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## Wealth from waste: the role of food consumers in the circular economy

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Abstract:	<p>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 reveal 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 the natural environment and people.</p>

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## Wealth from waste: the role of food consumers in the circular economy

### 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 reveal 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 the natural environment and people.

**KEY WORDS:** circular economy, food waste, valued-adding, moral norms.

**WORD COUNT:** 7,085 (including references)

### 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). 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). The horticulture industry in Australia is grappling with the food waste challenge, along with climate change (Fleming, Dowd, Gaillard, Park, & Howden, 2015). It is a significant sector of the economy, generating exports worth \$2.1 billion and employing an estimated 56,700 people (Australian Government, 2016). Curbing food loss should help it economically and ensure it continues to play a role in the prosperity of people living in rural and regional Australia. Approximately one quarter of all vegetables that are produced do not leave the farm (Australian Government, 2017). Food can be conceptualised as embedded water and energy (Martin & Schouten, 2012) and therefore throwing away vegetables represents a highly inefficient use of resources. The circular economy approach is one response to these challenges. Value adding - which involves turning fruit and vegetable residues into high value products (Lin et al., 2013) - is one example of the reuse of materials and hence illustrates circular economy principles (Murray, Skene & Haynes, 2017). This study focuses on Australian consumers' attitudes towards novel, value added products which helps fill a gap in the literature. Studies on the consumer's perspective of the circular economy are lacking, with scholars stating: "little is known about consumers' willingness to participate in a circular economy" (Borrello, Caracciolo, Lombardi, Pascucci, & Cembalo, 2017, p.1).

The structure of this article is as follows: background information is presented on food waste, the circular economy framework and the role of consumers in advancing the circular economy.

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3 The conceptual model and the hypotheses are then presented. The methodology section  
4 describes the research design and the results section presents the findings from a survey of  
5 Australian food consumers. The data findings are then discussed in the context of existing  
6 studies and the last section outlines practical implications and possibilities for future research.  
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## 9 **RATIONALE FOR STUDY**

10  
11 Food waste is one of the most challenging issues humankind is currently facing and one  
12 solution is the marketing of novel, value added foods. However, growers in regional and rural  
13 Australia need to ensure that consumer demand exists. Consumer acceptance of novel foods,  
14 and an understanding of its determinants, are widely recognised as key success factors for new  
15 product development (Verbeke, 2005). However, scholars note that consumers are averse to  
16 novel, food-related technologies for many reasons, including risk aversion and perceptions of  
17 unnaturalness (Lusk et al., 2014). The branded products derived from food waste are today  
18 rather limited, and commercialisation (i.e., the process of taking patented products and  
19 processes to the market) is challenging (Galanakis, 2012). Most studies on value-added foods  
20 are located in the food science discipline and describe restricted examples and pilot-scale  
21 laboratory experiences (Mirabella et al., 2014). Hence, this study is likely to have practical  
22 implications for growers and other value chain members. Furthermore, it may help address a  
23 gap in the literature. Academic literature on the circular economy is still nascent, particularly  
24 when it comes to the consumer perspective (Chamberlin & Boks, 2018).  
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## 29 **LITERATURE REVIEW – THE CIRCULAR ECONOMY CONCEPT**

30  
31 Fruit and vegetables are the second largest commodity contributing to food loss around the  
32 world. Food is lost during, or immediately after, harvesting on the farm for several reasons:  
33 fruit is bruised, eaten by pests, does not meet the rigid quality standards set by retailers or is  
34 dumped due to a glut in the marketplace (Lippinski et al., 2013). The two major sources of  
35 surplus food and food waste at the farm are overproduction and non-compliance with market  
36 standards—in terms of size, shape, or appearance (Garrone, Melacini, & Perego, 2014). In  
37 Australia, the power of supermarkets to enforce ‘quality standards’ is a source of frustration for  
38 farmers (Richards, Lawrence, Loong & Burch, 2012). It is estimated that 25% of all vegetables  
39 produced in Australia do not leave the farm and the total cost of agricultural food losses to  
40 farmers is \$2.84 billion (Australian Government, 2017). The scale of this loss makes waste  
41 reduction, at the pre-and post-harvest stages, an important policy goal, as outlined in the *Food*  
42 *Waste Strategy* (2017).  
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46 The vision of a circular economy is gaining traction in academic and practitioner-oriented  
47 literatures. However, there is no commonly accepted definition of the circular economy (Yuan,  
48 Bi & Moriguchi, 2006), and scholars have in fact identified 114 definitions of circular  
49 economy (Kirchherr, Reike, & Hekkert, 2017). The concept of a circular economy, in general  
50 terms, promotes resource minimisation (Anderson, 2007). The circular economy is most  
51 frequently depicted as a combination of reduce, reuse and recycle activities (EU Commission,  
52 2014; Kirchherr, Reike, & Hekkert, 2017; Lewandowski, 2017; Martin & Schouten, 2012;  
53 Woźniak & Pactwa, 2018), which help turn a linear system into a circular system. In a linear  
54 economic model, the physical environment is treated as a receptacle for waste products from  
55 the economy, and design for disassembly, recycling and reuse are not fundamental parts of the  
56 system. This is inefficient since resources (i.e., materials, energy, water etc.) flow out of the  
57 system. A circular economy, on the other hand, is an industrial system that is restorative or  
58 regenerative by intention and design. It is founded on the principle of the earth as a closed  
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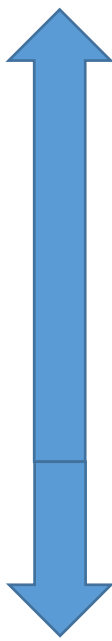
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3 economic system, where the environment and economy are linked in a circular relationship.  
4 The circular nature refers to materials flowing within a closed-loop - to be reused again and  
5 again (Jackson, Lederwasch, & Giurco, 2014). Scholars in the circular economy field often  
6 draw on the waste hierarchy framework (reduce, reuse, recycle, recovery, landfill) and it is  
7 agreed that the most important step in the approach to waste management is waste prevention  
8 (Papargyropoulou, Lozano, Steinberger, Wright, & bin Ujang, 2014).  
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11 This study adopts the following definition of the circular economy:  
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13 “A circular economy describes an economic system that is based on business models  
14 which replace the ‘end-of-life’ concept with reducing, alternatively reusing, recycling  
15 and recovering materials in production/distribution and consumption processes, thus  
16 operating at the micro level (products, companies, consumers), meso level (eco-  
17 industrial parks) and macro level (city, region, nation and beyond), with the aim to  
18 accomplish sustainable development, which implies creating environmental quality,  
19 economic prosperity and social equity, to the benefit of current and future generations”  
20 (Kirchherr, Reike, & Hekkert, 2017, p. 225).  
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24 Figure 1 offers examples of how a linear horticultural sector can be turned into a circular system and  
25 the strategies are outlined below. For instance, commodities such as fruit and vegetables are grown,  
26 consumed, composted and returned to the earth to enrich the soil. Commodities can also be used to  
27 make processed food and the materials (i.e., packaging) or waste (i.e., products such as oils, peels  
28 and seeds) can be recycled and returned to the producer or processor and used as inputs in another  
29 industry.  
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**Figure 1.**  
Moving Australian horticulture towards a circular economy – strategies.

Circular Economy	Circularity Strategies	Examples
	Avoid or reduce waste	Education campaigns. Research for more efficient production methods. Cold chain management. Packaging initiatives to improve shelf life.
	Avoid or reduce waste	Food Rescue donations. Aesthetically imperfect food used by different customer groups.
	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).
Linear Economy	Disposal	Produce left to rot in fields, going to sewer or landfill

Adapted from Potting, Hekkert, Worrell & Hanemaaijer (2017) and the National Food Waste Strategy (2017).

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 et al., 2018 ). The use of the food waste should follow waste hierarchy principles with waste prevention (Papargyropoulou et al., 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, Castellani, Manfredi, & Sala, 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 Woolworths did sell 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

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3 adopted by growers in reaction to globalisation pressures (Rodríguez Cohard, Sánchez  
4 Martínez, & Gallego Simón, 2017). Excess produce can be converted into highly processed  
5 products, such as baby food, juices, jams, fermented foods, pickles, sauces, soups and so forth.  
6 In Australia, there is growing interest in waste valorisation practices based on innovative, plant-  
7 based products. For example, *Natural Evolution Foods*, is a company that transforms organically  
8 grown, green bananas into gluten-free banana flour and starch-resistant dietary fibre  
9 (Australian Government, 2017). It is possible to convert food waste into energy, although it is  
10 not the most sustainable and cost-effective option for dealing with food waste. Problems relate  
11 to the capacity of treatment infrastructure and difficulty in separating food waste from other  
12 waste streams (Kibler, Reinhart, Hawkins, Motlagh, & Wright, 2018). *Sundrop Farms* in South  
13 Australia is an example of an innovative, ‘circular’ food producer that grows tomatoes in  
14 greenhouses by using solar power, electricity generation, fresh water production and  
15 hydroponics (Sundrop Farms, n.d). Another solution to the food waste problem is to divert it to  
16 animal feed. Food waste can be turned into compost which helps ‘close the loop’ in a circular  
17 economy (Borrello et al., 2017). One example is the company *BioRegen*, an Australian  
18 company that manufactures a liquid that enriches soil health (BioRegen, n.d).  
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25 Value adding refers to the process of increasing the value of the input through transformation,  
26 using manufacturing processes or using differentiated production techniques, such as organic  
27 production (CSIRO, 2017). For instance, citrus peel can be used as a natural sweetener (i.e.,  
28 sugar syrup) in processed foods, and pectin can be utilized as gelling agent in the confectionary  
29 sector. In recent times, there has been a move towards ‘redesign’ of commodity products by  
30 extracting nutrients from biomass. The shift towards converting food waste into high-value  
31 products is driven by several factors: more advanced technologies, consumer interest in health,  
32 as well as the sophisticated marketing of functional foods and nutraceuticals by the cosmetic  
33 and pharmaceutical industries (Ernst, 2001). Nutraceutical is a term derived from the words  
34 “nutrition” and “pharmaceutical” and it can refer to any substance that is a food, or a part of a  
35 food, and provides medical or health benefits, including the prevention and treatment of  
36 diseases (DeFelice, 1995). Examples include fish oils or olive leaf extract. Likewise,  
37 ‘functional foods’ refer to foods that may provide health benefits beyond basic nutrition, such  
38 as probiotic drinking yogurt (Siro, Kapolna, Kapolna, & Lugasi, 2008). Food waste is a source  
39 of valuable compounds for the pharmaceutical and nutraceutical industries - for instance,  
40 bromelain is an enzyme found in pineapple juice and in the stem of the pineapple and can be  
41 used to treat medical ailments (Laufenberg, Kunz, & Nystroem, 2003; Lin et al., 2013;  
42 Galanakis, 2012, Mirabella, Castellani, & Sala, 2014). The fresh cut fruit industry discards  
43 large percentages of by-products, such as peels, seeds, and unused flesh that can present similar  
44 or even higher contents of bioactive compounds, such as phenolic compounds, carotenoids and  
45 vitamins, than the final product (Mirabella et al., 2014).  
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50 Hence, options for dealing with waste in the Australian horticultural sector are a mix of the  
51 linear and the circular economy. Many challenges to reducing food loss exist, including the  
52 current nature of food production, with its inherent risks (such as perishability, bad weather,  
53 disease and market price falls) as well as deeply embedded social habits and institutional  
54 practices (see Canali et al., 2017 for a review). Australian growers cite barriers in the form of  
55 added expenses, lack of time, knowledge, and markets, to sell value-added products  
56 (Duarte Alonso & Northcote, 2013).  
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3 This study focuses on one strategy in Figure 2 – re-thinking, re-processing, redesign (using  
4 parts, or all, of a discarded product in a new, improved product). A study by the *Commonwealth*  
5 *Scientific and Industrial Research Organisation* (CSIRO) shows that valuable food ingredients  
6 and snack products can be produced using vegetables, which are dried and ground to a powder,  
7 with minimal loss of nutrients (CSIRO, 2018a). Extrusion (i.e. mixing, cooking, shearing,  
8 puffing, shaping and drying) is a process designed to produce a wide variety of foods in sectors  
9 such as snacks, ready-to-eat (RTE) cereals, biscuits, confectionery and extruded crisp breads.  
10 The technology has been restricted to two types of biomass - whole carrots and broccoli  
11 (CSIRO, 2018b). Market reports have highlighted the trend towards health and wellness, along  
12 with convenience, in the food and beverages industry. Companies are using different strategies  
13 to address the health and wellness trend, such as including more plant-based ingredients in high  
14 growth sectors such as beverages, snacks, cereals and baked goods and providing premium  
15 priced, value-added food products with significant health claims (CSIRO, 2017; Euromonitor,  
16 2017a; Euromonitor, 2017b).

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

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

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37 This study focuses on the role of consumers in purchasing ‘circular products’ and moving the  
38 horticultural sector towards a circular economy. In order to understand reasons for buying a  
39 value-added product, the authors draw on the norm-activation model (Schwartz & Howard,  
40 1981). This model posits that awareness of consequences (AC) is one factor (amongst others)  
41 that influences pro-social or environmental behaviour. It refers to whether someone is aware of  
42 the negative consequences for others, or for other things one values, when not acting pro-  
43 socially (Steg & Velk, 2009). Food waste is regarded as a moral problem given the inequality  
44 of access to food across the globe (Aschemann-Witzel, Jensen, Jensen, & Kulikovskaja, 2017;  
45 Neff, Spiker, & Truant, 2015) and the rising problem of food security (Foley et al., 2011;  
46 Godfray et al., 2010). There is ample evidence that consumers feel guilty, uncomfortable or  
47 bothered to some extent if they waste food (Brook Lyndhurst, 2007; Hamilton, Denniss, &  
48 Baker, 2005; Parizeau, vol Massow, & Martin, 2015; Setti, Falasconi, Segrè, Cusano, &  
49 Vittuari, 2016; Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013; Watson & Meah, 2012).  
50 Several scholars link food waste avoidance to moral judgements (Borteledo, Kurisu, & Hanaki,  
51 2012; Gjerris & Gaiani, 2013; Stancu, Haugaard, & Lähteenmäki, 2016). Based on these  
52 studies, the following hypothesis is developed:

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57 **H1** People who are willing to buy value added foods show more awareness of the food waste  
58 problem than those who are not willing to buy value-added foods.  
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## RESEARCH METHODS

A quantitative research methodology was chosen in order to incorporate the consumer perspective into the circular economy framework.

### Questionnaire development and scales

Data was collected using a questionnaire. The questionnaire 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.

Items in relation to 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). Willingness to buy was designed as a 7-point scale, anchored from extremely unwilling (=1) to extremely willing (=7). Consumers' purchasing priorities were also assessed. They were required to rank six factors that would influence 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).

Multi-item scales were used to measure awareness of the food waste problem. To achieve the best possible quality, items with a high Cronback's alpha were selected from previous studies. Instructions, such as "Please rate your level of agreement or disagreement with the following statements", were given to respondents. All items were designed as a 7-point scale, anchored from very strongly disagree (=1) to very strongly agree (=7). A seven-point scale was selected to be consistent with previous studies (Grunert, Brunsø, Bredahl, & Bech, 2001), and it was assumed that the respondents would be familiar with surveys and be relatively literate.

### Recruitment of respondents and sample

Ethics approval was secured from the Human Ethics Committee in the authors' 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. A commercial panel 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). Sampling was conducted with due concern for demographic variation in terms of gender and age. 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 Analysis

Analysis included frequency distributions and t-tests, using IBM SPSS 25 software (Field, 2013). A total of 330 usable surveys were obtained. Table 1 shows that Cronbach's alpha values of  $>.8$  were obtained.

**Table 1**  
Cronbach's alpha score, mean and standard deviation

Scale items	Cronbach's alpha	Mean	Standard Deviation
<b>Awareness of the food waste problem</b>	0.853	5.0651	.88136
In my country, households are responsible for a great proportion of the food waste.			
Food waste is a big environmental issue.			
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.			

## FINDINGS

### Summary statistics

The summary statistics for the sample of 330 respondents are 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.

### Willingness to buy value-added foods

The vegetable snack product received the highest score, with 51.5% of the sample being willing to buy it, and 20% being very willing or extremely willing to buy it. Slightly less respondents were willing to buy the vegetable powder (46.9%) and the fermented product (44.2%). It must be noted that more than a quarter of the sample were 'neither willing nor unwilling' to buy the value added food products based on food waste (29.1% and 26.7%). 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*)

<b>Attitudinal Item</b>	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. Table 3 displays the percentage of respondents who ranked each of the six factors.

**Table 3**

Factors influencing demand for value-added foods.

<b>Factor</b>	<b>1</b> % ( <i>n</i> )	<b>2</b> % ( <i>n</i> )	<b>3</b> % ( <i>n</i> )	<b>4</b> % ( <i>n</i> )	<b>5</b> % ( <i>n</i> )	<b>6</b> % ( <i>n</i> )
Helping farmers	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)
Healthy food	11.7 (34)	12 (35)	15.8 (46)	21.3 (62)	23 (67)	16.2 (47)
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)
Price	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 preferences; effects on the economy (34.4%) were just as important. Meeting consumer demand for healthy food was of medium importance (23.7%), along with helping society (22.7). Meeting the needs of the price-conscious consumer was the lowest ranked factor (18.9%) - this factor had relatively low proportions of respondents across the top two preferences.

## Willingness to buy value added foods: role of cognitive factors

Exploration of consumers' cognitions in relation to food waste took place via a series of statements. 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). 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). People who were aware of the ramifications of food waste for society were more inclined to state that they were willing to buy value-added foods.

**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	<b>Group 1</b> Willing to buy (responses >=5) Mean	<b>Group 2</b> Unwilling to buy; neither willing nor unwilling to buy (responses <5) Mean	Sig. (t- test)
<b>Awareness</b>			
In my country, households are responsible for a great proportion of the food waste.	5.09	4.54	.000
Food waste is a big environmental issue.	5.39	4.94	.000
Food waste is an important social issue (e.g. world hunger).	5.54	5.18	.006
Foods are scarce over the world and should be consumed consciously.	5.42	5.16	.027
Foods are gifts of nature and have to be treated as such.	5.34	5.08	.042
In my country, the food waste generated by households has great financial consequences.	4.92	4.53	.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). It draws on the norm activation model as a framework to understand consumers' willingness to buy value-added food and reasons for participating in the circular economy. 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 consequences 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 consequences of food waste for people and the natural environment.

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). This study did not conduct taste tests with consumers, even though taste is the single largest determinant of food choice (Verbeke, 2005). One limitation of this study relates to the sampling procedure and hence generalisations beyond this convenience sample are limited.

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. 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.

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