

## Article

# Food Waste and Social Practices in Australian Households

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**Abstract:** Food waste is a critical sustainability issue, and the solutions, particularly in middle-to-high-income countries, lie in shifting practices within households. The purpose of this paper is to contribute to the research in an Australian context, provide insights from a social practice theory approach and understand the influence of growing your own food to waste production. The research is based on respondents completing a two-week food diary documenting food acquisition and disposal and then undertaking a survey on their food practices and attitudes to waste. This study finds that the preparation of meals and storage practices are critical towards the production of food waste. These practices can be shifted by focusing on upskilling and the introduction of new materiality or technologies. The acquisition of food is also a pivotal practice in which to intervene in order to reduce waste in other food practices in the household. Interventions, such as growing your own food, are recommended to shift food practices to reduce an output of waste to landfill. The research is limited by its reliance on self-reported data for food waste. However, the focus on social practices in food waste is novel in an Australian context.

**Keywords:** food waste; food practices; grow your own food; social practice theory; Australia



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## 1. Introduction

Food waste is an increasingly pressing sustainability issue globally [1–3]. It is a concern on many levels, not least due to the impact of exponential population growth on the Earth's natural resources and climate [4]. Food waste is also responsible for 8% of global greenhouse gas emissions [2,5]. The United Nations Food and Agricultural Organisation estimates that one third of all edible food, equivalent to 1.3 billion tons, is lost or wasted annually [6]. Significant land, water and energy resources are used to produce food for human consumption [7,8]. These levels of food waste also have significant social and economic impacts. The United Nations Sustainable Development Goals have stated the global aim to halve per capita food waste across retail and consumer levels and reduce food losses along the production and supply chains by 2030 [7]. Improving practices across the board to avoid and reduce food loss and waste will be essential in meeting future global food requirements and achieving sustainable development.

An environmental lens sees food waste play an avoidable role contributing to wasted natural resources and an increase in greenhouse gas emissions [9]. There are substantial negative environmental externalities attributed to the production of food, and thus, food waste throughout the entire supply chain through to the consumer. The land changes and degradation associated with agricultural practices pose a risk to biodiversity, impact soil erosion and increase pollution of soil and freshwater via the use of chemical fertilisers [3,10]. In Australia, a country prone to drought and water shortages, it is estimated nearly a quarter of all the water used in agriculture is used to produce food that is then lost or wasted [11,12]. Fossil fuels used in the transportation of food through the current complex supply chain, which sees produce flown around the world, also has environmental implications, are futile should that food not be consumed by humans on arrival. At the consumer end, food waste

finds its way to a landfill via government operated waste services, where it is responsible for producing methane gas. Methane gas is 20 times more potent than carbon dioxide and food waste is responsible for 8% of global greenhouse gas emissions [2,5]. It, thus, plays a direct and significant role in the expected adverse changes to our global climate systems [6,13]. The environmental impacts of food waste are, therefore, significant, yet avoidable, or at the very least, they can be reduced via a more effectual food system and behaviour changes amongst consumers.

At a global level about 793 million people suffer from hunger and lack food security [14]. Food security, the physical and economic access to safe and nutritious food, is closely tied to the issue of food waste [3,11,13,14]. For instance, the current amount of food loss and waste is sufficient to alleviate one eighth of the world's population from undernourishment [1]. Addressing food waste is key to this injustice. Additionally, there is an economic argument that improving the efficiency of the food supply chain would make food more affordable at the consumer level for those that lack economic access [2]. Collectively, the environmental and social consequences of the food waste produced throughout the global food system are estimated to have an additional \$1.6 trillion impact [10]. This figure is in addition to the estimated direct economic one trillion-dollar cost [10]. In Australia, the economic cost is approximately \$20 billion a year [5]. Undoubtedly, there is a significant business and individual financial impact too [11]. All things considered, the issue of global food loss and waste has far reaching adverse impacts across environmental, social and economic realms.

Food waste occurs at all stages of the food supply chain; however, in high-income countries, the issue undeniably lies with the retail and consumer levels [1,2,15]. In high-income countries where the agricultural sector has high-tech systems, refrigeration and reliable supply chains to fall back on and there are successful measures in place to avoid food loss, it is the consumer and their behaviour in the household which remains the concern [15–18]. This is the case in Australia, where the sector contributing the most to the 7.3 million tonnes of food waste generated annually is households [12]. In Australia, the government has set its own target to reduce food waste by half by 2030 [5,12,19].

Given the volumes, and considering it occurs at the end of the system, minimising food waste in the household is the best way to reduce the impact on the environment [18]. In Australia, food waste is estimated to cost each household between \$AUD2200 to \$AUD3800 per year and results in 3.1 million tonnes of edible food being sent to a landfill [5]. Although much can be done to avert sending food waste to a landfill, currently, 79% of food discarded is sent there through municipal rubbish services [20,21]. Unlike other countries, there are limited services to facilitate source level separation of organic food waste from general waste at the household level [22]. For instance, a program was introduced in Western Australia in late 2019 which allows for the disposal of food organics and garden organics in the same bin for collection weekly by the municipal waste services, but programs across Australia are the exception [23,24]. This suggests that a focus on households in high-income countries, such as Australia, would be of great benefit in resolving the issue. Building on the understanding of the potential causes of, and solutions to, household food waste is critical.

Several social science theories have been applied to the issue of household food waste in recent years. As is common for environmental issues, the theory of planned behaviour, in which an individual's behaviour is thought to reflect their beliefs, has been applied [15,25,26]. Theories associated with social marketing, involving a cross section of stakeholders, are often applied by government behaviour change education campaigns [13]. These theories provide insight into some element of the issue, namely an individual's behaviour and how to influence it via education. However, recent studies have recognised how embedded the issue of food waste is in daily practices and the complexity of addressing it [8,27–30]. Rather than a focus on the individual and their behaviour, the disposing of food is considered as part of a range of integrated daily food practices and an unintended consequence of these [27,31]. This is influenced by the skills and technology or materials

a person has access to when undertaking a practice, which can vary across households, influenced by socio-economic factors and cultural practices. Social practice theory changes the unit of study from the human as the actor to the practice itself [32]. The practice is under analysis and the human merely the carrier of that practice. Behaviour is categorised as influenced by motivators and barriers, whereas practices are made up of three elements, with an emphasis on the inclusion of materiality or technology or skill, as well as meaning and social norms [32]. Social practice theory is increasingly being applied to food waste in order to bring the necessary complexity to addressing the issue [27,31]. According to Southerton and Yates, it brings a necessary framework that offers a valid new avenue of research beyond individualism and behaviour change [31].

The aim of this study is to address the critical issue of household food waste in an Australian context. Food waste is defined in this research in line with the WRAP definition that “food waste consists of any food (i.e., product intended for human consumption) that could have been eaten (even if it is no longer suitable to be eaten when it’s thrown away) together with the inedible parts associated with food such as bones, rinds, pits/stones, and egg/seafood shells” [33]. Household food waste makes up a significant portion of food waste in Australia; however, it is an under-researched area. This research contributes to this gap. The objective is to gather first-hand qualitative data on household level food practices via food diaries and survey entries, with additional data on the volume of food wasted reported in cups over a two-week period. A focus on practices, rather than behaviours, is important and rare in the current literature [31]. This research contributes to the theoretical understanding of how food waste is influenced by other factors, namely the skills and technology that participants have access to, such as knowing how to compost or grow your own food, as well as preparing a shopping list and food preparation. The research will also test the hypothesis that those growing their own food produce less household food waste. There is a potential disconnect from the source of food to the how it ends up in the household, which can be overcome by edible gardening.

This study is centred on three main research questions:

Q1: What food practices are performed in Australian households and what is their relationship to waste?

Q2: What insights can social practice theory provide regarding food waste in households?

Q3: Does growing your own food influence household food waste?

The paper is structured as follows: to begin, the literature review provides an overview of current academic thinking structured in four sections. These are an overview of food waste in a global, Australian and household context, the reasons for food waste, the application of social practice theory used to examine food waste and the proposed interventions in the literature. Next, the methodology for the research is explained. Section 4 includes the results of the study and relevant discussion. This is structured in the context of each research question. Finally, the limitations are presented, and conclusions made.

## 2. Literature Review

The literature covered in this review is foremost the articles from scientific journals that have been peer-reviewed. There are some instances where grey literature has been consulted to provide insight into the level of government policy response. There has been a considerable increase in the number of studies in the past 5 to 10 years in this area. The review focuses on the most recent literature from 2011–2019 in order to present an up-to-date and current understanding. The databases of Web of Science and Scopus were used as a basis. The key word search included the search strings “food waste” and “social practices”, as well as “food waste” and “Australia” in order to uncover localised studies. Given that the research was conducted in English, the results represent English speaking Westernised countries that tend to be middle income. The equivalent studies from low income and/or foreign speaking countries are, therefore, not included in this research.

### 2.1. Food Waste

Research by the Food and Agriculture Organisation indicates one third of all food produced goes to waste, and it is from this data that much of the literature is validated [2]. There is, however, some ambiguity to the data and to how terms such as unavoidable, avoidable and ‘possibly unavoidable’ food waste are applied [2]. A systematic literature review conducted by Xue et al. found that a majority of the studies relied on secondary data, with only 20% of the studies analysing direct observations [7,26]. There is agreement across several existing literature reviews of Australian studies that national data are lacking [16,34]. As such, there is a prevailing argument for greater efforts to be put towards research and improving the availability of data [1,7]. A significant amount of research has been conducted in the UK and led by the government organisation Waste and Resources Action Programme, which operates as WRAP [35]. However, efforts to understand levels of food waste in Canada and the United States are in their infancy [26,36]. Nevertheless, a 2018 article indicates food waste related journal articles have doubled over the previous five years [8]. Although the number of studies is growing, there is a need to continue to research this issue and compile comprehensive data from which to tailor effective solutions.

It is a well-supported view that in middle- to high-income countries, food waste occurs predominantly at the consumption or household level [1,7]. Up to 40% of food waste is attributed to the consumer in middle- to high-income countries [1,7]. In the European Union, the household level is responsible for 45% of the total food loss and waste [1]. Some data suggest the developed nations in Europe, North America and Oceania, as well as China, Japan and South Korea are responsible for 56% of global food loss and waste [11]. In these countries, sophisticated systems are in place at primary production, storage and manufacturing stages, which have been shown to be proficient at minimising food loss and reduce the volume sent to a landfill [8]. It is, thus, particularly unfortunate that once the energy and resources have been utilised to farm, store and transport produce it, it is disposed of at the end of the cycle by the consumer, thereby increasing the impact on emissions and climate change [10]. In Australia, data from 2017 points to the household as responsible for 34% of total food waste [12]. Furthermore, in the Australian state of Victoria, government research shows as much as 88% of household food waste is avoidable [37,38]. Although much can be done to avert sending food waste to a landfill, currently, 79% of food discarded is sent there through municipal rubbish services [20,21]. Research suggests food waste constitutes on average 35–45% by weight of total municipal garbage in Australia [39]. In addition, a recent study by Reynolds et al. suggested Australian households divert 15 times more food waste from a landfill via informal methods than via formal municipal composting [6]. A gap remains in the literature on how to address this level; therefore, the question this paper will focus on is how to address the consumer impact of the high volumes of food waste in developed countries.

### 2.2. Reasons for Food Waste

Culture influences how or why consumers waste food. Culture, for instance, has a role in defining what food is edible and inedible. Research discusses how consumers learn in childhood what is culturally acceptable and internalise it into their food practices for life [40]. Researchers Ishangulyyev, Kim and Lee similarly found that cultures that have strong food rituals place higher value on food, and as a result, produce less food waste [1]. Other research has found that Australian food waste practices are similar to those in other Westernised cultures, such as the United States, that have weak food traditions. This is compared to certain European countries, such as France, where fundamental food rituals and rules play a crucial role in the household [41]. An insightful ‘Foodway’ study involved taking a collaborative social practice approach to understanding consumers’ understanding of ‘how we do food’ across three countries [8]. The findings included a recognition of the importance of ‘local’ food in food systems. A noteworthy insight is related to the self-proclaimed ‘foodie’ culture of Melbourne, Australia, and their interest and reverence for food to a limited culture of composting or respecting food waste [41].



This study concluded that there was little realisation of the connection of a love for food to not wasting it. Lastly, a review evaluating empirical studies from Europe recommended further research on the relationship of culture to food waste [8]. Where demographics is concerned, the strongest arguments are related to income and age. Several studies found youth to be more wasteful than those over the age of 65 [28]. For instance, Italian research found youth were concerned about food freshness, which led to more food waste [42]. Australian research on demographic factors influencing food waste is not too dissimilar from international research. A 2018 literature review found that those who discard the most food are a combination of young people, between the ages of 18–24 years, families with young children and those earning more than \$100,000 a year [43]. There is a correlation between culture and demographics with the production of household food waste that is recognised in this research project.

The consumer connection to their food source is often far removed and this may play a role in the production of food waste [27,44]. Typically, the acquisition of food in the modern food system takes place in a retail environment removed from where or how it is grown. It is argued this results in a lack of food citizenship [44,45]. The term food citizenship is defined as “the practice of engaging in food-related behaviours that support, rather than threaten, the development of a democratic, socially and economically just, and environmentally sustainable food system” [45]. A consideration of food waste in a citizen’s behaviour is crucial to active food citizenship. Furthermore, it is reasonable to assume food citizenship is improved when consumers take a more involved approach to their food’s journey, as many in low-income countries would be accustomed to. This can be realised through growing the food themselves or having access to a local farmers market [27,44]. In fact, O’Kane’s research refers to a hierarchy of engaged consumers from those involved in community gardens to those shopping in large retail supermarkets where food may have travelled from global sources [45]. Community gardeners exhibit a range of personal characteristics, such as patience and perseverance, that can inform their food decisions. Further up the hierarchy, supermarket shoppers show less engagement [40]. Csikszentmihalyi and Rochberg-Halton made a similar argument that when we dedicate energy and time to a certain object, it becomes part of us and even “emerges from self” (1981, [33]). Integral to engagement with the food system is an aversion for waste [45]. There is a significant correlation between the disengagement with the food system facilitated by the modern supermarket and the overproduction of food waste. The literature supports a macro-level food system shift towards greater local food systems as part of the solution to food waste issues [45].

Utilising values and attitudes of consumers to explain food waste has been studied extensively [8,9,27,30,35,43,46,47]. A frequent acknowledgement sees the provision of food in the household as tied up in a ‘good provider identity’ [43,48]. In relation to the waste of food, it is generally valued as improper behaviour [8]. This brings feelings of guilt for the majority [8,27,47]. Waitt and Phillips drew on qualitative research conducted in Australia [49]. They have suggested consumers reconcile guilt over food waste by taking pride in their ability to abide by social norms of freshness and food safety. Thus, the social norm of the ‘good provider’ is not always congruent with a reduction in food waste. The literature review further found evidence of how an individual’s attitudes and ideology can determine what is avoidance, unavoidable or possible avoidable food waste [3,40]. For instance, produce that is close to the end of life might be possible avoidable food waste; for some people, if it is not fresh it does not align to their ideology and must be replaced. Lastly, an Australia study on ‘green consumers’, those likely to follow sustainable living practices and prioritise organic produce and vegetarianism, were not concerned with food waste as an issue [13]. This point may reflect a lack of education on the issue impacting attitudes and behaviours. A lack of consumer connection to the food source and this impact on the values we associate with our food may also play a role in the production of waste [27,44]. There are a range of ways values and attitudes influence how we value food, and thus, the volumes of household food waste produced.

Finally, food practices that consumers undertake daily are of great significance to understanding why and how we waste food. Whilst undertaking research on the values and attitudes consumers bring to this issue have been extensive, the study of daily practices is limited, though it has increased in the past two decades. A study involving Italian youths points to practices such as poor pre-shopping planning, in-store behaviour such as impulsive purchases, storing food incorrectly, poor meal planning and lack of portion control [42]. The Food and Agricultural Organisation's 2011 study relays many of the same practices as responsible for food waste [2]. When you consider these practices as 'non-cognitive determinants' that lead to food waste, it underscores how little consumers realise their patterns or the consequence [50]. "Household food waste emerges as the many dynamics of daily life intersect with food provisioning, preparation and consumption" [43]. This quote accurately reflects how social practices interact and influence food waste. The overwhelming demands of everyday life surpass the intention to reduce food waste and the repetition of practices, whether positive or negative for food waste, become default [31]. The significance of social practices and their implications for food waste is a newly explored area and will form the basis of this paper.

### 2.3. Theories

The literature review identified two primary theories to address food waste: the theory of planned behaviour and the social practice theory. The Theory of Planned Behaviour is a popular model to apply to environmental issues; however, there was doubt as to its applicability to the issue of food waste in households [25,48,50].

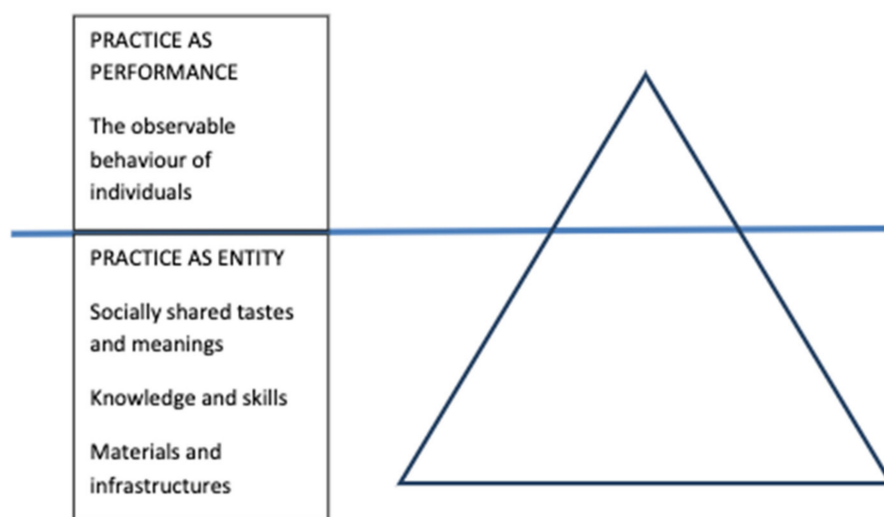
#### Social Practice Theory

The key theory this research will focus on, as identified in the literature, is the social practice theory. The prominence of social practice theory and its application to environmental issues came about due to the influence of Shove and colleague's work [32,51–53]. Furthermore, Shove built on work by Schatzi, that instigated renewed interest in theories of practice in the social sciences [54,55]. The literature review found a number of studies express a preference for the ability of social practice theory to provide a coherent response to the need to shift society to more sustainable lifestyles and resource use [27,28,53,56–63].

The theory is built upon the need to consider more than just an individual's attitude in relation to behaviour change. Rather, it takes a three pillars approach incorporating an individual's knowledge or attitudes, the material world or technology used, and competences or skills involved in performing a practice [32,56]. These three pillars have also been referred to as meaning, technology and skill [63,64]. Importantly, the theory suggests that in order to shift practices, each pillar takes a role and the application of just one may not influence change [59,61]. Thus, rather than discussing the individual's attitudes and behaviour change over time, the focus is on how practices evolve [56]. A social practice approach highlights how food practices are interlinked with other daily practices that should be considered when attempting to change them.

In transitioning to social practice theory, the literature has referred to why it is preferential to an individual behaviour-based approach [32,53]. This reasoning began with Shove's 2010 paper titled 'Beyond the ABC; Climate Change Policy and Theories of Change' [32]. The ABC refers to A, values and attitudes, which drive B, behaviour, that C, is the choice for individuals to adopt [32]. Shove references the multitude of government reports, policies and campaigns that rely on this approach and regrettably take the focus off governments to make any broader shifts in infrastructure, technology or upskilling [32]. The primary method of influence is education campaigns tackling motivations and barriers in order to drive behaviour. Generally speaking, these have an impact, but again, as discussed earlier, the value-action gap is well-founded [32]. Researchers have demonstrated that whilst individuals can believe and value one thing, their behaviour or action demonstrates another [32]. Figure 1 illustrates how social practices are constructed by more than the surface level behaviour of the individual, but involve social shared meanings, skills and

materiality [56]. The decisions and actions made by individuals every day are not only driven by their values but are part of on-going practices, bundled up in other practices and not a one-off event [27,53,59]. A social practice approach is necessary to overcome the daily complexity of choices an individual has to face, which may impede their values. It also highlights how food practices are interlinked with other daily practices, in the Home System of Practice. Research has shown that the timing of food consumption is consistent in households that are more highly interlinked with routine practices than those that are loosely interlinked [63].



**Figure 1.** Observable behaviour is just the tip of the practice [56].

There is limited research linking social practice theory to food waste in households; however, the literature review uncovered an increase in research in the last few years [8,27–29,43,45,49,60]. Several studies make the point that food waste is not simply a result of a lack of knowledge or awareness and is entangled in sociological connections [8,28]. There is also a consistent position in the literature that food waste does not occur independently, but should be recognised as a by-product of a complex set of practices as well as influenced by social context, cultural norms and available infrastructure [8,27–29,43]. These practices include food provisioning, preparation and consumption. Waitt and Phillips study made a valuable contribution to the literature by examining how the infrastructure of refrigeration underscores food practices [49]. Almost 100% of Australians own a refrigerator and 34% have two or more in use [49]. The majority of food practices are influenced by how we use the refrigerator. One example being the ability to store and keep leftovers fresh, which allows consumers to cook more than is needed [49]. The refrigerator may seem as though it makes a positive contribution to keeping food fresh and avoiding waste; however, in many ways, it creates a lazy consumer who relies too heavily on it [65]. For instance, a large fridge allows you to buy too much food and eventually produce spoils. Interesting to note from an Australian state government body, the New South Wales (NSW) Environmental Protection Authority, is that spoilage is the main reason for food becoming waste and leftovers comes in at number two [66]. The social practice theory has well-founded principles that could be applied further to the issue of food waste [63].

The use of the social practice theory to implement interventions to household food waste was found to be limited in the literature review. As a theory, it is still to be widely applied and tested in real-life interventions. A consistent approach is to view practices as either food waste drivers or conducive to a food waste reduction and to look for opportunities within these practices to shift the outcome [20]. The act of identifying the connections between practices was a proposed intervention [27]. Furthermore, it is recommended that interventions are implemented at the moment of action; for instance, to make the connection during acquisition of food, in the supermarket, to food waste occurring whilst

in storage [56]. Schanes, Dobernig and Gozet utilise social practice theory, along with other social ontologies, to suggest interventions such as training of cooking skills and using kitchen devices for better portion control and mobile applications that list food inventory [8]. Lastly, there's evidence of the use of meaning or ideology to shift practices. Rituals and the meaning surrounding them could be an entry point to intervening on food waste outcomes [29]. Similarly, the recognition of meaning associated with food and practices could be used to develop interventions that reduce the conflict between consumer intentions and practices [56]. Lastly, the review found that there is a consistent admission that food waste in the household is unlikely to be solved by a single intervention. Researchers caution that the issue is complex, and there is a need for multiple types of interventions to be implemented to see success and interventions that work in one household may not work in another [28,53,60].

### 3. Methodology

The research undertaken in this paper set out to capture primary data on food waste practices in Australia and examine it through a social practice lens. Utilising social practice theory provides a valid and pertinent lens from which to analyse practices and identify fracture points to apply interventions. The set of dispersed food practices focused on were acquisition, storage, preparation and waste. This covers the areas of the food journey that consumers have influence over and are an important contribution to the entire life cycle of food from growth to disposal [67].

The study collected data through two means over a month-long period in early 2020. Participants recorded a food diary for two weeks, followed by an online survey. The use of either a diary and/or survey are considered two of the main methods used in household food waste research [44,59,68,69]. Silvennoinen et al. collected data via a self-reported food diary though on a larger scale with 380 households participating [27,70].

The use of self-reported data is common amongst the research reviewed, whether facilitated via a recorded diary, online survey, face to face interview, focus group or telephone survey. There can be a degree of bias that comes through with self-reported data, i.e., participants are likely to shed a positive light on their behaviours [44]. To overcome this potential bias, the food diary conducted in the first instance provides some realistic insight into a participant's behaviours. Giordano et al. suggested diaries are used in research to overcome any doubt on the reliability of survey results [71]. Schanes et al. named kitchen diaries as a more objective technique to avoid self-reported discrepancies in surveying [8].

A third method used commonly in household food waste studies is to conduct waste auditing. This provides an accurate representation of types of food waste and volumes. It is considered best practise, particularly when coupled with diary entries [71]. However, waste auditing is a timely and expensive process and not necessarily useful in order to understand when, where and why food waste occurs in the household, which is the purpose of this research [44,68]. As waste auditing was not an option in this research, the preferred methodological approach to gain the most accurate, reliable data was the two-week diary followed by a food and social practices survey.

A copy of the food diary provided to the participants can be found in Appendix A Figure A1. A copy of the survey can be found in Appendix B.

While most data generated is qualitative data, respondents did record the amount in cups of food wasted each day, producing some quantitative data. The chosen focus on more qualitative data differentiated this study to others that focus more on quantitative data such as those undertaking waste audits or life cycle assessments on food waste [22,67,72]. This methodological decision aligns this research with the social practice theory literature that has investigated this topic previously, albeit not in an Australian context [59].

Recruitment of a reliable, engaged set of participants for the research was crucial to the study. There was little risk for those involved; however, the time input and commitment over two weeks was of significance. Taking part in the research project was voluntary, with participants self-selecting themselves, and unpaid and consent was obtained from all

participants in line with ethics approval. The aim was to conduct the study using data from all over Australia and from a fairly diverse set of demographic make-up. The one condition necessary for the research question was for a portion of participants to be involved in growing their own food, to address RQ3. The recruitment reflected this intention and was undertaken via two methods. One method was via a local community noticeboard in Manly, Sydney, and through the researcher's personal networks. The recruitment called for volunteers to undertake 'food waste and social practices research' and was careful not to use language that desired a certain type of person or household. The flyer unfortunately did not attract any interested participants. However, being cognisant of the low completion rate to be expected from a two-week long study, the researcher went out to a series of networks, and this resulted in 40 interested participants who sent the paperwork for the food diary. The secondary method was via a nationwide program, Grow It Local and its approximate 2000 member-base. The methods were chosen to reach a variety of audiences, but to ensure a portion were made up of participants involved in edible gardening. To reduce social desirability bias, respondents were told their data would not be identifiable and the participation information would be coded by the researcher. Recruitment and completion of the diary and survey exceeded the initial goal of 25 participants.

Grow It Local is an online platform and program that seeks to engage the community in growing, sharing and eating locally grown food. It is a recently established organisation made up of a member base of keen edible garden enthusiasts from around Australia. Members of Grow It Local sign up to register their garden patch on the online map and connect with like-minded local community members. One of the researchers holds a part-time role with the social enterprise and was able to access the database for this purpose. The initial email to participants to request volunteers provided little information on food waste and was simply a request to volunteer their time. The language was careful not to be biased and remove any marketing spin. The email went to a database of 2435 and received a positive response from 135 members interested to be involved. Once provided with the exact requirements and paperwork to conduct the food diary, the number reduced by ten and reasons such as taking a holiday or being busy with work were provided. In any case, it proved to be a reliable source of engaged community members, who could help with researching the connection between growing your own food and the impact it has on food practices. This will be explored further in the results and discussion section.

The data from the two-week long food diary provide insight into when and why food waste occurs in the household and any of the associated practices. To reduce barriers to involvement, the researcher provided a month-long window to record a two-week period. The estimated time involved was 5–10 min a day; however, remembering to complete the diary was most likely the greater burden and may have resulted in data being recorded after the actual event, i.e., food thrown away one day and recorded the next. This is recognised as a risk in the accuracy of the data collected via a food diary [68,71]. To prevent this from occurring, it was suggested to participants to keep a printed copy in the kitchen and to inform all household participants of its purpose and use at the beginning of the period. As Giordano et al. rightly suggested, a diary correctly filled out in the moment of disposal removes the risk of false entries or ideals of self-perception [71]. To further reduce the barrier to involvement, rather than weighed measurement of waste, the request was to estimate the volume using the standard metric cup. This is also common practice as highlighted by Elimelech et al. [73]. The outcome sought after was to understand comparatively the volume of food disposed at various mealtimes or via storage or shopping practices, and as such, this method was sufficient. It was not the intention of researchers in this study to undertake a more detailed measurement process for food waste, such as a food waste sorting analysis, due to the constraints around project duration and the focus instead on the elements of the practices. As Koivupuro et al. pointed out, the value of the diary is in the context provided for each single disposal [68]. Participants were not given specific instructions regarding inedible and edible foods. All food that was not consumed and disposed of via the garbage, compost or to animals was to be recorded. A study by



Herzberg et al. took the same approach, leaving the classification of food waste to the participants discretion [74]. The recorded data, thus, provide insight into the individuals' concept of waste and the distinction of avoidable and unavoidable food waste, i.e., most recorded vegetable peelings; however, some individuals did not make this distinction. Some households returned the diary with no records, claiming zero waste. The concept of 'zero food waste' households is also touched on by Herzberg et al. and recommended that it is given further exploration [74]. The requirement was to also record the incoming food into the household and its source. This provided insight into the regularity of acquisition of food and some qualitative understanding of the types of sources utilised. The food diary, once completed, was sent back to the researcher via email to record on the database.

To recap, within the food diary, the follow information had to be provided (as specified in the instruction form):

- Day of the week;
- Incoming food (e.g., what kind of food, weekly shop or just for dinner);
- Source of incoming food (i.e., supermarket, market, garden);
- When was it wasted (i.e., during which practice, or which meal);
- Type of food wasted;
- Amount (suggested to be estimated in cups);
- How it was disposed;
- Reason for disposal.

To complement the food diary, a survey on food waste and social practices was also conducted with participants. Questions were based on the series of dispersed practices that come together to form a food waste nexus. As discussed in the literature review, practices that involve food are the basis from which to influence food waste [8,30]. The survey link was sent to all interested participants in order to collect a robust set of data. The survey was sent at completion of the diary to allow for the survey responses to reflect the real-life data captured in the diary, as per the approach by Elimelech et al. [73]. Participants who had completed the food diary were asked to enter their full name to correlate the data. The remaining respondents were anonymous to protect their privacy and reduce the influence of social bias.

The survey began with confirming consent and a short demographic survey, including nominating if the participant was a member of Grow It Local. This was followed by five distinct sections that followed patterns of food practices. These were the acquisition of food, meal planning and preparation of food, cooking, eating and waste. The final section asked a small number of questions about their attitudes and education regarding food waste as a sustainability issue. For instance, 'what concerns you the most about food waste?' Lastly, the survey provided the option for comments in order to yield some qualitative data on behaviours and attitudes and the meaning associated with food waste. The majority of the 43 questions were multiple choice to facilitate data analysis, with multiple opportunities to select 'other' and explain the response. Many of the questions were about general food practices, rather than waste-related, which may contribute to reducing selection bias. The goal was to uncover how these dispersed practices come together to produce waste, the meaning, skill and technology involved and provide thinking of appropriate solutions to successfully intervene to avoid food waste in the household. A copy of the survey can be found in the Appendix B.

The data in the food diary entries and survey responses were thematically analysed to identify trends in what, when, why and how food was wasted. This was conducted through identifying a number of codes or themes that were covered in the responses [75]. The goal was to uncover how these dispersed practices come together to produce waste, the meaning, skill and technology involved and provide guidance to appropriate solutions to successfully intervene to avoid food waste in the household. These themes included why food was wasted, the reasons given for food being inedible, how the food waste was disposed of and how food was acquired. A further analysis of the results identified the social practice elements relating to these themes, such as the technology used (e.g.,

refrigerators, compost bins or animals), the meaning associated with the practice (e.g., valuing organic food or having mealtimes together) and the skills associated with the practice (e.g., knowing how to store leftovers or reusing organic waste in the garden). The survey results complemented the food diaries and further allowed for cross-tabulation of the data to compare answer choices to one question across the rest of the survey. For example, the question on growing your food was factored in to produce results comparing this response to that of other questions. The volume of waste discarded was recorded in the food diary, and this was considered in relation to the reasons why it was being wasted. This provides insights into the links across practices without using statistical analysis. Furthermore, the qualitative data gathered through both the diary and survey was useful to extract greater meaning and context behind these data. Results reported as a percentage were obtained through presenting the number of results of a particular answer as a percentage of the total responses to that question.

#### 4. Results and Discussion

This section provides the results of the socio-demographic details of respondents to the study, followed by a discussion of the results in relation to the three research questions.

Responses were completed by participants with a mix of socio-demographic details. In total, 21 completed food diaries and 64 completed surveys were collected. There were a number of respondents who declared that they completed the diary on the survey, but rather, they sent an email correspondence in its place explaining why no diary was necessary, as they produced zero waste. These respondents were those who grew their own food, fed the food to chickens or composted it. The recruitment process via the researcher's networks and the membership base of Grow It Local produced participants based around Australia, though a majority from NSW. These networks consist mostly of middle-income individuals with an average education above secondary school. This aligns the research with previous studies that have concluded that in middle- to high-income countries (such as Australia), the proportion of household expenditure on food consumption is low in the total expenditure of households [1]. Hence, many households can afford to waste food without experiencing adverse financial impacts.

The household composition of participants included 45% from a two-person household, 20% from a four-person household, 16% from a three-person household and 13% living alone. A smaller percentage lived in households of five or more. Descriptions of these households ranged from family units and those with young families to housemates, de facto partners, singles, young professionals and retirees. As far as gender is concerned, the majority of survey respondents were female, with 61% females and 38% males. Although the study did not set out to collect data from strictly those responsible for household food, these results are congruent with the high percentage (62%) of women responsible for grocery shopping and who would have been likely to engage in the study [76]. Age is also of interest in regard to household food waste levels. In total, 40% of survey respondents were within the age of 30–39 years, 19% between the ages of 50–59 years, 17% between 60–69 years and 14% between 40–49 years. This is an appropriate sample size of the Australia population, given that the median age is 37.

##### 4.1. Australian Household Food Practices

###### 4.1.1. Type of Food Waste

The results of the research indicate the greatest volumes of waste can be categorised as vegetables, fruit and meat and dairy. Figure 2 shows the results from respondents on which types of produce were disposed of most commonly. Vegetables were recorded across the board as the number one category of produce to be disposed of through the survey. The survey analysis involved comparing this data point with a number of factors across the various practices; however, it still remained as number one. For instance, if the shopping practice involved shopping with a list or deciding at the time of purchase, the practice still resulted in vegetables being the number one category. The details from the food diary

demonstrated that 70% of respondents disposed of a majority of food waste categorised as inedible food scraps. These ‘inedible’ scraps were labelled as items such as bread crusts, vegetable ends, apple cores, vegetable peels, coffee grounds, chicken bones, eggshells, garlic and onion skins etc. Thus, they included a lot within the category of vegetables. The records on the volumes disposed indicate the greatest volumes were from vegetable ends, fruit cores and other food often recognised as inedible. The preparation for an evening meal, for instance, is recorded as 2–3 cups of vegetable peelings, such as carrot peel, bok choy ends and kale stems. These data correlate with the 58% of respondents who reported that the most waste is disposed of whilst preparing a meal, compared to other practices such as eating or storing. Those whose waste was made up of a greater part by edible food waste included the two families with young children, single dwellers and households with four occupants. There was just one instance of a household of two disposing of edible waste. The edible food disposed of was made up of leftovers (e.g., chicken stir fry, cooked sausages, edamame) and food that had past use-by dates or were deemed unsafe (e.g., milk, bread, hummus). Overall, the data suggest that vegetables, fruits and the food scraps present the greatest challenge to shifting food waste volumes in households.

What are the most common food items thrown away? Please number from most common as 1.

Answered: 61 Skipped: 4

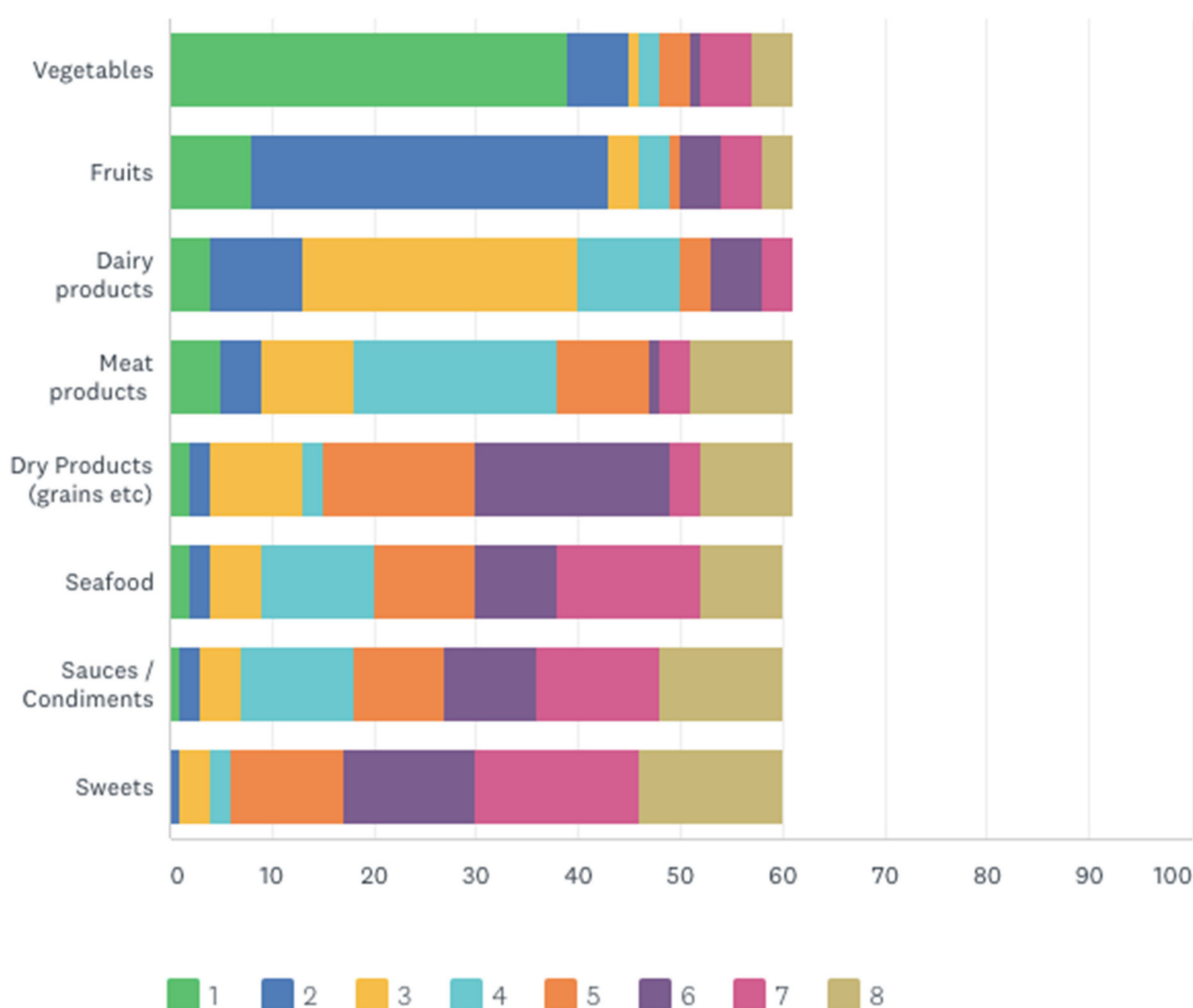


Figure 2. The most common food items thrown away as reported by participants.

The prevalence of vegetable food scraps underscores the importance of a consistent definition for food waste. Referring to the views of Werf, Seabook and Gilliland, there are many definitions of food loss and waste, edible versus avoidable or, inedible etc. [20,26,27,29]. Respondents recorded food waste such as ‘garlic skins, stones’ and ‘apple core, potato peels, celery tops’ were disposed of, with the reason being they are ‘inedible’. Several respondents did not list any vegetables and fruit peelings, cores or ends as waste at all, suggesting that it was considered unavoidable waste, but also, therefore, does not factor into their conscious of how much waste they produce. Given that inedible food thrown away is considered under current Australian benchmarking studies, it is concerning that some residents do not recognise it as such, and presumably, do not consider its impact once sent to a landfill. As per the discussion in Section 2 in the literature review, it is clear that there is some ambiguity as to the definition of food waste, and this impacts data collection and successful analysis.

Several households defined food scraps in three different ways, as follows:

*“Nonedible parts of the fruit or vege [sic]: Peelings, rinds, skins, seeds, roots. Food left on plates. Cooked food that is leftover that isn’t eaten. Doesn’t include the fresh produce that goes bad in the fridge in my mind—don’t know why . . . ”,*

a second as: “Anything organic from the preparation of foods (cuttings and peelings) to soiled or past use by dates. Meats, dairy and breads included” and a third as:

*“Something inedible (onion skins) to begin with. Something unable to provide nutritional benefit or flavour, so lemon peels are scrap once you’ve zested them, root trimmings if cannot grow them, veg bits once you’ve stocked them, and so on.”*

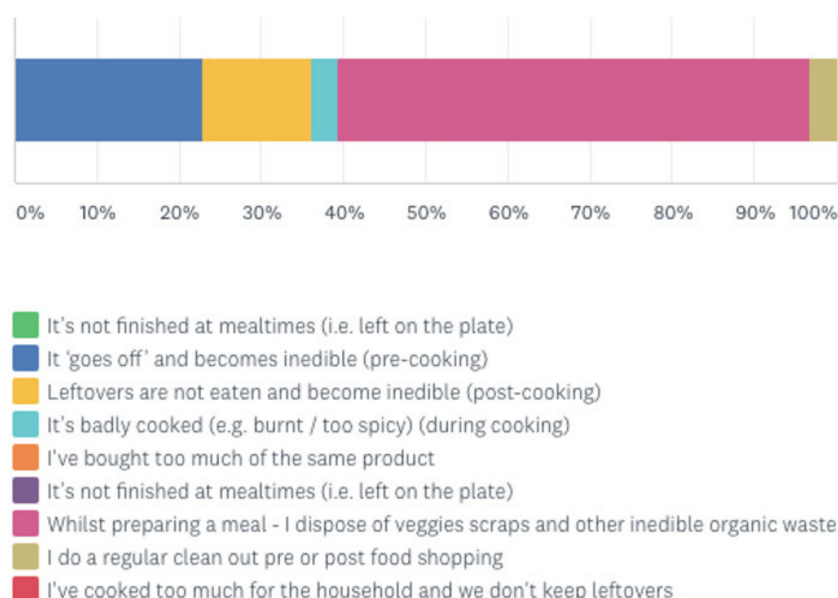
These comments demonstrate the range of definitions associated with food waste, and this influences how food plays out in practices and disposal. The third comment and definition relayed, one where vegetables are not disposed of until all value has been taken from them, is where all Australian households should aspire to be in order to reduce food waste.

#### 4.1.2. Stage of Food Waste

Second to ‘preparing a meal’ (58%), respondents stated the practice of ‘storing’ food (pre-cooking) (23%) was the reason most food goes to waste. This was followed by leftovers at 11%, but all other responses were not represented very well or at all. Figure 3 demonstrates the dominance of preparation and storage waste. Storage was also widely cited in the food diary after ‘preparation of meals’. The ‘reason why food wasted’ entry includes examples such as ‘out of date’, ‘went off in fridge’, ‘cleaned out fridge’, ‘past use-by date’ and ‘spoilt in storage’. This type of waste can be undoubtedly categorised as avoidable, particularly compared to some preparation waste which is unsafe to consume, and thus, could be a more valuable area to focus on to reduce food waste practices. Certainly not all households or respondents have a storage issue. There was evidence of patterns within the households who consistently disposed of food in this way, whereas some rarely did. An example being a single household respondent, with 18 instances of disposing of food such as salami, rotten bananas and expired eggs, all identified as storage issues and zero instances of preparation waste. These patterns correlate to those who grow their own food, which will be explored further later in this article.

## At what stage does the most food go to waste in your household?

Answered: 61 Skipped: 4



**Figure 3.** Survey response to “at what stage does the most food go to waste in your household?”.

### 4.1.3. Disposal of Food Waste

In terms of disposal practices, the research considered how often food is wasted and how it is disposed. The number of instances of food disposed of over the two-week diary period varied considerably. One household of four recorded 67 instances of food thrown away, whilst another household of two recorded just one. However, on average, no matter the household size, some form of food waste is recorded once to twice a day and generally several items at once. There were some comments made by respondents that the act of completing the diary increased awareness of how often food is disposed of. This links back to the HomeLabs study and the act of reflecting and recognising practices as an intervention to changing them [60]. Despite this, it is evident that the act of disposal is an almost invisible and unconscious result of previous decisions, bound within other practices [59].

The food diary data indicated a significant portion of disposal is informal, rather than captured by government operations. There were 11 respondents out of 21 completing the food diary utilising compost to dispose of waste. There were also seven respondents who provided waste to animals regularly. The diaries show extensive use of the household general bin collected by municipal services and most likely headed to a landfill. Only one respondent indicated that her local government provided a specific food and organics waste service, which will likely be industrially composted. This finding correlates to the argument provided by Reynolds et al. that 21% of household waste is informal in an Australian context [6]. The NSW government Environment Protection Authority study also found that those who compost or give leftovers to household pets do not always perceive this to be food waste [77]. Given that inedible food thrown away is considered food waste under current Australian benchmarking studies, it is concerning that some residents do not recognise this as such, and presumably, do not consider its impact once sent to a landfill.

### 4.2. Social Practice Theory Insights into Food Waste in Australian Households

A social practice theory approach to understanding food practices involves identifying the skills, meaning and materiality supporting each [77] practice. Each practice (acquiring,



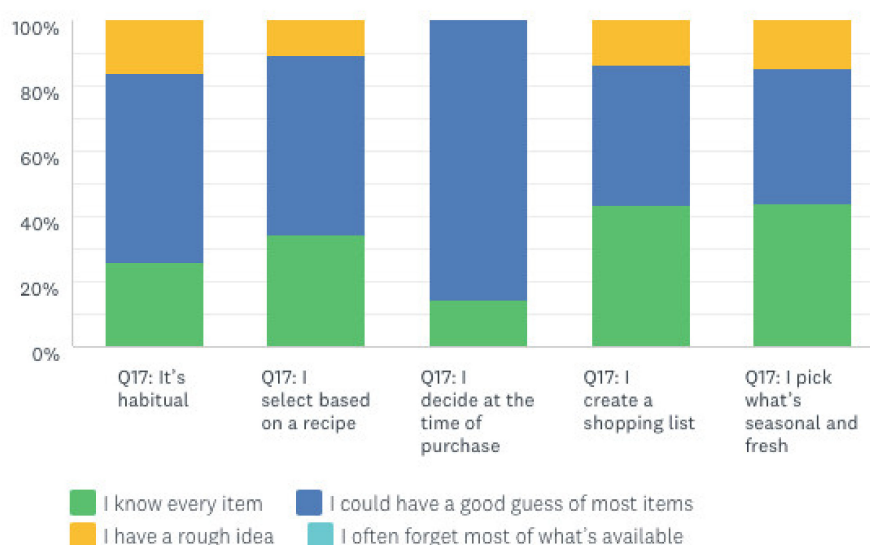
meal planning, storing, cooking, eating and the practice of disposing itself) provides a decisive moment where skills, meaning and materiality come together to prevent or drive food waste [3,40]. This research recognises these food-related practices as dispersed coming together around the nexus of food waste. However, each practice, such as cooking or eating, could also be considered as integrated given the complexity of them even in isolation and with own rules and goals interwoven [45,60].

#### 4.2.1. Skill

Firstly, the element of skill will be explored in respect to the research's findings. Acquisition of food and the skills associated with it proved to be a powerful element with connections to decisions made in other food related practices. For instance, those who decide at the time of purchase what to buy also indicate a reduced ability to remember the contents of what is in storage in their fridge or pantry at home (Figure 4). Only 14% of those who bought the food could remember every item versus 45% of those who created a list. Equally, those who decide what to buy at the time of purchase revealed little skill in cooking practices. Overall, only 4% of respondents 'plan to make more when cooking, just in case', but this jumps to 14% for those who make poor decisions at acquisition. Unfavourable 'purchasing without planning' practices at acquisition also correlated to a higher rate of food being disposed of in storage. The insight from social practice theory is that by identifying the weakness of practices and the interdependencies between them, we can define practices and design interventions to shift them [28,31].

### How well do you know the contents of your fridge and/or pantry?

Answered: 62 Skipped: 1



**Figure 4.** Respondents' knowledge of their food in storage varied according to their acquisition practices.

With this in mind, the overarching skill to emphasis is good household management, including responsible acquisition of food that complements meal planning. The research demonstrates these skills are closely linked. The respondents who shop with a list always plan their meals either weekly or the day before, rather than a couple of hours before or at the time shopping. Stefan et al., amongst other researchers, are supportive of careful planning and shopping routines that help to reduce food waste [15,26,78]. Less than 50% of respondents indicated that they use a shopping list when deciding what to buy, and as such, it is a relevant skill to build upon in the Australian context. In this scenario, household management as a skill could be complemented by the introduction of new materiality, such as a kitchen whiteboard list or a shopping list app to record items that have finished and

plan meals. Hebrok and Heidenstrøm recommended that helpful cues are placed within the moment of action to assist in changing practices [28,48].

Taking the Sahakian and Wilhite approach to use stories in context, the recommendation to encourage these respondents to begin composting would be to create the 'learning proposition' within their specific social context [56,59], i.e., small spaces, with children etc. Community research in Australia has also endorsed backyard composting as the preferred policy driver to food waste reduction [8]. Thus, composting is a solid step in the right direction to reduce unavoidable food waste.

Another effective measure would be to encourage developing skills to utilise all parts of plant and animal produce. Utilising the waste hierarchy as a guide to efficiency in resource recovery, avoidance and reduction are prioritised over reuse and recycling, such as composting. This point also highlights the issue surrounding the definition of edible and inedible, avoidable and unavoidable food. Meanings and social norms as an element of social practice plays a role here [48]. In some cultures, or social contexts, it is acceptable to eat the whole animal, or there are recipes that incorporate the whole plant or vegetable. Hennchen discussed the idea of 'meaningful knowledge', linking meaning to competence [56,59]. Essentially, it is based on the concept that knowing how to do something is tied up in the practitioner's social context [3]. Furthermore, Shove and Spurling suggested existing social networks are crucial for how practices of comfort circular and change [55]. In an Australian context, where food is inexpensive, the desire to incorporate aesthetically undesirable food is limited, but new meanings or skills can be developed to overcome this predisposition. The intervention from a social practice theory perspective may find building social norms whilst teaching skills via cooking demonstrations or communications may be effective. For instance, TV shows that use up the typically 'inedible' ends, skins and leaves of vegetables or the use the 'whole animal' in the meal. Recognising the strength that meaning and skill hold in how the practice of cooking unfolds is useful to shift this practice, specifically in the context of using the whole food and all avoidable waste. The recommendation is, therefore, to address the great volume of waste being produced via the preparation of home-cooked meals through food scraps.

#### 4.2.2. Meaning

The research finds a strong culture of cooking and mealtimes in the home in the Australia context. In total, 95% of respondents indicated they or someone in the household prepares a nightly meal at home every night or most nights of the week. The diary entries supplement this finding with limited instances of takeaway meals. The reason for food waste response 'it's not finished at mealtimes' was not selected by any respondent as the stage at which most food goes to waste and 86% of respondents never or very rarely leave food on the plate. These results indicate that Australians value and make time for cooking and eating within their household. There is a recognition in the literature that practices are not individual choices but are shaped by shared experiences and culture norms [66]. Mealtimes are one of the only food practices in the household that typically happen in the company of others. Furthermore, given that waste disposed of at this stage is pronounced and self-evident, it is reassuring to see that plate waste rarely occurs. It has been argued that food rituals, such as cooking and eating at home regularly, particularly sharing a meal with the household, create value for food [28]. The above findings stimulate the argument on the importance of meaning and social context for the practice of cooking and eating, and its relation to waste.

The strength of the 'meaning' or 'value' element in the practice of acquisition is evident through this research. The most prominent response for how you select what to buy is 'I pick what is seasonal and fresh'. This behaviour was chosen by 67% of respondents and came out ahead of shopping with a list or topping up habitually. An Australian study by Pearson et al. also found the importance of high standards of quality and freshness came through in the reason for the acquisition of food [16]. Food awareness

campaigns can, therefore, leverage the good provider identity to go beyond the household and make the connection to looking after the planet and future generations by reducing waste [9,27,28,48]. The strategy is to utilise social networks and participatory learning to infuse this new meaningful knowledge [9]. In the Australian context, the suggestion is that a good provider aims to provide fresh ingredients [79]. There was evidence in diary responses of 'old' food being disposed of, i.e., salami that had been "open for more than 5 days" was given as a reason for disposal. As Waitt and Phillips suggested, the emotional connection cannot be disentangled from food practices [49], specifically found in this research during the acquisition stage.

Interventions to reduce food waste could leverage the agency of meaning at the acquisition of food phase. Given that acquisition is a practice that undoubtedly has an influence on increasing or decreasing the disposal of food waste, it would be pertinent to draw the connection for consumers [8]. There is value in utilising the seasonal, fresh and good provider identity at acquisition to link it through to meal-time practices, where food is, furthermore, seen as valued. Creating this link in otherwise dispersed practices would help consumers reinforce the value of food in their lives.

Awareness and education to shape meaning associated with food waste can succumb to the 'value-action gap', but the research shows that it is still a relevant and powerful element. This research found that 93% of those who disposed of less than 10% of their household food knew food scraps produced methane when sent to a landfill. This demonstrates an education and awareness of the environmental impact of their food waste that may influence their practices. This is compared to just 67% of those who reported disposing a higher rate, of 10–20%. Furthermore, 76% of those disposing of less than 10% of food waste reported climate change as an extremely important issue to them, compared to 50% of those whose waste was in the higher, 20–30% bracket. The reported failures of the theory of planned behaviour ring true when education is solely relied on to influence behaviour. Shaw, Smith and Williams argued that the power of information as a driver of food waste behaviour is somewhat limited [3,49]. Within social practice theory, this is addressed through the understanding that knowledge builds meaning and it is recognised as a pillar upholding a practice that should not be altogether dismissed.

Building on this point, with respect to the pillar of meaning, drivers to reduce food waste were uncharacteristically found to be linked to environmental concerns. Data from the literature review suggest 85% of Australians identify financial loss as their primary concern when food is wasted, compared with just 41% concerned with the impact on the natural environment [66]. However, this research found resources wasted (i.e., waste, energy and labour) and the impact on the planet (i.e., greenhouse gas production) account for 90% of prevailing concerns about food waste. Financial concerns were most important for only 8% of respondents. It was evident there is an existing societal norm and meaning associated with the reduction of food waste, the environmental outcomes and climate action. Education and communication that strengthens the societal norm currently building around climate action in Australia and leverages that this driver would be a valuable strategy for reducing food waste.

These findings counter the research of Australian studies reporting consumers unaware of the environmental impact of their food waste [13,16]. The 2019/2020 bushfire crisis in Australia, and specifically those surrounding Sydney, may have amplified the concern for climate change and environmental protection in the early months of 2020 when this research was being undertaken. This research and previous research on food networks from a Queensland university both involved participants with a similar education level, beyond secondary school [13]. The Queensland study recruited based on participants being 'green consumers'; yet, there was no recognition by these consumers of the sustainability link to food waste. This research went further to specifically recruit members of Grow It Local, who grow their own food. Although being a green consumer has been shown not to influence their view of food waste as being an environmental issue, the edible home growers and their connection to their natural environment and the food system and its

cycles may be key to forming the relationship between the environmental impact of their food. The inclusion of edible home growers may have impacted the environmental concern. This will be discussed further in Section 4.3.

#### 4.2.3. Technology

The third pillar of social practice theory is materiality or technology. This is the influence of objects, infrastructure and tools in how practices are performed [43,80]. Often overlooked in behaviour change theories, social practice theory recognises technologies dictate a set of dispositions that have the power to shape practices and, in some cases, agency [66]. The findings of this research point to the agency of the materiality in storage practices. Discussions about meanings point to a good provider identity that sets out to supply fresh food and succeeds to carry out this practice in acquisition, cooking and eating, but inadvertently creates food waste during storage. Participants cited examples such as 'out of date', 'went off in fridge', 'cleaned out fridge', 'past use-by date' and 'spoilt in storage'. See the example food diary entry in Figure 5, citing 'rotten' and 'expiry', as well as the 'bought fresh for sandwich' item. Similar responses have been discussed previously; planning meals is a skill most respondents have and employ, and available ingredients was selected as the most common variable in deciding what to cook. The skills and the intentions are evident. However, 60% of respondents reported that they could only have a good guess or have a rough idea of the contents of their fridge or pantry. Similar to this study's findings, the NSW Environmental Protection Agency, where this research was collected, cite spoilage as a main reason for food becoming waste [27]. The conclusion is that there is a material barrier to shifting storage practices to reduce food waste.

Food Waste & Social Practices

Curtin University

DAY:	INCOMING FOOD:	Source	FOOD WASTED:	Type of Food	Amount	How Disposed	Reason
3 MONDAY 27/11/20			STORAGE	MILK	500ML	GARBAGE	WENT OFF (PAST EXPIRY DATE)
11			STORAGE	JUICE	500ML	GARBAGE	WENT OFF (PAST EXPIRY DATE)
1 SATURDAY 1/2/20	COLES WEEKLY SHOP	COLES	STORAGE	EGGS	6	GARBAGE	EXPIRED
11			STORAGE	SALAD LEAVES	200G	"	EXPIRED (CAN'T FINISH WHOLE BAG IN TIME)
11	BANANAS		"	BANANAS	4	"	ROTTEN (BOUGHT NEW FROM COLES)
SUNDAY 2/2/20			"	COOKED CHICKEN	200G	"	BOUGHT FRESH CHICKEN FOR SANDWICH

Participant Survey Version 2, 29/11/2019

Page 3

Curtin University Human Research Ethics Committee (HREC) has approved this study (HRE2019-0817)

Figure 5. An example food diary demonstrating storage as a point for disposal.

The refrigerator stands out as an important materiality in storage practices. It allows households to fulfil their fresh and seasonal values surrounding food and provides the comfort of storing perishable items, such as vegetables, longer than one otherwise would. Waitt and Phillips described the refrigerator as responsible for the development and maintenance of household food practices [49]. Several studies have centred their research on the refrigerator as central to intervening in unsustainable food waste production [27,45].



To utilise the agency the materiality provides in this practice, an effective suggestion is having a smaller fridge to reduce the amount of food that could be left forgotten in the back and in large drawers [28]. Alternative interventions include utilising smart refrigerator and apps, such as refrigerators cameras that are accessible via WiFi. This would allow households to check the refrigerator whilst out of home [28]. The Homelab experience shows us that simply recording and reflecting on the practices surrounding the use of the refrigerator could influence consumers to intervene in their own bad behaviours [28]. As storage has been found to be a key practice in the production of waste, though not through any intention of the household, a shift in the materiality used to uphold these practices could see a positive shift to reduction of waste.

#### *4.3. Does Growing Your Own Food Influence Household Food Waste?*

The third research question relates to the practice of growing your own food to food waste in the household.

Firstly, the results of this study demonstrate those who grow their own food are more likely to compost, and this influences their relationship to waste. The presence of an edible garden requires good soil, and a nutritious organic soil can be created via home composting. This study found that 87% of Grow It Local members have access to a compost or worm farm system, compared to 37% who are not Grow It Local members and do not grow their own food. The use of compost in the garden, thereby, changes the nature of food scraps from a waste product to a valuable resource that can be recovered and reused. The Grow It Local respondents answered favourably when asked how often food scraps are thrown in the general rubbish bin. The results show that 67% of Grow It Local respondents never throw scraps into the bin compared to 27% of non-members. Ganglbauer et al. also found that growing your own food changed the relationship to waste [27]. For one of their interviews, the respondent indicated the relationship to a circular system, where food via composting becomes food once again [27]. The introduction of composting as a driver to reducing food waste is also discussed as a successful intervention in multiple Australian studies [43,80]. One study found that the community supports government policy to encourage backyard composting [13]. By encouraging households to grow their own food, policy makers inherently encourage composting as a skill and reframe waste as a valuable resource. Previous life cycle analysis studies of the global warming potential of emissions generated from composting waste is less than those generated through sending food waste to a landfill or incineration, and can also reduce the use of chemical fertilisers in gardening, furthering sustainability narratives in society [72].

A challenge to incentivising composting is the food waste disposal hierarchy. As discussed with respect to skills earlier, the food waste hierarchy dictates that first food waste must be avoided or reduced before turning to reuse solutions, such as compost [66]. This research found that those who grow their own food were likely to turn to composting or animals, such as chickens, as a guilt-free disposal option. The following quote is from a Grow It Local member explaining their position: “We do not have any food waste or put food into landfill, we have chickens, 2 sheep, 3 worm farms, and many compost bins”.

Whilst growing your own food to reduce waste should be encouraged, there must be a nuanced message regarding the avoidance and reduction of food scraps, before turning to composting and feeding animals.

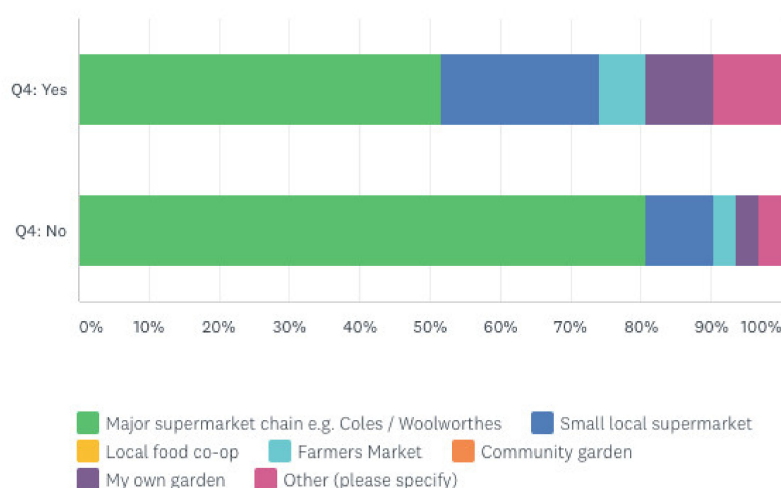
Overall, the research data demonstrated that growing your own food was advantageous to reducing food waste. A large majority of respondents from Grow It Local (87%) stated that they waste less than 10% of food grown or purchased each week. This compares agreeably to only 57% of non-members who were in the bottom category of less than 10% of food wasted. One reason for this result can be linked back to the acquisition or provisioning of food and the shift in values it represents. Greater engagement with food, via dedicated time and energy in the garden, is likely to evolve the meaning associated with food to one of respect and appreciation [27]. Whilst supermarkets were favoured as the source of the majority of food for all respondents, those who also grew their own food



demonstrated a deviation away from them. Research consistently indicates the importance of the role of infrastructures in provision in household food [8]. Figure 6 illustrates the variance. Only 53% of Grow It Local members source the majority of their food from major supermarkets, compared to non-members, where 80% source the majority of the household's food supply from supermarkets. Across the board, when selecting sources of food, Grow It Local members utilised local food co-ops, farmers markets and community gardens more than those who did not grow their own food. They seek out ways to be more connected to the source of their food and represent an engaged segment of food citizens who waste less food as a result. The findings from this study and wider research point to an adjustment from the current global food system that supports major supermarkets to one that gives agency to growing your own food or sourcing it locally [44,45].

Where does the majority of your household's food come from? Please select just one answer.

Answered: 62 Skipped: 2



**Figure 6.** The variance between 'yes'—Grow it Local members and 'no'—non-members, in food acquisition.

Lastly, this research also links growing your own food to further practices conducive to reducing waste. This may be attributed to the materiality of the garden, which itself causes a shift in practices from the norm. For instance, produce in the garden can be picked fresh and used as required, avoiding produce 'going-off' in storage [27]. The access to a garden also allows the gardener to avoid the temptations of over consumption at a supermarket. This research found that Grow It Local members were more likely to shop just once a week (36%) compared to non-members (13.3%), potentially due to sourcing fresh food from their own properties. There was also a link in the findings to storage practices. Almost 100% of Grow It Local members know every item or could have a good guess of what is in the fridge or storage, compared to 74% of non-members. A good knowledge of produce in storage avoids food going to waste. Growers were also more likely to cook based on available ingredients. These outcomes shed a positive light on the influence of growing your own food to other food practices. There is an overarching positive correlation between growing your food and fostering sustainable food practices within the household.

## 5. Limitations

This study's main limitation is the reliance on self-reported data. The risk is that respondents want to present themselves favourably and do not accurately report the amount of food they dispose of. The methodology was designed to overcome this by conducting a food diary, rather than a waste diary, that provided a daily opportunity to recognise food practices. This was conducted by half of the respondents before completing the survey and

would have achieved some level of accurate representation of real-life practices. The research is also limited by its sample size. It had relatively small contributions from youths, who are attributed with a high level of waste. Equally, there was no recognition of household income, which is also often identified in the literature as a factor in household waste production. However, this could also have presented a risk to the completion of the survey as this constitutes sensitive information. A thorough waste audit to complement the diary and provide accurate volumes of waste, together with a larger source of respondents, would improve the findings, although this would add to the complexity and time of the data collection.

## 6. Conclusions

This research aimed to identify food practices in Australian households and their relationship to food waste. The second objective was to utilise social practice theory to provide insights into household food waste. The third objective was to examine the influence of growing your own food on household food waste practices. The research is based on a qualitative analysis of participant food diaries, survey responses and records of food waste disposed of in a total of 64 Australian households. Viewing the issue through a social practice lens, rather than behavioural, allowed the focus to be taken away from the individual and onto the various aspects of the practice itself. It is clear from the qualitative analysis that there was no intention to create waste, and the 'guilt' associated with it was evident. However, the competing priorities of daily lives embed habits that ensure practices are repeated again and again with even the best of intentions, aligning with previous research on the routine nature of practices [63]. Applying social practice theory led to identifying strong and weak elements of the practice and the way in which food practices are connected in order to shift them to achieve more positive outcomes.

The findings point to acquisition, preparation of meals and storage practices to be the most problematic for food waste. Acquisition practices, whilst not a point for waste itself, proved imperative to address, as they influence practices throughout the food nexus. Improving this awareness would be valuable for consumers. The preparation of meals and storage practices are targets for interventions, and new skills and technology should be introduced. The results show Australians value home cooking and mealtimes and the cultural norms associated with these practices are conducive to reducing waste. Importance was placed on seasonal and fresh food, which could be employed to further drive the 'good provider' identity beyond the household. Those who understood the connection with climate change reported less food waste and exposed awareness and education as a focus to encourage a shift in practices. A social practice lens provides a useful analysis tool for this complex problem. The solutions lie in reshaping social norms, demonstrating new ways of performing practices or introducing a new object or technology.

The recent COVID-19 pandemic, which resulted in lockdowns worldwide only a month after the data collection for this research was completed, has provided a unique opportunity to examine how household food wastage practices can change. Initial studies have supported previous research, showing that purchasing larger quantities of food (when panic-buying) can result in more food wastage at the household level due to a lack of skills and technology for adequate storage [81]. Less frequent and larger food shopping can also lead to more spoilage occurring if meal planning and storage practices do not support the greater volumes of food acquired. While cooking and eating more meals at home can lead to lower food wastage from the plate, it can increase wastage occurring at the storage and preparation phases, as supported by this research, if the skills and technology to do so (such as composting) are not in place. While online shopping may reduce the impulse purchased made, the connection and value placed on the food purchased may be diminished due to not needing to physically transport the food home [81]. This can create a disconnect with the value placed on food, also leading to higher rates of spoilage [81]. However, if food is consciously purchased and viewed as valued (a change in the meaning associated with food), there may be more effort by people to learn the skills and acquire the technology needed to reduce wastage [82]. There has also been a rise in efforts to grow food at home

or within the local community [82], which can reduce wastage, as shown by this research. The broader food supply networks have been interrupted by the pandemic, and there has been greater food wastage on farms, an increase in single-use plastics and a demand for non-perishable items contained within packaging. This may influence the sustainability of the food system and have a detrimental impact on broader sustainability and biodiversity protection efforts if the waste is not managed correctly [82].

This research also found edible gardening as a practice has a positive impact on the reduction of household food waste. Rather than food scraps ending up at a landfill, edible gardeners had a sense of its value. They put in place the necessary processes to utilise the most common waste source coming out of the preparation of meals, turning it from waste to resource. This circular economy model reframed their relationship to waste, the caveat being that gardeners must first avoid waste before turning to recycling. In any case, this connection to the food source proved to be a positive impact on the waste produced in the household. Edible gardening and the skills, materiality and meaning it harnesses are supportive of a reduction in food waste.

This research was undertaken to contribute to the gap in the literature in an Australian context. Food waste has been identified as a critical sustainability issue globally; however, Australian academic research was found to be lacking. These findings contribute to an understanding of food wastage at a household level in Australia and provide insight into the common definitions applied in the household, i.e., inedible food scraps. The application of social practice theory also provides new insight into the relationship of practices to waste. Previously, theories relying on behavioural science have been applied, but social practice theory is emerging as a relevant lens through which to solve complex sustainability and environmental issues. This research, thus, applied a practice approach to both map the determinants of waste generation throughout food practices and to dissect the agentive elements. The findings confirm the validity of this approach. Meanings, skills and technologies that strengthen or weaken the goal to reduce food waste were identified. Growing your food introduces new food practices, and we hypothesise that these are conducive to reducing household waste. This research has shown that it is necessary to have not only the desire to grow your own food, but the additional skills and technology to support this practice. This supports the theoretical argument that all three of these factors are influential in the performance of a practice.

Further research is needed to undertake broader, more in-depth studies of food waste and practices in Australian households. An accurate and up-to-date understanding of the data of food waste in households is critical to underpin successful interventions. To better understand the implications of these results, future studies could focus on the role of acquisition of food in reducing food waste. Testing interventions that utilise social networks and participatory learning to infuse new, meaningful knowledge. Furthermore, based on these conclusions, practitioners should consider an intervention that encourages uptake of edible gardening and track the causes and effects of the relationship to waste. The connection between the current climate crisis and food waste should also be explored more as an effective piece on awareness and education to shift meaning. A last recommendation for future work on the topic is the importance of materiality to shift practices. Food waste in the household is an avoidable issue that Australia can overcome with further application of social practice theory.

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study, including to publish the results.

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## Appendix A. Food Waste Diary Template

Food Waste & Social Practices

**PARTICIPANT FOOD WASTE DIARY**

PARTICIPANT NAME: .....

NUMBER OF PEOPLE IN HOUSEHOLD: .....

START DATE: .....

END DATE: .....

Example form:

DAY	INCOMING FOOD:	Source	FOOD WASTED:	Type of Food	Amount	How Disposed	Reason
DAY 1: MONDAY	Weekly shop	Coles	Breakfast	Eggs	2 cups	Garbage	Cooked too much
	A couple of items for dinner recipe	Small Deli	Storage – fridge	Carrots	2 cups	Compost	Didn't use and went off in fridge
DAY 2: TUESDAY			Dinner	Chicken drumsticks	3 cups	Feed to dog	Kids didn't want to eat it all
	1 item – 2L Milk,	Aldi	Leftover lunch	Salad	4 cups	Garbage	Leftovers that went off in fridge & compost full
			Storage – fridge	Tomato pasta sauce	1 cup	Garbage	Past used by date.

**TIPS FOR CONDUCTING FOOD WASTE DIARY:**

- ☐ Print out as many pages as required for 2 weeks and leave clearly visible in the kitchen.
- ☐ Before you begin, make it clear to all relevant household members to complete when bringing in food to the home or disposing of it.
- ☐ To work out how much is being disposed, please estimate the number of standard metric 250ml cups.

Participant Survey Version 2, 29/11/2019
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Curtin University Human Research Ethics Committee (HREC) has approved this study (HRE2019-0817)

Food Waste & Social Practices

**PLEASE ENTER EACH NEW DAY IN THE FIRST COLUMN:**

DAY:	INCOMING FOOD:	Source	FOOD WASTED:	Type of Food	Amount	How Disposed	Reason

**TIPS FOR CONDUCTING FOOD WASTE DIARY:**

- ☐ Print out as many pages as required for 2 weeks and leave clearly visible in the kitchen.
- ☐ Before you begin, make it clear to all relevant household members to complete when bringing in food to the home or disposing of it.
- ☐ To work out how much is being disposed, please estimate the number of standard metric 250ml cups.

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**Figure A1.** Food waste diary provided to participants to complete.

## Appendix B. Food Waste and Social Practices Survey Participants Completed

### Food Waste and Social Practices

#### Research Consent

\* 1. I have received information regarding this research and had an opportunity to ask questions. I believe I understand the purpose, extent and possible risks of my involvement in this project and I voluntarily consent to take part.

☐ Yes

\* 2. Have you completed the two week food diary?

If so, please email to [emily.keegan@postgrad.curtin.edu.au](mailto:emily.keegan@postgrad.curtin.edu.au).

☐ Yes

☐ No

3. If you've completed the food diary, please enter your full name (to match to your data) or type n/a

\* 4. Are you a member of Grow it Local?

☐ Yes

☐ No

### Food Waste and Social Practices

\* 5. Which gender do you identify with?

☐ Man

☐ Woman

☐ Prefer not to say

☐ Option not available (please specify)



\* 6. In which of the following age groups do you belong?

- ☐ 18-24 year
- ☐ 25-29 years
- ☐ 30-39 years
- ☐ 40-49 years
- ☐ 50-59 years
- ☐ 60-69 years
- ☐ 70+ years
- ☐ Prefer not to say

\* 7. What state or territory do you live in?

- ☐ ACT
- ☐ NSW
- ☐ NT
- ☐ QLD
- ☐ SA
- ☐ TAS
- ☐ WA
- ☐ VIC

\* 8. How many people live in your household in a usual week?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ Greater than 5

9. Please describe who lives in the household. Include details such as gender and age.

\* 10. Are there any dietary requirements or choices in your household? i.e gluten free, vegetarian

## Food Waste and Social Practices

## ACQUISITION OF FOOD

\* 11. How many people are responsible for buying food for the household?

- ☐ One adult
- ☐ Two adults
- ☐ More than two adults
- ☐ It's a household wide responsibility

\* 12. Are you primarily responsible for the acquisition of food for the household?

- ☐ Yes
- ☐ No

\* 13. How often is food shopping done? i.e. how often is food brought into the house.

- ☐ Every day
- ☐ 2-3 times a week
- ☐ 4-5 times a week
- ☐ Once a week
- ☐ Once a fortnight

\* 14. Where does your household's food come from? Please select all that apply.

- ☐ Major supermarket chain e.g. Coles / Woolworths
- ☐ Small local supermarket
- ☐ Local food co-op
- ☐ Farmers Market
- ☐ Community garden
- ☐ My own garden
- ☐ Other (please specify)

\* 15. Where does the **majority** of your household's food come from? Please select just one answer.

- ☐ Major supermarket chain e.g. Coles / Woolworthes
- ☐ Small local supermarket
- ☐ Local food co-op
- ☐ Farmers Market
- ☐ Community garden
- ☐ My own garden
- ☐ Other (please specify)

\* 16. Do you grow your own food?

- ☐ Yes
- ☐ No

\* 17. How do you decide what to buy or select from the garden? Please choose all that apply.

- ☐ It's habitual (I top up as things run out)
- ☐ I select ingredients based on a recipe
- ☐ I decide at the time of purchase
- ☐ I create a shopping list
- ☐ I pick what's seasonal and fresh
- ☐ Other (please specify)

#### Food Waste and Social Practices

#### MEAL PLANNING & PREPARATION OF FOOD

\* 18. When do you usually decide what to prepare for a meal?

- ☐ The day before
- ☐ A couple of hours before
- ☐ At the time of cooking
- ☐ Other (please specify)

\* 19. More often than not, which factor is most important when you decide what to prepare for a meal? Please list with 1 the most important.

☐

Time

☐

Skill

☐

Available ingredients

☐

Cravings or requests from the household

\* 20. Who makes the decision in the household about what to prepare for meals? Please comment

\* 21. How well do you know the contents of your fridge and/or pantry?

☐

I know every item

☐

I could have a good guess of most items

☐

I have a rough idea

☐

I often forget most of what's available

## Food Waste and Social Practices

### COOKING

\* 22. How often do you or a member of the household prepare the nightly meal at home? Please select the answer that best applies.

☐

Every day

☐

Most nights of the week

☐

Weeknights only

☐

Not often

☐

Rarely (Less than once a week)

\* 23. How much time do you set aside for cooking a meal each night?

- ☐ Less than 30 mins
- ☐ 30mins to 1 hour
- ☐ More than 1 hour
- ☐ I don't cook at home

\* 24. Do you have a process for food scraps during cooking? i.e. peelings, cores etc

- ☐ Yes
- ☐ No

\* 25. If yes, then please describe this process;

\* 26. How do you decide the quantities to cook? Please select the answer that applies best

- ☐ I try to estimate accurately given the number of people eating
- ☐ I always make more, just in case
- ☐ I often don't make enough
- ☐ I plan to cook extra for leftovers
- ☐ I usually follow the quantities from a recipe

## Food Waste and Social Practices

### EATING

\* 27. Who typically serves your meal onto the plate?

- ☐ The cook
- ☐ I do
- ☐ Someone else in the household



\* 28. How often do you leave some edible food on the plate?

- ☐ Every meal
- ☐ Once a day
- ☐ Once every couple of days
- ☐ Once a week
- ☐ Very rarely
- ☐ Never

\* 29. What is the most common reason you may leave food on your plate?

- ☐ I didn't like the taste of it
- ☐ I was full
- ☐ I didn't have enough time to finish the meal
- ☐ The food was badly cooked
- ☐ Dietary reasons or allergies
- ☐ N/A - I never leave edible food on my plate
- ☐ Other (please specify)

\* 30. Is it acceptable in your household to leave food behind on your plate?

- ☐ Yes
- ☐ No, never
- ☐ Sometimes
- ☐ Yes, if there's a valid reason.

\* 31. Which meal do you most often leave food behind?

- ☐ Breakfast
- ☐ Lunch
- ☐ Dinner
- ☐ Snack
- ☐ I never leave food behind on my plate.

**WASTE**

\* 32. Do you have access to a compost bin or worm farm?

- ☐ Yes
- ☐ No – but I'd consider getting one.
- ☐ No - option to comment;

\* 33. At what stage does the most food go to waste in your household?

- ☐ It's not finished at mealtimes (i.e. left on the plate)
- ☐ It 'goes off' and becomes inedible (pre-cooking)
- ☐ Leftovers are not eaten and become inedible (post-cooking)
- ☐ It's badly cooked (e.g. burnt / too spicy) (during cooking)
- ☐ Whilst preparing a meal - I dispose of veggies scraps and other inedible organic waste
- ☐ I do a regular clean out pre or post food shopping
- ☐ I've cooked too much for the household and we don't keep leftovers

\* 34. How much food purchased or grown for consumption do you waste each week?

- ☐ < 10%
- ☐ 10% - 20%
- ☐ 20% – 30%
- ☐ 30% - 40%
- ☐ 50% - 60%
- ☐ 60%- 70%
- ☐ 70% - 80%
- ☐ 80% - 90%
- ☐ > 90%

\* 35. Please provide your understanding of the term 'food scraps' i.e. ends of veggies etc

\* 36. How often do food scraps go into the general rubbish bin after each meal?

- ☐ Every meal
- ☐ Very often (70% of the time)
- ☐ Often (50% of the time)
- ☐ Sometimes (30% of the time)
- ☐ Only when the compost / worm farm is full
- ☐ Never

\* 37. What are the most common food items thrown away? Please number from most common as 1.

- Vegetables
- Fruits
- Dairy products
- Meat products
- Dry products (grains / pasta / flour)
- Seafood
- Sweets
- Sauces / Condiments

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