Circular agri-food approaches: will consumers buy novel products made from vegetable waste?

ABSTRACT

This article discusses the challenges associated with managing waste in the horticultural sector and it presents the circular economy framework as a solution to the food waste problem. Value adding is one strategy that transforms food waste for reuse in accordance with the concept of circular economy. This research focuses on the role that consumers play in the circular economy. A structured questionnaire was submitted to a sample (n= 330) of Australian households to assess the willingness of consumers to buy food that is derived from underutilised biomass. The survey indicates that half of the sample is willing to buy value-added food and helping Australian farmers is the top-ranking factor driving demand. Awareness of the food waste problem is significant in distinguishing consumers who are willing to buy value-added food from those who are not. The recommendations for marketers when designing their marketing communications for a circular economy are to stress empathy and care for farmers and highlight the consequences of food waste for both the natural environment and people.

KEY WORDS: circular economy, food waste, value-added food.

INTRODUCTION

International momentum to curb food loss and waste is growing, with governments and businesses making commitments to address this issue, which has significant ethical, economic and environmental ramifications for global society (United Nations, 2016). If food loss and waste were its own country, it would be the third largest greenhouse gas emitter after the United States and China (World Resources Institute, 2015). At the same time, the world's population is forecasted to reach 9.6 billion people by 2050 and sustainably feeding a growing population demands urgent solutions to the food waste problem (World Resources Institute, 2013).

Since the industrial revolution, economies have followed a model of "take-make-use-dispose" which is called the linear economy (Andrews, 2015). The linear economy results in products becoming waste at the end of their life (see Figure 1) and many scholars (see e.g. Andrews, 2015; Lewandowski, 2016; Murray, Skene, & Haynes, 2017) have discussed the linear economy's lack of sustainability and propose alternative concepts that follow nature's life cycles, the so called, circular economy. So, the circular economy approach is one response to the problem of food waste and loss. The circular economy represents a closed-loop system in which resources are kept in a loop of production and continuous usage, which allows precious and finite resources to generate more value for a longer period (McDonough & Braungart, 2002). The circular economy involves reuse, repair, refurbishing, and recycling of the existing materials and products and what was earlier considered to be waste becomes a resource (Jurgilevich et al., 2016).

In this study, we focus on one circular economy approach, namely value-adding, to deal with the food waste problem in the Australian horticulture industry. In Australia, the horticulture industry is grappling with the food waste challenge, along with climate change (Fleming, Dowd, Gaillard, Park, & Howden, 2015). Approximately one quarter of all vegetables that are produced do not leave the farm (Australian Government, 2017), representing a highly inefficient use of resources given that food can be conceptualised as embedded water and energy (Martin & Schouten, 2012). Nevertheless, the horticulture industry is a significant sector of the economy, generating exports worth $2.1 billion (Australian Government, 2016). The agri-food supply chain plays an important socio-economic role in Australia (Pagotto & Halog, 2016) and it contributes significantly to rural economies. In 2012–13 approximately 56,700 people were employed in Australia to grow fruit, vegetables and nuts for the domestic and export markets (Department of Agriculture, 2016) and the bulk of the industry is located in regional, and sometimes very remote, places in Australia (Howe, Reilly, van den Broek, & Wright, 2019). Numerous authors highlight waste and inefficiencies in the agri-food supply chain and call for more cooperation amongst stakeholders (Mena, Terry, Williams, & Ellram, 2014; Göbel, Langen, Blumenthal, Teitscheid, & Ritter, 2015) as well as circular economy approaches (Ingrao, Faccilongo, Di Gioia, & Messineo, 2018; Pagotto & Halog, 2016; Secondi, Principato, Ruini, & Guidi, 2019) to enhance sustainable food production systems. Göbel et al., (2015, p.1440) call for "…regional initiative and model projects for innovative waste management, focused on the re-use of waste and the development of supporting services". Managing waste in an innovative way is seen as a key factor to more sustainable rural communities (Blades et al., 2017) and it also enhances farmer' profits (Chen, Rojas-Downing, Zhong, Saffron, & Liao, 2015). It is argued that tackling food waste and loss would lead to "important opportunities for local economies and stakeholders" (Secondi et al., 2019, p.10) and "value chain innovation, such as converting horticulture waste into fresh vegetable juices and natural food colors" (Kouwenhoven, Reddy Nalla, & Lossonczy von Losoncz, 2012, p. 132). Curbing food loss should help rural and regional economies and ensure that the agri-food sector

continues to play a role in the prosperity of people living in rural and regional Australia. One solution to the food waste generated in Australian horticulture industry is value-adding, which involves turning fruit and vegetable residues into high value products (Lin et al., 2013). It is one example of the reuse of materials and hence illustrates circular economy principles (Murray, Skene & Haynes, 2017).

Given that in the food markets the consumers are the final users of foods, it is imperative to understand to what extent such a circular economy solution to the food waste issue, i.e., novel, value-added food made from food waste, is appealing to the consumers. However, studies on the consumer's perspective of the circular economy are lacking (Chamberlin & Boks, 2018), with scholars stating: "little is known about consumers' willingness to participate in a circular economy" (Borrello, Caracciolo, Lombardi, Pascucci, & Cembalo, 2017, p.1). In the area of value-added food derived from food waste, most of existing studies are located in the food science discipline and describe restricted examples and pilot-scale laboratory experiences (Mirabella, Castellani, & Sala, 2014). With regard to the consumers' perspective, scholars note that consumers are averse to novel, food-related technologies for many reasons, including risk aversion and perceptions of unnaturalness (Lusk, Roosen, & Bieberstein, 2014). The branded products derived from food waste are today rather limited, and commercialisation (i.e., the process of taking patented products and processes to the market) is challenging (Galanakis, 2012). This study hence focuses on Australian consumers' attitudes towards novel, value-added products which not only helps fill a gap in the literature, but also has practical implications for growers and other value chain members.

LITERATURE REVIEW – THE CIRCULAR ECONOMY CONCEPT IN THE FOOD WASTE CONTEXT

Fruit and vegetables are the second largest commodity contributing to food loss around the world. Food is lost during, or immediately after, harvesting on the farm for several reasons: fruit is bruised, eaten by pests, does not meet the rigid quality standards set by retailers or is dumped due to a glut in the marketplace (Lipinski et al., 2013). The two major sources of surplus food and food waste at the farm are overproduction and non-compliance with market standards in terms of size, shape, or appearance (Garrone, Melacini, & Perego, 2014). In Australia, the power of supermarkets to enforce 'quality standards' is a source of frustration for farmers (Richards, Lawrence, Loong & Burch, 2012). It is estimated that 25% of all vegetables produced in Australia do not leave the farm and the total cost of agricultural food losses to farmers is $2.84 billion (Australian Government, 2017). The scale of this loss makes waste reduction, at the pre-and post-harvest stages, an important policy goal, as outlined in the *Food Waste Strategy* (2017).

The vision of a circular economy is gaining traction in academic and practitioner-oriented literatures. However, there is no commonly accepted definition of the circular economy (Yuan, Bi & Moriguichi, 2006), and scholars have in fact identified 114 definitions of the circular economy (Kirchherr, Reike, & Hekkert, 2017). The concept of a circular economy, in general terms, promotes resource minimisation (Anderson, 2007). The circular economy is most frequently depicted as a combination of reduce, reuse and recycle activities (EU Commission, 2014; Kirchherr, Reike, & Hekkert, 2017; Lewandowski, 2017; Martin & Schouten, 2012; Woźniak & Pactwa, 2018), which help turn a linear system into a circular system. In a linear economic model, the physical environment is treated as a receptacle for waste products from the economy, and design for disassembly, recycling and reuse are not fundamental parts of the system. This is inefficient since resources (i.e., materials, energy, water etc.) flow out of the system. A circular economy, on the other hand, is an industrial

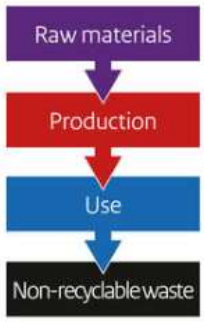
system that is restorative or regenerative by intention and design. It is founded on the principle of the earth as a closed economic system, where the environment and economy are linked in a circular relationship. The circular nature refers to materials flowing within a closed-loop - to be reused again and again (Jackson, Lederwasch, & Giurco, 2014). Scholars in the circular economy field often draw on the waste hierarchy framework (reduce, reuse, recycle, recovery, landfill) and it is agreed that the most important step in the approach to waste management is waste prevention (Papargyropoulou, Lozano, Steinberger, Wright, & bin Ujang, 2014). This study adopts the following definition of the circular economy:

> "A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" (Kirchherr, Reike, & Hekkert, 2017, p. 225).

Figure 1 offers examples of how a linear horticultural sector can be turned into a circular system and the strategies are outlined below. For instance, commodities such as fruit and vegetables are grown, consumed, composted and returned to the earth to enrich the soil. Commodities can also be used to make processed food and the materials (i.e., packaging) or waste (i.e., products such as oils, peels and seeds) can be recycled and returned to the producer or processor and used as inputs in the food industry or another industry.

Figure 1. Moving Australian horticulture towards a circular economy – strategies.

Linear Economy	Linear economy strategy: Disposal	Produce left to rot in fields, going to sewer or landfill



Transition to a circular economy

Circular Economy	Stages	Circularity Strategies	Examples
	Production	Avoid or reduce waste	Research for more efficient production methods. Cold chain management. Packaging initiatives to improve shelf life.
	Use	Avoid or reduce waste	Education campaigns. Food Rescue/Charitable donations. Aesthetically imperfect food used by different customer groups.
	Recycling	Repurpose	Composting, soil enrichers, worm farms. Animal feed (for farmed fish, chickens, livestock etc.) and biotechnology solutions for animal feed.
		Rethink / reprocess / redesign	Use parts, or all, of discarded product in a new product (cosmetic, pharmaceutical and nutraceuticals) with a different function. Use higher quality (high grade) materials and parts of the discarded product in a new improved, product.
		Process / value-add	Use lower quality (low grade) materials for food processing.
		Recover	Incineration of food waste (waste-to-energy).

Adapted from Potting, Hekkert, Worrell & Hanemaaijer (2017) and the National Food Waste Strategy (2017).
Pictures from Government of the Netherlands webpage (https://www.government.nl/topics/circular-economy/from-a-linear-to-a-circular-economy)

Currently, Australian horticulture is struggling with food loss and food waste. In general, the term 'food loss' refers to food lost in the primary production and processing stages of the value chain and food waste refers to food lost at the retailer, catering and household levels (Cristóbal, Castellani, Manfredi, & Sala, 2018). The use of the food waste should follow waste hierarchy principles with waste prevention (Papargyropoulou, Lozano, Steinberger, Wright, & bin Ujang, 2014), such as consumer education campaigns and donations to charity, being the preferred options. However, evaluating the relative merits of waste management alternatives is a complex task (Garcia-Garcia et al., 2017). Life cycle

analysis shows that some actions (such as consumer education campaigns, cold chain management) should always be prioritized since they avoid a high environmental impact at a low cost (Cristóbal et al., 2017). Food that is edible, but deemed of lower quality in terms of aesthetics, can be sold through local farmers' markets, and there is a rich literature on the benefits of alternative food networks to society (see Turner & Hope, 2014). As mentioned previously, rigid food product standards are in place in mainstream channels, however a major retailer, Woolworths, sells some fresh produce at a discount under the '*Odd Bunch'* campaign (Calvo Porral, Medín, & Losada-López, 2017). Food waste can be lightly processed, such as chopped and packaged salads or mixed vegetables. Food can undergo traditional food processing techniques and examples include canned, dried or frozen products. This strategy has its limitations since the horticultural sector must compete directly with both processed and fresh imports from countries with very low labour rates, which is a challenge (Queensland Government, n.d).

Value adding in commodity value chains is increasingly being adopted by growers in reaction to globalisation pressures (Rodríguez Cohard, Sánchez Martínez, & Gallego Simón, 2017). Excess produce can be converted into highly processed products, such as baby food, juices, jams, fermented foods, pickles, sauces, soups and so forth. In Australia, there is growing interest in waste valorisation practices based on innovative, plant-based products. For example, *Natural Evolution Foods,* is a company that transforms organically grown, green bananas into gluten-free banana flour and starch-resistant dietary fibre (Australian Government, 2017). It is possible to convert food waste into energy, although it is not the most sustainable and cost-effective option for dealing with food waste. Problems relate to the capacity of treatment infrastructure and difficulty in separating food waste from other waste streams (Kibler, Reinhart, Hawkins, Motlagh, & Wright, 2018). *Sundrop Farms* in South Australia is an example of an innovative, 'circular' food producer that grows tomatoes in greenhouses by using solar power, electricity generation, fresh water production and hydroponics (Sundrop Farms, n.d). Another solution to the food waste problem is to divert it to animal feed. Food waste can be turned into compost which helps 'close the loop' in a circular economy (Borrello et al., 2017). One example is the company *BioRegen*, an Australian company that manufactures a liquid that enriches soil health (BioRegen, n.d).

Value-adding refers to the process of increasing the value of the input through transformation, using manufacturing processes or using differentiated production techniques, such as organic production (CSIRO, 2017). For instance, citrus peel can be used as a natural sweetener (i.e., sugar syrup) in processed foods, and pectin can be utilized as gelling agent in the confectionary sector. In recent times, there has been a move towards 'redesign' of commodity products by extracting nutrients from biomass. The shift towards converting food waste into high-value products is driven by several factors: more advanced technologies, consumer interest in health, as well as the sophisticated marketing of functional foods and neutraceuticals by the cosmetic and pharmaceutical industries (Ernst, 2001).

Nutraceutical is a term derived from the words "nutrition" and "pharmaceutical" and it can refer to any substance that is a food, or a part of a food, and provides medical or health benefits, including the prevention and treatment of diseases (DeFelice, 1995). Examples include fish oils or olive leaf extract. Likewise, 'functional foods' refer to foods that may provide health benefits beyond basic nutrition, such as probiotic drinking yogurt (Siro, Kapolna, Kapolna, & Lugasi, 2008). Food waste is a source of valuable compounds for the pharmaceutical and nutraceutical industries - for instance, bromelain is an enzyme found in pineapple juice and in the stem of the pineapple and can be used to treat medical ailments (Laufenberg, Kunz, & Nystroem, 2003; Lin et al., 2013; Galanakis, 2012, Mirabella, Castellani, & Sala, 2014). The fresh cut fruit industry discards large percentages of by-products, such as peels, seeds, and unused flesh that can present similar or even higher

contents of bioactive compounds, such as phenolic compounds, carotenoids and vitamins, than the final product (Mirabella et al., 2014).

Hence, options for dealing with waste in the Australian horticultural sector are a mix of the linear and the circular economy. Many challenges to reducing food loss exist, including the current nature of food production, with its inherent risks (such as perishability, bad weather, disease and market price falls) as well as deeply embedded social habits and institutional practices (see Canali et al., 2017 for a review). Australian growers cite barriers in the form of added expenses, lack of time, knowledge, and markets, to sell value-added products (Duarte Alonso & Northcote, 2013).

This study focuses on one strategy in Figure 1 – re-thinking, re-processing, redesign (using parts, or all, of a discarded product in a new, improved product). A study by the *Commonwealth Scientific and Industrial Research Organisation* (CSIRO) shows that valuable food ingredients and snack products can be produced using vegetables, which are dried and ground to a powder, with minimal loss of nutrients (CSIRO, 2018a). Extrusion (i.e. mixing, cooking, shearing, puffing, shaping and drying) is a process designed to produce a wide variety of foods in sectors such as snacks, ready-to-eat (RTE) cereals, biscuits, confectionery and extruded crisp breads. The technology has been restricted to two types of biomass - whole carrots and broccoli (CSIRO, 2018b). Market reports have highlighted the trend towards health and wellness, along with convenience, in the food and beverages industry. Companies are using different strategies to address the health and wellness trend, such as including more plant-based ingredients in high growth sectors such as beverages, snacks, cereals and baked goods and providing premium priced, value-added food products with significant health claims (CSIRO, 2017; Euromonitor, 2017a; Euromonitor, 2017b).

Turning fruit and vegetable residues into higher value products allows growers to capture more value in the supply chain. The potential benefits are as follows: increased competitiveness by generating additional profits and reducing disposal costs (Lin et al., 2013); better health outcomes; an increase in the overall quantity of vegetables eaten by Australians; prevention of pollution; the conservation of scarce resources such as energy, water, labour, land and agrochemicals, (CSIRO, 2017) and patenting and licensing opportunities.

Critics of the circular economy concept argue that the social dimension (inherent in sustainable development thinking) is absent (Murray et al., 2017) and furthermore, the role of consumers as enablers of the circular economy is not outlined (Chamberlin & Boks, 2018; Kirchherr, Reike, & Hekkert, 2017). Chamberlin & Boks (2018) recently addressed this limitation by incorporating a marketing and communications perspective on the circular economy and they examined the ways in which businesses providing circular products or services use communications to market their offerings and influence consumer behaviour.

This study focuses on the role of consumers in purchasing 'circular products' and moving the horticultural sector towards a circular economy. In order to understand reasons for buying a value-added product, the authors draw on the norm-activation model (Schwartz & Howard, 1981). This model posits that awareness of consequences (AC) is one factor (amongst others) that influences pro-social or environmental behaviour. It refers to whether someone is aware of the negative consequences for others, or for other things one values, when not acting pro-socially (Steg & Velk, 2009). Food waste is regarded as a moral problem given the inequality of access to food across the globe (Aschemann-Witzel, Jensen, Jensen, & Kulikovskaja, 2017; Neff, Spiker, & Truant, 2015) and the rising problem of food security (Foley et al., 2011; Godfray et al., 2010). There is ample evidence that consumers feel guilty, uncomfortable or bothered to some extent if they waste food (Brook Lyndhurst, 2007; Hamilton, Denniss, & Baker, 2005; Parizeau, vol Massow, & Martin, 2015; Setti, Falasconi, Segrè, Cusano, & Vittuari, 2016; Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013; Watson & Meah, 2012). Several scholars link food waste avoidance to moral judgements

(Borteledo, Kurisu, & Hanaki, 2012; Gjerris & Gaiani, 2013; Stancu, Haugaard, & Lähteenmäki, 2016). Based on these studies, the following hypothesis is developed:

H1 People who are willing to buy value added foods show more awareness of the food waste problem than those who are not willing to buy value-added foods.

RESEARCH METHODS

Questionnaire development and scales

Data was collected using a questionnaire, which contained measures of willingness to buy value-added foods, awareness of the food waste problem, motives for buying value-added foods, as well as demographic information such as age, education, gender and income level. The concept of value-added foods were sourced from food scientists after attending workshops on food waste organised by the *Commonwealth Scientific and Industrial Research Organisation* (CSIRO). The aim of the CSIRO team is to create healthy food ingredients and products from edible biomass left in the field, lost biomass after harvest or from side-streams of food processing (CSIRO, 2018). This is part of the circular economy approach to reduce food waste, i.e., by reprocessing the lost biomass to value-added food, thus moving away from the linear economy approach of disposing food waste. Three types of value-added food made from fruit and vegetable waste were identified, i.e., a vegetable powder made from 100% whole carrot that can be used as a healthy ingredient for smoothies, dips, sauces and so forth; a vegetable snack product made from 20% broccoli that is an ideal on-the-go healthy snack, and a fermented product based on vegetables that is rich in nutrients and fibre and can be used in products such as baby food, dips and smoothies. To understand consumers' willingness to buy value-added food, we asked the question "are you willing to buy any one of the following products that can be made from fruit and vegetable waste?". Consumers then indicated their willingness to buy which was measured for each one of the three types of value-added products using a seven point scale, anchored from extremely unwilling (=1) to extremely willing (=7).

We measured general awareness of the food waste problem using six items taken from a scale developed by Delley & Bruner (2017), and some of these items were previously used by Stefan et al., (2013) and Gjerris & Gaiani (2013). Such a measure includes three components: awareness of the social, environmental and financial consequences of food waste. It also includes a measure of perceived food scarcity and a general awareness of the intrinsic value of food, which is linked to the natural environment. One item measures attribution of responsibility for the food waste problem. Respondents were asked to rate their level of agreement or disagreement with given statements with a seven point scale, anchored from very strongly disagree (=1) to very strongly agree (=7). The scale items were: "Food waste is a big environmental issue"; "In my country, households are responsible for a great proportion of the food waste"; "Food waste is an important social issue (e.g. world hunger)"; "Foods are scarce over the world and should be consumed consciously"; "Foods are gifts of nature and have to be treated as such"; "In my country, the food waste generated by households has great financial consequences". The six item scale had a Cronbach's alpha of .853 (M=5.07, SD= .88), confirming the reliability of the scale. We also measured perceived consumer effectiveness in curbing food waste with one item "I believe that every little effort by consumers helps to reduce the food waste problem" using a seven point scale (Thφgersen, 1999). Consumers' motives for buying value-added food were also assessed. Respondents were required to rank six factors that would influence their demand for value-added food. The six factors considered consumer demand for health and price, but also effects on humans versus effects on the environment, and

these items have been used before in studies relating to sustainability, notably clean energy (see Poortinga, Pidgeon, & Lorenzoni, 2006).

Recruitment of respondents and sample

Ethics approval was secured from the Human Ethics Committee in the first author's university (H6601). A pre-test of the survey was undertaken with the help of students and three marketing scholars, highly experienced in consumer behaviour, who reviewed the survey. The target population were food shoppers who had responsibility for food shopping, cooking or waste disposal. An online panel provided by Qualtrics Data Service was utilized to recruit respondents given that the use of panels is becoming increasingly common in food waste studies (Birau & Faure, 2018; de Hooge et al., 2017; Ilyuk, 2018; Mallinson, Russell, & Carker, 2016; Stancu et al., 2016). We employed a quota sampling method to ensure the distribution of gender and age was aligned with the population of Australian food shoppers. An incentive (the chance to win a $100 voucher) was used to encourage completion of surveys. To reduce social desirability biases, which is a tendency to respond in a manner considered to be socially desirable (van de Mortel, 2008), an online survey and a guarantee of anonymity were used to counteract inclinations to offer 'socially correct' answers. Data was collected from April 2018 to May 2018 and a total of 330 usable surveys were obtained.

FINDINGS

Summary statistics

The profile of the 330 respondents is as follows: more females (68.5 %) than males participated in the survey. Income levels were diverse, with an estimated 13.9% having a total household income of less than $20,000 and 15.7% were earning between $100,000 and $200,000. Data from the Australian Bureau of Statistics (ABD, 2016a) shows that the average annual gross household income was $109,668 in 2015/16 (before tax and Medicare levies); hence, our sample captured the low and average income earners, but also some of the high-income earners. The sample was well educated, with 21.5% reporting a Bachelor's degree as their highest level of educational attainment. This is higher than average. Statistics show that approximately 17% of the Australia's population has a Bachelor degree (ABS, 2016b). Respondents came from all age groups, with slightly more (27%) being drawn from the 30-39 age category. A quarter of the sample (25.8%) was in full-time employment, mean household size was three persons, and close to half of the sample (43.6%) had young children, aged under 12, in the household. The detailed profile information is shown in Table 1.

Table 1. Profile of Respondents

		Australia %
Gender	Male	31.52
	Female	68.48
Age	Under 20 years	2.42
	21-29 years	22.12
	30-39 years	26.97
	40-49 years	14.55
	50-59 years	10
	60 years or over	23.94

Employment status	Full-time employed	25.76
	Part-time employed	23.33
	Seeking work	5.45
	Retired	19.09
	Home duties	18.79
	Student	5.45
	Other	2.12
Education	No qualification	2.73
	Year 10 or 12 certificate	33.64
	Trade certificate/vocational	8.48
	Certificate	14.85
	Diploma	11.21
	Bachelor's degree	21.52
	Post-graduate degree	7.58
Household size	One-person household	13.33
	Two-person household	31.82
	Three-person household	21.52
	Four-person household	21.52
	Five-person household	7.58
	Six-person household or more	4.24
Children in household	One child	19.7
	Two children	17.88
	Three children	3.64
	Four children	1.82
	Five or more children	0.6
	None	56.36
Household income level	Less than $*19,999	13.94
	$20,000–$39,999	18.49
	$40,000–$59,999	18.78
	$60,000–$79,999	15.46
	$80,000–$99,999	16.06
	$100,000–$199,999	15.76
	$200,000 or more	1.52

Willingness to buy value-added foods

Respondents show moderate willingness to buy for the three types of value-added food products made from food waste, with 51.5% of the sample willing to buy the vegetable snack products, followed by 46.9% and 44.2% willing to buy the vegetable powder and fermented product respectively. We also note that more than a quarter of the sample were 'neither willing nor unwilling' to buy the value added food products based on food waste (26.7% to 29.1%).Table 2 shows the willingness to buy value-added foods, based on a sample of 330 respondents.

Table 2
Willingness to buy value-added foods derived from food waste (N=330).

Attitudinal Item	Sample Mean	Std. Deviation	Extremely Unwilling	Not at all Willing	Unwilling	Neither willing nor unwilling	Willing	Very willing	Extremely willing
1. A vegetable powder made from 100% whole carrot that can be used as a healthy ingredient for smoothies, dips, sauces etc.	4.22	1.484	7.3 (24)	7.6 (25)	9.1 (30)	29.1 (96)	30.9 (102)	11.2 (37)	4.8 (16)
2. A vegetable snack product made from 20% broccoli that is an ideal on-the-go healthy snack.	4.37	1.460	6.1 (20)	5.2 (17)	10.6 (35)	26.7 (88)	33.9 (112)	10.3 (34)	7.3 (24)
3. A fermented product based on vegetables that is rich in nutrients and fibre and can be used in baby food, dips, smoothies etc.	4.11	1.460	8.5 (28)	6.1 (20)	12.1 (40)	29.1 (96)	30.9 (102)	10 (33)	3.3 (11)

Factors influencing demand for value-added foods

One question was designed to gain insight into what consumers themselves think is important in influencing the purchase of value-added foods. We asked the question "what factors are most important in influencing your decision to buy a new food product that uses fruit or vegetable waste as a raw material?" Respondents had to rank the factors in order of their relative importance, using a rank of one (1) as most important and six (6) as least important. Table 3 displays the percentage of respondents who ranked each of the six factors.

Table 3a
Factors influencing demand for value-added foods (N=304).

Ranking / Factor	1 *% (n)*	2 *% (n)*	3 *% (n)*	4 *% (n)*	5 *% (n)*	6 *% (n)*
Helping farmers/growers to prevent food waste	37.9 (125)	24.1 (70)	12 (35)	8.6 (25)	5.5 (16)	6.9 (20)
Effects on economy	10.7 (31)	23.7 (69)	18.2 (53)	21.3 (62)	16.8 (49)	8.9 (26)
Meeting consumer demand for healthy food	11.7 (34)	12 (35)	15.8 (46)	21.3 (62)	23 (67)	16.2 (47)
Positive effects on the natural environment	19.6 (57)	16.5 (48)	21.6 (63)	16.2 (47)	15.8 (46)	10.3 (30)
Helping society	7.9 (23)	14.8 (43)	20.3 (59)	19.9 (58)	21.3 (62)	15.8 (46)
Meeting the needs of the price-conscious consumer	11.7 (34)	7.2 (21)	11.3 (33)	11.3 (33)	17.2 (50)	40.5 (118)

Note. 1 = ranked as first factor to 6 = ranked as the last factor influencing decision to buy value-added foods

Responses to this question varied greatly. 'Helping farmers/growers to prevent food waste' was perceived as more important than other factors, with 62% of respondents ranking this in their top two preferences. 'Positive effects on the natural environment' were of second-most importance, with 36.1% of respondents ranking this in their top two reasons; effects on the economy' (34.4%) were just as important. 'Meeting consumer demand for

healthy food' was of medium importance (23.7% ranked it in top two reasons), along with 'helping society' (22.7% ranked it in top two reasons). 'Meeting the needs of the price-conscious consumer' was the factor with relatively low proportions of respondents across the top two preferences (18.9%).

We further investigated if there were any differences in the factors influencing demand for value-added foods between people who were willing to buy a value-added snack food product and those who were not. For this analysis, willingness to buy was recoded into 'willing' (score of 5, 6 or 7) and 'unwilling or neutral' (score of 1, 2, 3 or 4). The results are shown in Tables 3b and 3c. Respondents' priorities varied greatly. Comparing the two groups, 'helping farmers/growers to prevent food waste' was selected by the largest number of people as the most important factor influencing demand. Such results suggest that even though a large number of consumers are aware that value-added food is a solution to the farmers' food waste issues, they do not necessarily show a willingness to buy value-added food. In contrast to those who were not willing to buy value-added food, a larger percentage of people in the willing to buy segment selected 'meeting consumer demand for healthy food' and 'positive effects on the natural environment'. Such results imply that marketers could highlight personal benefits for the consumer, such as improved health and nutrition, as well as positive impact on environment, in their promotional strategies.

Table 3b. Factors influencing demand for value-added foods – Group with willingness to buy

Factor	**1** *% (n)*	**2** *% (n)*	**3** *% (n)*	**4** *% (n)*	**5** *% (n)*	**6** *% (n)*
Helping farmers/growers to prevent food waste	41.04% (87)	26.42% (56)	12.26% (26)	9.91% (21)	5.66% (12)	4.72%(10)
Effects on economy	10.85% (23)	23.11%(49)	19.81% (42)	20.28% (43)	16.51% (35)	8.96% (19)
Meeting consumer demand for healthy food	13.21% (28)	11.79% (25)	14.62% (31)	21.23% (45)	24.06% (51)	15.09% (32)
Positive effects on the natural environment	22.17%(47)	14.62%(31)	21.70%(46)	16.98%(36)	15.09%(32)	9.43%(20)
Helping society	7.55%(16)	16.51%(35)	19.81%(42)	20.28%(43)	18.87%(40)	16.98%(36)
Meeting the needs of the price-conscious consumer	11.32%(24)	6.60% (14)	10.85 %(23)	9.91%(21)	18.40%(39)	42.45%(90)

(N = 212)

Table 3c. Factors influencing demand for value-added foods – Group without willingness to buy (N = 79)

Factor	**1** *% (n)*	**2** *% (n)*	**3** *% (n)*	**4** *% (n)*	**5** *% (n)*	**6** *% (n)*
Helping farmers/growers to prevent food waste	48.10%(38)	17.72% (14)	11.39% (9)	5.06% (4)	5.06% (4)	12.66%(10)
Effects on economy	10.13%(8)	25.32% (20)	13.92% (11)	24.05 %(19)	17.72% (14)	8.86%(7)
Meeting consumer demand for healthy food	7.59%(6)	12.66% (10)	18.99% (15)	21.52%(17)	20.25% (16)	18.99%(15)
Positive effects on the natural environment	12.66%(10)	21.52% (17)	21.52% (17)	13.92%(11)	17.72% (14)	12.66%(10)
Helping society	8.86%(7)	10.13% (8)	21.52% (17)	18.99%(15)	27.85% (22)	12.66%(10)
Meeting the needs of the price-conscious consumer	12.66%(10)	8.86% (7)	12.66% (10)	15.19%(12)	13.92% (11)	35.44%(28)

Willingness to buy value added foods: role of cognitive factors

Our results in relation to the factors influencing consumer demand for value-added food suggest that even if a consumer is aware that value-adding is a solution to the farmers' food waste issues, he/she does not necessarily show a willingness to buy value-added food. To further understand why consumers are not responsive to value-adding as a solution to food waste, we explored consumers' cognitions in relation to the food waste problem and perceived consumer effectiveness. T-tests were performed to explore differences between people who were willing to buy a value-added snack food product and those who were not (see Table 4). Results suggest that people who state they are willing to buy value-added foods tend to show higher awareness of the consequences of food waste, have a general awareness of the intrinsic value of food as a scarce natural resource, and have a belief that households are responsible for the problem and that preventing food waste depends on the actions of the individual. Such results imply that if consumers are not convinced of the consequences of food waste, or doubt the efficacy of individual action in resolving the problem, they will not show interest in value-added food as a solution to the food waste problem.

Table 4
Comparing attitudes towards food waste between people who are willing to buy a value-added snack food and those who are not (1= very strongly disagree and 7 = very strongly agree).

Scale item	**Full sample**	**Group 1** Willing to buy (responses >=5) Mean	**Group 2** Unwilling to buy; neither willing nor unwilling to buy (responses <5) Mean	Sig. (t-test)
Awareness of the consequences of food waste				
Food waste is a big environmental issue.	5.17	5.39	4.94	.000
Food waste is an important social issue (e.g. world hunger).	5.36	5.54	5.18	.006
In my country, the food waste generated by households has great financial consequences.	4.72	4.92	4.53	.002
Awareness of food scarcity				
Foods are scarce over the world and should be consumed consciously.	5.26	5.42	5.16	.027
Foods are gifts of nature and have to be treated as such.	5.21	5.34	5.08	.042
Attribution of responsibility				
In my country, households are responsible for a great proportion of the food waste.	4.83	5.09	4.54	.000
Perceived consumer effectiveness				
I believe that every little effort by consumers helps to reduce the food waste problem.	5.15	5.28	4.81	.002

DISCUSSION

This article explores circular economy principles and by synthesising examples of 'circular' activities, products and companies in the horticultural sector, potential benefits for regional and rural Australia are outlined. Unlike other studies on the circular economy, which tend to focus on industrial processes and activities such as design for disassembly and recycling, this research focuses on the consumer perspective. This article contributes to the

small, but growing, literature advocating a more nuanced perspective on the circular economy (Chamberlain & Boks, 2018).

Almost half of the sample are willing to buy novel, value-added snacks, a 'circular food product', even though they do not have actual product experience. Our results show that awareness of the consequences of food waste is significant in differentiating between people who are willing to purchase value-added foods and those who are not. Furthermore, consumers cite factors such as helping farmers and caring for the natural environment as factors motivating purchase. Hence, the survey supports other studies that highlight morality as an influential factor in explaining how people feel about food waste, as well as their intentions to avoid wasting food (Borteledo et al., 2012; Gjerris & Gaiani, 2013; Parizeau et al., 2015; Setti et al., 2016; Stancu et al., 2016; Stefan et al., 2013; Watson & Meah, 2012). In addition, some scholars argue that raising customer awareness may lead to more sustainable behaviour (Whitehair, Shanklin, & Brannon, 2013). Hence, the recommendations for marketers when designing their marketing communications for a circular economy are to highlight empathy and care for farmers and show the various consequences of food waste for people and the natural environment, as well as educate consumers about their responsibility in curbing food waste. Although this study reveals the market potential for novel, value-added foods, caution is advisable. Academic research on the adoption of innovations has shown that intentions are far from perfect predictors of behaviour (Arts, Framback, & Bijmolt, 2011). With regard to our findings linking willingness to buy value-added food and consumers' awareness of the food waste problem, we could only show the correlation, which implies the causal relationship. Future research could be conducted to prove the causal relationship using other methods such as experiments or in-depth interviews.

Future research can move forward in several directions. One direction is to use qualitative research to explore attitudes towards 'circular foods' and the ways in which consumers can be involved in closing loops when it comes to food waste (i.e., sharing of food, composting, acceptance of seconds, etc.). Future researchers could use a food choice experiment and present different product concepts to respondents, conduct taste tests and examine willingness to pay. This study did not conduct taste tests with consumers, even though taste is the single largest determinant of food choice (Verbeke, 2005). Qualitative research could probe consumer's support for circular economy principles and explore whether ethical issues (such as supporting farmers) conflict with other considerations (such as price, quality perceptions, avoiding packaged products and eating fresh produce). There is a diversity of factors that explain early adoption of new products by consumers and other theories, such as the diffusion of innovation model (Rogers, 2003) or theory of planned behaviour (Ajzen, 1991) are useful in explain adoption. It should be possible extend the current conceptual model by incorporating other variables that increase, or deter, consumer demand for novel foods (see Bredahl, 2001; Lusk, Roosen, & Bieberstein, 2014). These include environmental concern personal values, health concern; level of involvement with food; personality characteristics such as necrophilia, and product-related attributes (i.e., price, taste, branding, eco-certification, natural attributes, etc.). Finally, semi-structured interviews with experts in the horticultural supply chain could be undertaken in relation to how the principles of the circular economy could be enacted, the type of training and knowledge required along with useful measures of performance or 'circularity indicators' (Ellen MacArthur Foundation, 2015).

CONCLUSIONS

Due to the scale of the food waste problem, there is an urgent need to move towards a circular economy. A survey was undertaken and it shows the willingness of Australian

consumers to buy food made from underutilised biomass. Results illustrate that there are significant differences in attitudes between those who are willing to buy value-added foods and those who are not; furthermore, empathy and care for farmers' welfare is a purchasing criterion. The circular economy model deals mainly with materials and resources, and incorporating the consumer perspective into the circular economy model provides essential knowledge for decision-makers.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

REFERENCES

Ajzen, I., (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes,* 50, 179–211.

Andrews, D. (2015). The circular economy, design thinking and education for sustainability. *Local Economy*, 30(3), 305-315.

Arts, J. W., Frambach, R. T., & Bijmolt, T. H. (2011). Generalizations on consumer innovation adoption: A meta-analysis on drivers of intention and behavior. *International Journal of Research in Marketing*, *28*(2), 134-144.

Aschemann-Witzel, J., Jensen, J. H., Jensen, M. H., & Kulikovskaja, V. (2017). Consumer behaviour towards price-reduced suboptimal foods in the supermarket and the relation to food waste in households. *Appetite*, *116*, 246-258.

Australian Bureau of Statistics. (2016a). *6523.0 - Household Income and Wealth, Australia, 2015-16.* Retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/6523.0Main+Features12015-16?OpenDocument

Australian Bureau of Statistics. (2016b). *6227.0 - Education and Work, Australia, May 2016*. Retrieved from http://www.abs.gov.au/ausstats/abs@.nsf/mf/6227.0

Australian Government (2016). *Horticulture Fact Sheet.* Retrieved from http://www.agriculture.gov.au/ag-farm-food/hort-policy/horticulture_fact_sheet

Australian Government. (2017). *National Food Waste Strategy: Halving Australia's Food Waste by 2030.* Canberra: Commonwealth of Australia.

Bioregen (n.d). *The Process.*
Retrieved from http://www.vrm.com.au/bioregen/index.html#section2

Birau, M. M., & Faure, C. (2018). It is easy to do the right thing: Avoiding the backfiring effects of advertisements that blame consumers for waste. *Journal of Business Research*, *87*, 102-117.

Blades, L., Morgan, K., Douglas, R., Glover, S., De Rosa, M., Cromie, T., & Smyth, B. (2017). Circular biogas-based economy in a rural agricultural setting. *Energy Procedia*, *123*, 89-96.

Borrello, M., Caracciolo, F., Lombardi, A., Pascucci, S., & Cembalo, L. (2017). Consumers' perspective on circular economy strategy for reducing food waste. *Sustainability*, *9*(1), 141.

Bortoleto, A.P., Kurisu, K.H., Hanaki, K., (2012). Model development for household waste prevention behaviour. *Waste Management* 32 (12), 2195–2207.

Bredahl, L. (2001). Determinants of consumer attitudes and purchase intentions with regard to genetically modified food–results of a cross-national survey. *Journal of Consumer Policy*, *24*(1), 23-61.

Brook Lyndhurst (2007). *Food behaviour consumer research—findings from the quantitative survey. Briefing Article.* UK: WRAP.

Calvo-Porral, C., Medín, A. F., & Losada-López, C. (2017). Can Marketing Help in Tackling Food Waste?: Proposals in Developed Countries. *Journal of Food Products Marketing*, *23*(1), 42-60.

Canali, M., Amani, P., Aramyan, L., Gheoldus, M., Moates, G., Östergren, K., ... & Vittuari, M. (2016). Food waste drivers in Europe, from identification to possible interventions. *Sustainability*, *9*(1), 37.

Chamberlin, L, & Boks C. (2018). Marketing Approaches for a Circular Economy: Using Design Frameworks to Interpret Online Communications. *Sustainability*, 10 (6),2070.

Chen, R., Rojas-Downing, M. M., Zhong, Y., Saffron, C. M., & Liao, W. (2015). Life cycle and economic assessment of anaerobic Co-digestion of dairy manure and food waste. *Industrial Biotechnology*, *11*(2), 127-139.

Cicatiello, C., Franco, S., Pancino, B., & Blasi, E. (2016). The value of food waste: An exploratory study on retailing. *Journal of Retailing and Consumer Services*, *30*, 96-104.

Cristóbal, J., Castellani, V., Manfredi, S., & Sala, S. (2018). Prioritizing and optimizing sustainable measures for food waste prevention and management. *Waste Management*, *72*, 3-16.

CSIRO (2017). *Food & Agribusiness Roadmap*. Retrieved from https://www.csiro.au/en/Do-business/Futures/Reports/Food-and-Agribusiness-Roadmap

CSIRO (2018a). *A value chain for vegetable waste – from farm to fork*. Retrieved from https://events.csiro.au/Events/2018/March/21/Value-chain-for-vegetable-waste

CSIRO (2018b). *Novel Extruded Food Products*. Retrieved from https://www.csiro.au/en/Research/AF/Areas/Food/Making-new-sustainable-foods/Extrusion

DeFelice, S. L. (1995). The nutraceutical revolution: its impact on food industry R&D. *Trends in Food Science & Technology*, *6*(2), 59-61.

Delley, M., & Brunner, T. A. (2017). Foodwaste within Swiss households: A segmentation of the population and suggestions for preventive measures. *Resources, Conservation and Recycling*, *122*, 172-184.

Department of Agriculture (2015). *Horticulture Factsheet.* Canberra: Australian Federal Government. Retrieved from http://www.agriculture.gov.au/ag-farm-food/hort-policy/horticulture_fact_sheet

Duarte Alonso, A., & Northcote, J. (2013). Investigating farmers' involvement in value-added activities: A preliminary study from Australia. *British Food Journal*, *115*(10), 1407-1427.

Ellen MacArthur Foundation (2015). *Circularity Indicators: An Approach to Measuring Circularity.* Ellen MacArthur Foundation: Isles of White, UK.

Ernst, E. (2001). Functional foods, neutraceuticals, designer foods: innocent fad or counterproductive marketing ploy? *European Journal of Clinical Pharmacology*, *57*(5), 353-355.

Euromonitor International (2017a). *Health & Wellness 2017 - New Insights & System* Refresher. Retrieved from https://blog.euromonitor.com/2017/09/global-consumer-trends-2017.html

Euromonitor International (2017b). *World Health & Wellness Company Strategies – Part 1.* Retrieved from http://www.euromonitor.com/world-health-and-wellness-company-strategies-part-i-commitments/report

EU Commission (2014). Towards a Circular Economy: A Zero Waste Programme for Europe, COM, 398.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Los Angeles: Sage

Fleming, A., Dowd, A. M., Gaillard, E., Park, S., & Howden, M. (2015). "Climate change is the least of my worries": stress limitations on adaptive capacity. *Rural Society*, *24*(1), 24-41.

Foley, J. A., Ramankutty, N., Brauman, K. A., Cassidy, E. S., Gerber, J. S., Johnston, M., ...Zaks, D. P. M. (2011). Solutions for a cultivated planet. *Nature*, 478 (7369), 337-342.

Galanakis, C. M. (2012). Recovery of high added-value components from food wastes: conventional, emerging technologies and commercialized applications. *Trends in Food Science & Technology*, *26*(2), 68-87.

Garcia-Garcia, G., Woolley, E., Rahimifard, S., Colwill, J., White, R., & Needham, L. (2017). A methodology for sustainable management of food waste. *Waste and Biomass Valorization*, *8*(6), 2209-2227.

Garrone, P., Melacini, M., & Perego, A. (2014). Opening the black box of food waste reduction. *Food Policy,* 46, 129–139.

Gjerris, M., & Gaiani, S. (2013). Household food waste in Nordic countries: Estimations and ethical implications. *Nordic Journal of Applied Ethics*, *7*(1), 6-23.

Göbel, C., Langen, N., Blumenthal, A., Teitscheid, P., & Ritter, G. (2015). Cutting food waste through cooperation along the food supply chain. *Sustainability*, *7*(2), 1429-1445.

Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., ...Toulmin, C. (2010). Food security: The challenge of feeding 9 billion people. *Science*, 327 (5967), 812-818.

Hamilton, C., Denniss, R., & Baker, D. (2005). *Wasteful consumption in Australia. Discussion Article*. Number 77, March 2005. The Australia Institute, Manuka, Australia.

Howe, J., Reilly, A., van den Broek, D., & Wright, C. F. (2019). Working Holiday Makers in Australian Horticulture: Labour Market Effect, Exploitation and Avenues for Reform. *Griffith Law Review https://doi. org/10.1080/10383441.2018*, *1482814*.

de Hooge, I. E., Oostindjer, M., Aschemann-Witzel, J., Normann, A., Loose, S. M., & Almli, V. L. (2017). This apple is too ugly for me! Consumer preferences for suboptimal food products in the supermarket and at home. *Food Quality and Preference*, *56*, 80-92.

Ilyuk, V. (2018). Like throwing a piece of me away: How online and in-store grocery purchase channels affect consumers' food waste. *Journal of Retailing and Consumer Services*, *41*, 20-30.

Ingrao, C., Faccilongo, N., Di Gioia, L., & Messineo, A. (2018). Food waste recovery into energy in a circular economy perspective: A comprehensive review of aspects related to plant operation and environmental assessment. *Journal of cleaner production*, *184*, 869-892.

Jackson, M., Lederwasch, A., & Giurco, D. (2014). Transitions in theory and practice: Managing metals in the circular economy. *Resources*, *3*(3), 516-543.

Jurgilevich, A., Birge, T., Kentala-Lehtonen, J., Korhonen-Kurki, K., Pietikäinen, J., Saikku, L., & Schösler, H. (2016). Transition towards circular economy in the food system. *Sustainability*, *8*(1), 69.

Kibler, K. M., Reinhart, D., Hawkins, C., Motlagh, A. M., & Wright, J. (2018). Food waste and the food-energy-water nexus: A review of food waste management alternatives. *Waste management*.

Kirchherr, J.; Reike, D.; Hekkert, M. Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation & Recycling,* 127, 221–232.

Kouwenhoven, G., Reddy Nalla, V., & Lossonczy von Losoncz, T. (2012). Creating sustainable businesses by reducing food waste: a value chain framework for eliminating inefficiencies. *International Food and Agribusiness Management Review*, *15* (1030-2016-82923), 119-138.

Laufenberg, G., Kunz, B., & Nystroem, M. (2003). Transformation of vegetable waste into value added products: (A) the upgrading concept; (B) practical implementations. *Bio-Resource Technology*, *87*(2), 167-198.

Lewandowski, M. (2016). Designing the Business Models for Circular Economy—Towards the Conceptual Framework. *Sustainability*, 8 (1):43.

Lin, C. S. K., Pfaltzgraff, L. A., Herrero-Davila, L., Mubofu, E. B., Abderrahim, S., Clark, J. H., ... & Thankappan, S. (2013). Food waste as a valuable resource for the production of chemicals, materials and fuels. Current situation and global perspective. *Energy & Environmental Science*, *6*(2), 426-464.

Lipinski, B., Hanson, C., Lomax, J., Kitinoja, L., Waite, R., & Searchinger, T. (2013). Reducing food loss and waste. *World Resources Institute*, *22*.

Lusk, J.L., Roosen, J., & Bieberstein, A. (2014). Consumer acceptance of controversial new food technologies: Causes and roots of controversies. *Annual Review of Resource Economics, 6*, 381–405.

Mallinson, L. J., Russell, J. M., & Barker, M. E. (2016). Attitudes and behaviour towards convenience food and food waste in the United Kingdom. *Appetite*, *103*, 17-28.

Martin, D., & Schouten, J. (2012). *Sustainable Marketing* (Vol. 1). Boston: Prentice Hall.

Mena, C., Terry, L. A., Williams, A., & Ellram, L. (2014). Causes of waste across multi-tier supply networks: Cases in the UK food sector. *International Journal of Production Economics*, *152*, 144-158.

Mirabella, N., Castellani, V., & Sala, S. (2014). Current options for the valorization of food manufacturing waste: a review. *Journal of Cleaner Production*, *65*, 28-41.

Murray, A., Skene, K., & Haynes, K. (2017). The circular economy: An interdisciplinary exploration of the concept and application in a global context. *Journal of Business Ethics*, *140*(3), 369-380.

Neff, R. A., Spiker, M. L., & Truant, P. L. (2015). Wasted food: US consumers' reported awareness, attitudes, and behaviors. *PloS one*, *10*(6), e0127881.

Pagotto, M., & Halog, A. (2016). Towards a circular economy in Australian agri-food industry: an application of input-output oriented approaches for analyzing resource efficiency and competitiveness potential. *Journal of Industrial Ecology*, *20*(5), 1176-1186.

Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N., & bin Ujang, Z. (2014). The food waste hierarchy as a framework for the management of food surplus and food waste. *Journal of Cleaner Production*, *76*, 106-115.

Parizeau, K., von Massow, M., & Martin, R. (2015). Household-level dynamics of food waste production and related beliefs, attitudes, and behaviours in Guelph, Ontario. *Waste Management*, *35*, 207-217.

Poortinga, W., Pidgeon, N., & Lorenzoni, I. (2006). *Public perceptions of nuclear power, climate change and energy options in Britain: summary findings of a survey conducted during October and November 2005*. Tyndall Centre for Climate Change Research. School of Environmental Sciences. University of East Anglia.

Potting, J., Hekkert, M. P., Worrell, E., & Hanemaaijer, A. (2017). *Circular economy: measuring innovation in the product chain*. PBL.

Queensland Government (n.d). *Adapting to Market Changes Project.* Retrieved from https://www.daf.qld.gov.au/business-priorities/plants/fruit-and-vegetables/fruit-and-nuts/pineapples/adapting-to-market-changes-project

Richards, C., Lawrence, G., Loong, M., & Burch, D. (2012). A toothless chihuahua? The Australian Competition and Consumer Commission, neoliberalism and supermarket power in Australia. *Rural Society*, *21*(3), 250-263.

Rodríguez Cohard, J. C., Sánchez Martínez, J. D., & Gallego Simón, V. J. (2017). The upgrading strategy of olive oil producers in southern Spain: origin, development and constraints. *Rural Society*, *26*(1), 30-47.

Rogers, E.M. (2003). *Diffusion of Innovations* (5th ed.) New York: Free Press.

Secondi, L., Principato, L., Ruini, L., & Guidi, M. (2019). Reusing Food Waste in Food Manufacturing Companies: The Case of the Tomato-Sauce Supply Chain. *Sustainability*, *11*(7), 2154.

Schwartz, S. H., & Howard, J. A. (1981). A normative decision-making model of altruism. In J. P. Rushton. (Ed.), *Altruism and Helping Behaviour: Social, Personality and Developmental Perspectives* (pp. 189–211). Hilldale N.J.: Erlbaum.

Setti, M., Falasconi, L., Segrè, A., Cusano, I., & Vittuari, M. (2016). Italian consumers' income and food waste behavior. *British Food Journal*, *118*(7), 1731-1746.

Siro, I., Kapolna, E., Kapolna, B., & Lugasi, A. (2008). Functional food. Product development, marketing and consumer acceptance—A review. *Appetite*, *51*(3), 456-467.

Stancu, V., Haugaard, P., & Lähteenmäki, L. (2016). Determinants of consumer food waste behaviour: Two routes to food waste. *Appetite*, *96*, 7-17.

Stefan, V., van Herpen, E., Tudoran, A. A., & Lähteenmäki, L. (2013). Avoiding food waste by Romanian consumers: The importance of planning and shopping routines. *Food Quality and Preference*, *28*(1), 375-381.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309-317.

Sundrop Farms (n.d). *Sundrop System.* Retrieved from http://www.sundropfarms.com/

Turner, B., & Hope, C. (2014). Ecological connections: Reimagining the role of farmers' markets. *Rural Society*, *23*(2), 175-187.

United Nations (2016). *UN announces first-ever global standard to measure food loss and waste*. Retrieved from https://news.un.org/en/story/2016/06/531392-un-announces-first-ever-global-standard-measure-food-loss-and-waste

van de Mortel, T.F. (2008). Faking it: social desirability response bias in self-report research. *Australian Journal of Advanced Nursing*, 25 (4), 40-48.

Verbeke, W. (2005). Consumer acceptance of functional foods: socio-demographic, cognitive and attitudinal determinants. *Food Quality and Preference*, *16*(1), 45-57.

Watson, M., & Meah, A. (2012). Food, waste and safety: negotiating conflicting social anxieties into the practices of domestic provisioning. *The Sociological Review*, *60*(S2), 102-120.

Whitehair, K. J., Shanklin, C. W., & Brannon, L. A. (2013). Written messages improve edible food waste behaviors in a university dining facility. *Journal of the Academy of Nutrition and Dietetics*, *113*(1), 63-69.

Woźniak, J., & Pactwa, K. (2018). Overview of Polish Mining Wastes with Circular Economy Model and Its Comparison with Other Wastes. *Sustainability*, 10(11):3994.

World Resources Institute (2013). *Creating a Sustainable Food Future.* Retrieved from https://www.wri.org/our-work/project/world-resources-report-creating-sustainable-food-future

World Resources Institute (2015). *What's Food Loss and Waste go to do with Climate Change? A Lot, Actually.* Retrieved from https://www.wri.org/blog/2015/12/whats-food-loss-and-waste-got-do-climate-change-lot-actually

Yuan, Z., Bi, J., Moriguichi, Y., (2006). The circular economy: a new development strategy in China. *Journal of Industrial Ecology*, 10 (1–2), 4–8.