every 20 respondents has already stopped eating dairy products. It is important to note that the motivation for this may not be to contribute to environmental sustainability but for health and/or animal welfare concerns. The motivations for those who have already given up eating meat products are similar to those for dairy products.

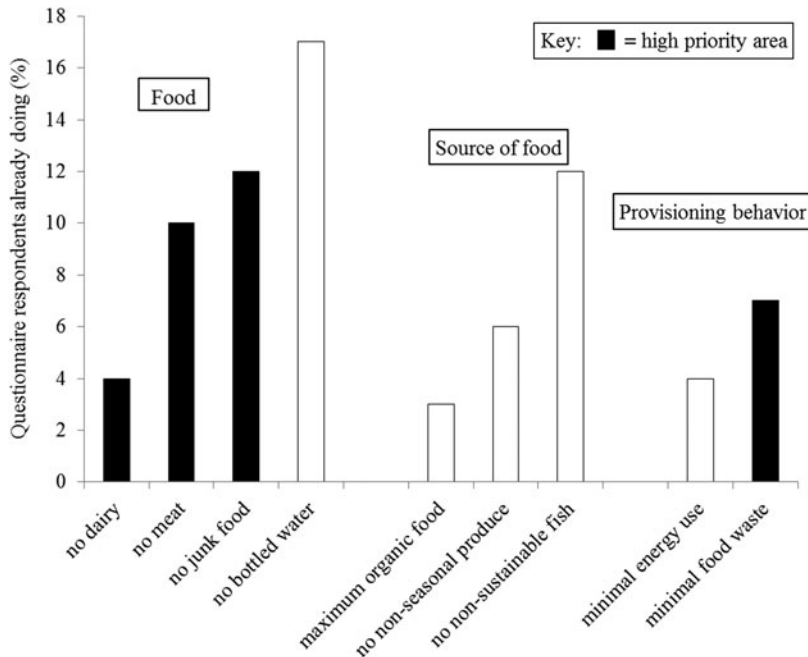


Figure 5. What are individuals doing? ( $n = 163$ ).

However, they represent a larger portion, at around only 1 in 10 respondents. A similar number of respondents do not eat junk food. However, it is important to note that the motivation for this may be for health benefits rather than to contribute to environmental sustainability. And finally, around 1 in 10 claim that they do not waste any food. Although not captured in this question, the issue of food waste through ‘over-eating’ is important, as a notable portion of the survey respondents, at around 1 in 3, was classified as being overweight or obese.

In relation to the less important behaviours as shown in Figure 5, almost 1 in 5 do not purchase bottled water. Over 1 in 10 respondents either do not purchase fish or only purchase fish that has been sourced from sustainable sources. Just over 1 in 20 believe that they eat only seasonal fruits and vegetables, an inevitable consequence if they only purchase them locally. This may not be from within a small region, such as a radius of 30 miles (50 km); however, they will not be imported from the other hemisphere. Although a more local sourcing of food was not specifically identified as one of the priority areas in the UK report (SDC 2009), interestingly local sourcing was much more popular than organic food purchases with respondents. The total of those ‘always’ and ‘frequently’ purchasing locally at 33% was much higher than that for organic at only 17%. A small portion, around 1 in 25, is consciously trying to reduce energy used to purchase, store and cook their food. And finally, around 1 in 30 feel that they are purchasing all the organic food that they can.

As shown in Figure 6, this research also investigated how likely these individuals were to change their behaviour when confronted with the statement that their choice would improve the environmental sustainability of their diets. In relation to the four high-priority areas for changing behaviours, as previously discussed (SDC 2009), around 70% of respondents would consider reducing their food waste as well as their consumption of junk food. Whilst around 30% would reduce their purchases of meat, only 15% would reduce

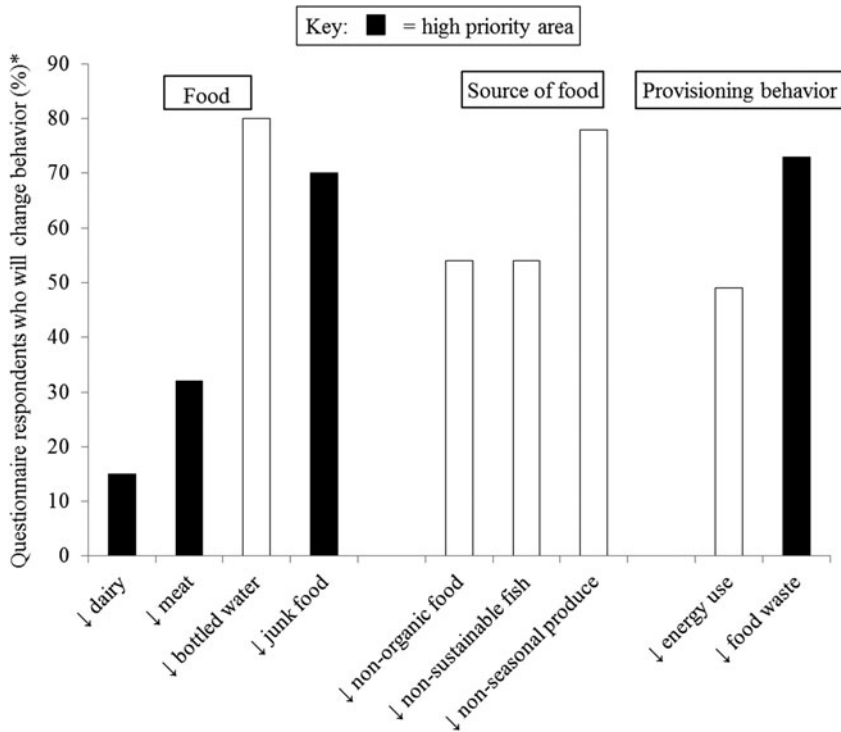


Figure 6. What will individuals do? ( $n = 163$ ).

Note: \*Sum of respondents who are 'extremely likely' and 'very likely' on a four-point scale through to 'somewhat likely' and 'not likely'.

their consumption of dairy products. In relation to the less important areas, around 80% would consider reducing their purchases of bottled water, with a similar number willing to increase their purchases of seasonal fruits and vegetables. In contrast, around 50% would increase their purchases of organic food and sustainably sourced fish, and engage in activities that reduce energy use.

### Discussion and conclusion

This research has contributed to the literature on choices made by individuals and the potential to nudge these in directions that will reduce environmental impacts from the food system. Dietary choices offer an area where most people are able to make a meaningful contribution to sustainability by engaging in more environmentally sensitive patterns of consumption in their daily routines.

The empirical results from a group of 'early adopters' in Australia, which provides an example of a developed country, indicate that most (almost 70%) support the idea of sustainable diets, whilst only a small number, around 1 in 10, are already engaging in one or more of the four most important behaviour areas. Hence, these results support other research (Davies 2011) that suggests that there is a significant opportunity to engage many more people in these sustainable dietary behaviours.

Furthermore, the most prospective areas for encouraging a more environmentally sustainable diet are reducing consumption of discretionary energy-dense and nutrient-poor junk foods, which relates to the specific products chosen, and amount of food waste, which

relates to food provisioning behaviour. These behaviours have a relatively large negative impact on the environment, and many people indicate a willingness to making these changes. Reducing purchases of junk food also offers potential co-benefits of encouraging a healthier diet. Whilst reducing food ‘wasted’ through the related behaviour of overeating also contributes to human health and well-being by reducing obesity.

There are limitations from these conclusions that relate to the methodology used. The most significant being those associated with use of self-reporting questionnaires rather than the observation of actual behaviour. Hence, the results may be overstated as they represent how an individual would like to behave, rather than how they actually behave, or will behave in the future. In addition, the scales used provide a simplified perspective on a complex issue. Hence, further research could explore, for example, how much of what foods are wasted and why this occurs. There are opportunities to extend this research beyond individuals who are ‘early adopters’ to others including ‘followers’ and ‘laggards’. As diets vary due to cultural, as well as national agronomic and economic conditions, results in this paper are specific to the Australian context. Hence, for other countries it would be essential to gather new empirical information to identify priority areas, before implementing policy initiatives. And finally, whilst this research makes a contribution, further research is required to support the necessary shift in patterns of consumption to identify complementary fiscal, regulatory and infrastructural measures that collectively reorient patterns of consumption towards healthy and sustainable dietary choices (Garnett 2011). This will create the necessary knowledge of individual motivations within temporal, social and spatial lived experiences where food-related decisions occur and thus provide rigorous evidence for sound policy initiatives.

In summary, this research has contributed by specifying the changes in behaviour that could shift citizen’s food choices towards environmentally sustainable and healthy dietary options. The successful implementation of these by Governments at all levels, with support from industry and non-government organizations in civil society, as well as the research community, will result in strengthening food security through the mitigation of the negative environmental impacts of the food system.

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