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Valuing environmentally sustainable agriculture? Food and water concerns, production literacy, and consumption behaviours in rural-regional Australia

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Although Australia currently enjoys a high level of food security, increasing climate change pressure on the planet's driest landmass which is governed by little climate change mitigating legislation, makes future food security tenuous in globalised, industrial food production systems. This article presents primary data exploring the salience of food and water concerns, compared with related knowledge, affecting agricultural product consumption. Online survey respondents (employees at a large organisation that states its values creating environmentally sustainable rural-regional communities while educating health, science, and agricultural professionals) demonstrated low pro-environmental sustainability literacy and behaviour regarding food and water consumption choices, despite having sustainability concerns and high level of education, including formal environmental science training. Data are contextualised amid interdisciplinary research and theory to further sociologically understand knowledge gaps about food choices and (un)awareness of conventional agricultural food/water production implications affecting socioeconomic and environmental sustainability. Given expansive literature argues sustainability initiatives must derive from individual and private sector action-taking, rather than await governmental change, the article argues policy and practice changes must prioritise knowledge-action gaps and value divergences. Research interrogating why low literacy about sustainable production and consumption practices persist is advocated to enhance consumer awareness and behaviour following internationally recommended pro-environment action-taking necessary for sustained global food/water security that facilitates agricultural sector capacity to support human and environmental health.

1. Introduction

Australia's natural environment bifurcates between extreme drought and flooding, experiences excessive heat, and has a small portion of arable land relative to its size. Although agribusiness technologies strive to increase productivity in challenging climate conditions, socio-cultural values inform food and water practices that perpetuate soil erosion and food insecurity fears as economic profit and short-term goals receive priority compared with historical 'pastoral care' approaches to natural resource management (Kopittke *et al.,* 2019). Australia ranks behind other G20 countries in terms of achieving climate change mitigation actions and targets. This includes resisting widespread adoption of renewable energies and leading in global coal exportation despite being one of eleven countries most severely impacted by rising global temperatures

(Climate Transparency, 2020). The international comparison further reveals that Australia's landscapes and human/non-human populations suffer from deforestation and pollution due to continued dependence on environmentally damaging and intensive food production practices (Roberts & Matto, 2018; Climate Transparency, 2020; UNEP, 2020).

As climate change research infiltrates global media and popular discourse, new technologies are changing global food production practices. Practices supporting economic sustainability/profit that address changing consumer preferences, while also considering climate change impacts, are emerging (Kelly & Rewhorn, 2019). Where production changes risk economic loss, however, few global examples exist that prioritise 'the environment' over human benefit. Much environmental production, for instance, is relegated to smaller, alternative farming models (Kelly & Rewhorn, 2019). In Australia, substantial pro-environmental action is necessary to regenerate land and return waterways to being self-sustaining systems having biodiversity indicators that meet pre-colonial settlement measures. Such actions cannot rely merely on technological advancments (Roberts & Matto, 2018), urban consumer preference changes (Kelly & Rewhorn, 2019), or improved data application, including big-data revolutions (Sarker *et al.,* 2019).

Australia is the only developed nation labelled as a deforestation hotspot. Unprecedented deforestation practices are being pursued to create pastures for the Australian meat and livestock sector that significantly contributes to climate change and greenhouse gas emissions. In America, technology and data have been instrumental in identifying locations most exposed to increased climate sensitivity and in need of varied agricultural production practices (e.g., crop types, irrigation) or policies (Ortiz-Bobea *et al.,* 2018). Agricultural technologies' ability to significantly mitigate climate change, however, necessitates a widespread social change to act upon environmental knowledge acquisition and behaviour modification recommendations valuing environmental sustainability. For example, although enforced legislation must accompany human food production changes, research shows that the social costs of pro-environmental actions are effective change-inducing agents. Agricultural irrigators sold water back to the government for environmental reasons because of social pressure from other irrigators promoting conformity (Haensch *et al.,* 2019). Changes in agricultural systems/practices demand a concerted global effort that takes sociological factors into account because, although human values persist over time (Stern, 2000), individual values can and do change to align with broader societal values.

Human values are defined according to what individuals consider important as they pursue goals and make decisions amongst behaviour options (Schwartz, 1994; Feather, 1995; Steg, Perlaviciute, *et al.,* 2014). Mounting research shows values affect individual behaviours, particularly pro-environmental actions (Ünal *et al.,* 2017; Maio, 2010; Crompton & Kasser, 2009; Rohan, 2000; Stern & Dietz, 1994; Dunlap *et al.,* 1983).

Moreover, individuals seek information aligned with their values (Steg, Goda *et al.,* 2014). Hence, relationships between knowledge acquisition and behaviour/actions are mediated by societal values. Theory and research show education alone insufficiently predicts healthy behavioural change. Health literacy research demonstrates knowing what causes ill-health, for humans and the environment, is not associated with health-promoting behaviour (Ragusa, 2020; Ragusa & Crampton, 2019). Theories about why individuals act upon health knowledge evidence information complexity (Ryan, 2009) and how information is framed or contextualised (Keyworth *et al.,* 2018; Lin & Yeh, 2017) matters. Further, self-conceptualisation and others' influence (Hoffman & Tan, 2015; Umberson *et al.,* 2010) affect behaviour, as does individual motivation by health prevention versus promotion (Keller, 2006), what stands to be gained or lost (Vezich, Katzman *et al.,* 2017), and risk perceptions (Bartels *et al.,* 2010).

Much of the research investigating what prompts human behaviour derives from consumer behaviour, health, and psychology research, not sociology. Meta-analyses show attitudes poorly predict healthy human behaviours (Keyworth *et al.,* 2018; Gallagher & Updergraff, 2012). While environmental attitudes determine pro-environmental behaviours more than environmental knowledge (Afroz *et al.,* 2015), environmental psychology finds that increased monetary cost widens behaviour-attitude pro-environment gaps (Mairesser *et al.,* 2012). For example, personal convenience affects pro-environmental behaviours such

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as European car-sharing (de Luca & di Pace, 2015) and increased cost led to less environmentally friendly consumer behaviour, irrespective of pro-environmental sentiments or knowledge in Australia (Morgan, 2017).

Multi-disciplinary research and theory suggest global food and water security are possible if more environmentally sustainable practices are adopted. Nevertheless, defining, valuing, and actioning sustainable food production remains a socially complex issue that is dependent upon individuals' roles in production/consumption processes. The present research (conducted at an organisation that educates future primary producers, scientists, industry leaders, and consumers and values environmental sustainability) identifies what individuals consider to be the most pressing environmental sustainability issues affecting their lives related to food and water. The UNEP (2020) notes lifestyle choices globally impact greenhouse gas emissions. Amidst scientific research documenting food production (e.g. food miles, organic production processes) and dietary behaviours (e.g. low-carbon vegetarian/vegan diets) affect environmental sustainability (Harris *et al.,* 2019; IPCC, 2019), findings provide insights about pro-environmental literacy, personal behaviours/actions, and values for several agriculturally-intense products and issue awareness/salience to inform future pro-environmental change since research indicates agricultural illiteracy generally exists about individual food choice, production, and environmental impact connectivity (Clemons *et al.,* 2018).

2. Research Methods

2.1 Methodological Framework and Research Design

Methodologically, interdisciplinary investigations and theorisation about what prompts human behaviour inform the research design. Whereas historical health and science literacy research utilised a deficit model of learning, whereby individuals are presumed tabula rasa and awaiting fact-learning (Paloff & Pratt, 2001), the present design draws upon contemporary education and communication theory countering deficit theory's utility. Using social construction theory (Berger & Luckmann, 1991; Pinch & Bijker, 1987) may advance interdisciplinary research by arguing that in order to address global problems, including climate change, research must consider the social context and environment where issues arise, which demands attitudinal change and new knowledge acquisition/dissemination strategies to alter public issue (un)awareness (Bucchi & Trench, 2014; Kahan, 2015; Seethaler *et al.,* 2019). Social construction prioritises questioning why some issues are perceived as concerning, whilst others are ignored or invisible. In theorising reality-construction as a social process (Berger & Luckmann, 1991), this methodology overcomes deficit theory limitations because behaviour and attitudes are understood as driven more by values than facts. According to interdisciplinary science and technology studies (STS) purport, scientific facts and technologies require society's acceptance and validation of the natural/environmental and social order (Sismondo, 2007) achieved through co-construction (Taylor, 1995) and co-production (Jasanoff, 2004). Hence, changing environmental sustainability practices requires research and policy transcending the provision of more scientific/health information.

According to international research, environmental literacy/awareness fails to promote environmental action-taking, especially when economic and/or practical matters incentivise anti-environmental behaviours (Gould & Golob, 1998; Mairesser *et al.,* 2012; Pojani & Stead, 2015). Hence, social construction offers an alternative sociological conceptualisation to the psychological, educational, and health theorisation prominent in environmental change literature. Specifically, environmental sociology is a new specialisation theorising "human dimensions of environmental change" (Longo & Clark, 2016, p. 464) to transcend sociology's historical avoidance of environmental research or theorising. Reviews of environmental sociological research (Longo & Clark, 2016, p. 476) call for "a critical and integrative approach" to complement natural science research investigating environmental sustainability problems since industrialised agricultural production is fastidiously entwined with the social relations of an era (Foster *et al.,* 2010) and environmental sustainability encompasses both natural and human systems (Liu *et al.,* 2007).

The research design follows this methodological imperative, taking a critical, integrative approach to deepen understanding of knowledge, values, and behaviours related to food and water. Commencing from the premise that scientific facts play a limited

role in predicting human behaviour without considering how the social reality of facts is constructed and embraced/rejected (Berger & Luckmann, 1991; Pinch & Bijker, 1987), this exploratory research adds to our understanding of what environmental sustainability concerns individuals know, or have, about food and water. The findings contribute to further documenting knowledge-action gaps apparent in psychological and health research and reveal knowledge deficits in agricultural production of sustainable food/water, which may be value-laden. By concurrently investigating knowledge, behaviours, and concerns, the study begins addressing calls for integrative environmental sociological research. Overall, the research aims to inform environmentally sustainable behavioural change and policy initiatives affecting food and water production/consumption to enhance agriculture and health systems/policy.

The research design utilises mixed methods to conduct an organisational study in the research location, the wheat-belt region of eastern Australia. As an investigation of employees' environmental sustainability awareness and activities, the research environment is a large, rural-regional organisation with sustainability values embodied in its mission statement promoting, "We are environmentally responsible and act in the best interest of the university and our communities" and "We consider the impact of our decisions on each other, our students, the environment, and our communities" (CSU, 2020). Specifically, the research design was created to explore what individuals environmentally value and what they know/do for a range of activities having scientifically documented negative environmental consequences related to food production, food consumption, and water usage. Prior to research commencement, university ethics committee approval for the conduct of human research was gained. All research instruments and processes received ethics clearance. Every participant was over age eighteen, willing and able to provide informed consent, and understood that their participation in the research would result no remuneration, nor advantage. Data collection costs were supported by a small university sustainability research grant and academic time buyout by the Institute for Land, Water, and Society. This article reports findings that answer five research questions:

1) How prominent are food and water amongst survey respondents' identification of the top three environmental sustainability issues affecting their lives? What are the sample's key food/water concerns?

2) Which of the food choices presented illustrate the sample's greatest/least environmental sustainability literacy about their agricultural production in Australia?

3) Are any demographic categories significantly associated with environmental sustainability literacy for the agricultural products surveyed?

4) Are individuals identifying food/water concerns as their key environmental sustainability issues more likely to correctly identify environmentally sustainable agricultural products?

5) Are individuals identifying food/water concerns as their key environmental sustainability issues more likely to engage in pro-environmental behaviours surveyed (i.e., avoid bottled water, use water refilling stations, choose water-friendly landscaping, participate in the meat-free week, shop at farmers' markets, buy locally produced vegetables, buy organic meat, or buy organic vegetables)?

2.2 Research sampling, instrument, and data analysis

Research sampling and instrument creation were informed by rurality's increased risk of experiencing poor health, disease, and unhealthier lifestyles compared with metropolitan locations (Alston *et al.,* 2019). Given the research population, members of a rural-regional Australian organisation, is highly geographically disbursed, and the research aimed to be an exploratory, mixed-methods organisational study, nonprobability sampling was selected (Neuman, 2014). A strength of this sampling method lies in its ability to maximise research participation and collect data from geographically disbursed individuals. Nonprobability sampling relies on individualistic desire to participate, which produces a non-random sample. Although the quantitative results are not generalisable beyond the research sample, they complement the deeper, personalised insights provided from the qualitative components of the research instrument

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(Babbie, 2021).

Sampling and data integrity were assured by the research instrument, an online survey, requiring organisational members to enter their personal identification password and the system only accepting one survey submission per employee. Recruitment commenced by advertising research aims and participation details using the organisation's internal communication systems (e.g., online announcements, emails, noticeboards). The strengths of online surveying are, first, its anonymity and, second, its ability to collect more authentic data by minimising participants trying to please researchers, as found in face-to-face interviews by providing socially desirable responses (Johnstone & Hooper, 2016). Piloting the survey supported the instrument's reliability. Fifteen volunteers completed the pilot survey. This allowed every survey question to be scrutinised for ambiguity and definitional clarity, resulting in the modification of five questions. Measurement validity was supported by reviewing and refining all piloted close-ended questions for face and content validity (Polgar & Thomas, 2020). The validity of open-ended questions was determined by ensuring questions permitted for authentic self-expression of ideas and supporting authentication throughout data analysis (Neuman, 2014).

Research literature highlighting discrepancies between individual expression of pro-environmental sentiments and actions/behaviours informed the survey's content. Specifically, questions assessing environmental beliefs/concerns were posed after questions measuring behaviours. Thus, survey construction carefully considered how questions were ordered (i.e., when they appeared). This allowed qualitative questions about individuals' sustainability concerns to be captured without being biased by the survey's close-ended questions. For example, after demographic questions, the first substantive question asked was, "What do you consider to be the top three environmental sustainability issues affecting your life?" Free-text entry allowed up to 100-word descriptions for each issue, collected before encountering science/health literacy and action/behaviour questions. Hence, question-ordering minimised response bias.

This article presents results found from analysing four survey questions and demographic data. In addition to analysing the Environmental sustainability Issues question previously described, it analyses the question, "Which are environmentally sustainable food choices?", which has eight options (dairy products (milk, cheese, yoghurt); free trade coffee; farmed salmon; wild caught salmon; locally sourced lamb; organic beef; I don't know; none of these). Respondents were allowed to select multiple food-options, or I don't know or none. The third question analysed is, "In the past six months, how often have you done any of the following?" Answer categories (purchased bottled water; used water refilling stations; selected environmentally sustainable landscaping for home; shopped at farmers' markets; purchased locally produced vegetables; purchased organic meat; or purchased organic vegetables) simultaneously collected frequency data (never; 1-5 times; mostly; always) for every activity. Fourthly, this article analyses participation in, and/or awareness (yes; no) of, Meat-Free Week.

Data was entered into SPSS (27th version). After data cleaning to remove incomplete surveys, qualitative content analysis and quantitative analysis (descriptive and inferential statistics) were performed. Content analysis employed keyword (manifest) and contextual (latent) coding for all qualitatively provided environmental sustainability issues to capture all respondent-generated data about food and water. This dualistic coding approach produced an exhaustive list of categories relevant to the research questions (Babbie, 2021); if only manifest keywords (water, food) had been searched, then respondent-generated discussion of water/food related issues, such as drought, catchment, and crop production (in contexts meaningful to the environmental sustainability of food and water), would have been missed.

Finally, once all environmental concerns were coded, two major categories (Food-Concerns, Water-Concerns) were created, with 1=yes (concerned about the environmental sustainability of food), and 2=no (unconcerned). Missing data was excluded. Where respondents expressed concern about food and water (e.g., food sustainability with water scarcity as a major environmental sustainability concern), such data was coded in both major categories (Food-Concerns and Water-Concerns). For minor categories (e.g., those emerging within food/water), the dominant concern was coded. For example, the concern, Food security

and the increased production of agricultural products in increasingly marginal climates, was coded Food Security, rather than Agriculture, to highlight the most pressing food/water-concerns visibility. The initial coding of respondents' concerns was reviewed and refined from cross-checking by the research team. This process assured final categories reflect respondents' most-pressing concerns and achieve the research's exploratory purpose (Polgar & Thomas, 2020). Direct quotes evidencing respondents' concerns appear as italicised text.

3. Results

3.1 Sample description

Descriptive details for the whole sample (n=412) appear in Table 1.

Most respondents were born in Australia and New Zealand (n=346/84.2%), with migrants derived from across the globe (Africa n=6/1.5%, Asia n=17/4.1%, Eastern Europe n=1/.2%, Western Europe n=28/6.8%, Middle East n=2/.5%, North America n=9/2.2%, South America n=2/.5%). Many respondents lived outside Australia for 10-49 years, with migrants staying in Australia for an average of 17 years. Four respondents (1%) did not specify their birthplace. Australians hailed from every state and territory. The majority of the sample were formally educated; 65% had at least a Bachelor's degree. Expectedly, since the research organisation was a university, 32% (n=134) held a Master's or Doctorate degree. Most (89%/n=363) had no formal environmental science education. Twice as many women participated than men, typical for survey research, and more (n=188/45.6%) held administrative than academic positions (n=134/32.5%). The remainder (n=90/21.8%) were retirees, adjuncts, and/or students. Overall, majority of the members (69%) were affiliated with the organisation for 1-10 years.

3.2 Environmental sustainability data

Fourteen percent (n=57) knew no agricultural food product (organic beef; locally sourced lamb; dairy products (milk, cheese, yoghurt); fair-trade coffee; farmed salmon; wild-caught salmon) provided for the question, "Which are environmentally sustainable food choices?" is environmentally sustainable in Australia. Salmon was the agricultural product most people (53%) considered sustainable; 9% (n=36) chose wild-salmon, 44% (n=182) farmed-salmon.

Thirty-five percent (n=144) chose organic beef, 34% (n=142) local lamb, 4% (n=17) dairy and coffee, and 2% (n=8) coffee alone as environmentally sustainable agricultural products. Education was the only significant demographic variable associated with this environmental sustainability literacy question; Having at least a bachelor's degree, in any specialisation, positively correlated with knowing none are environmentally sustainable food choices (.169, p=.001, n=405).

Table 1. Sample demographics

Demographic Variable	Descriptive Data
Age	mean=42 (oldest=79, youngest=18)
Education	Bachelor's degree or higher (n=263/65%), Less than a Bachelor's (n=142/35%)
Environmental education	Yes (n=46/11%), No (n=363/89%)
Gender	Male (n=132/32%), Female (n=280/68%)
Organisational role	Full-time employee (n=268/65%), part-time employee (n=76/19%), Not employed (n=65/16%)
Nationality	Australian-born 90.5% (n=373), 1st Generation migrant 8.9% (n=37), Unspecified (n=2/.5%)
Years at organisation	<1 (n=51/12.4%), 1-3 (n=121/29.4), 3-5 (n=83/20.1%), 6-10 (n=80/19.4%), 11-20 (n=50/12.1%), >20 (n=15/3.6%), Unspecified (n=12/3%)

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This association was supported by Chi-Square, where c2 (1, N=405) = 11.62, p=.00. Those with at least a bachelor's degree tended to be older (.256, p=.000, r=402) and male (-.203, p=.000, r=401). None of the 46 respondents with formal environmental studies education correctly answered the question.

Content analysis revealed 45% (n=184) of respondent-generated environmental concerns related to water, compared with 22% (n=89) food. All Food/Water concerns were captured in thirteen categories (8 food, 5 water).

Figure 1 shows Food Security was the greatest Food-Concern; 38% identified issues related to producing enough food for humanity's growing population. Examples included population growth and food sustainability (e.g., growing enough to feed the growing population). Feeding has always been discussed in relation to feeding humanity, with concerns about producers' capacity to feed the human population as it increases rapidly over successive generations, and the inevitable shortfall in natural resources to support such production. Food Security concerns manifested about the environmental impact agricultural production poses on the natural environment.

The environment's limit to feed populations was not discussed relating to changes in natural landscapes or food security for other species. Rather, Food Security was discussed generally, understanding agriculture as a system where environmental sustainability concerns posed risks to the capacity for farming, land management, water availability, and sufficient environmental resources to adequately produce human food. Food Security concerns are also related to geography, namely global food security, the developing world, food security for third world countries, and enabling food security and the protection of important natural ecosystems in the developing world. Similarly, those concerned about Soil Quality noted that it was denuded, listing concerns about soil quality for farming/food production, the need for greater soil management and mineral depletion, the protection of soil fertility and protection from degradation, over-salinity, and, consequently, desertification [in] Australia and worldwide, Chernobyl, fertiliser runoff.
Whilst Agriculture and Environmentally Unsustainable Production could be collapsed into one category

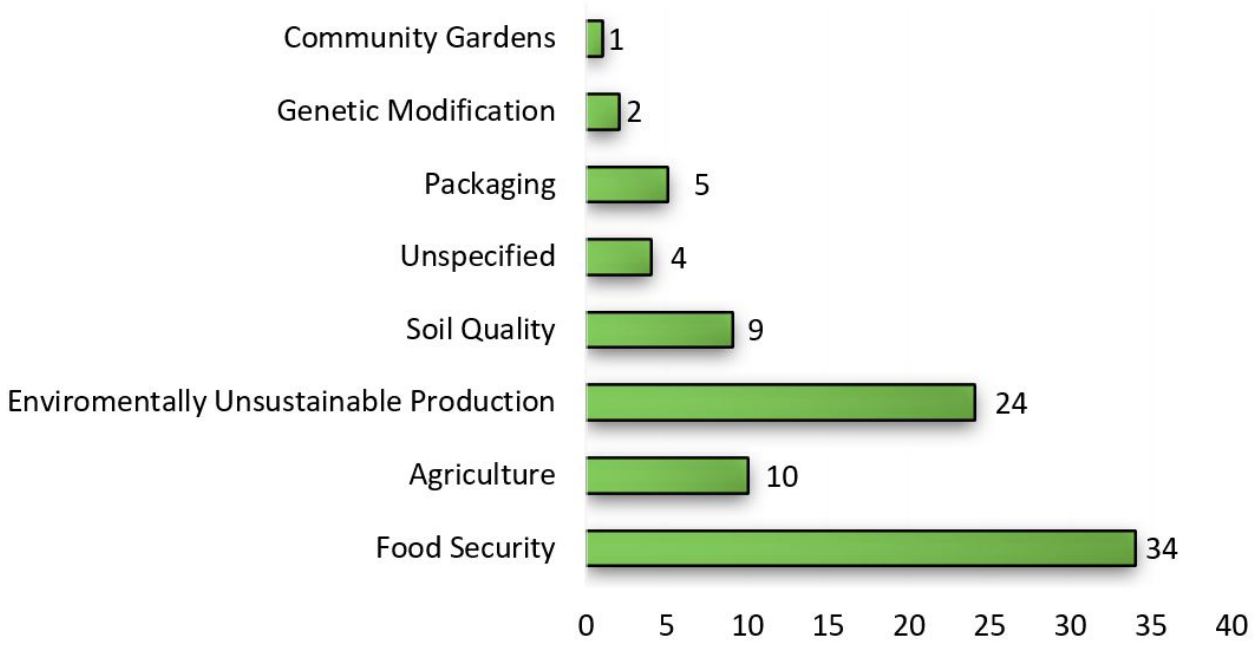

Figure 1. Enviromental sustaiability food concerns

equal in size to Food Security, qualitatively, those listing agricultural issues specified the keyword "Agriculture" (e.g., sustainable agriculture, conventional agriculture, cold seam gas, and damage to agriculture). Contrastingly, respondents coded as Environmentally Unsustainable Production mentioned how the system of food production more generally fostered environmentally unsustainable practices. Examples in this category included unsustainable production practices, chemical use, throw-away society, meat production of cattle/sheep, Food miles – importing food from overseas, production and shipping of non-seasonal foods, and generally stating production. Only one respondent connected food production to environmental concerns affecting non-human species: deforestation, animal habitat loss, species loss, food production, land encroaching on animal conservation, and meat production. Insufficient Community Gardens also concerned one respondent, with gardening as an environmental sustainability concern related more commonly to food security, particularly individuals' need to achieve self-efficiency in food production/home gardens rather than rely on global or national food production systems.

A weak positive association emerged between Food-Concerns and Meat-Free Week (.187, p=.00, n=407) participation, supported by a chi-square significant association: c2 (1, N=407) = 14.165, p=.00. Figure 2 shows more (18%) individuals with Food-Concerns, compared to 6% without, engaged in Meat-Free Week.

Likewise, raising Food-Concerns for environmental sustainability reasons is weakly associated with the awareness that Meat-Free Week exists (.101, p=.05, n=409). Having Food-Concerns did not increase environmentally sustainable literacy (-.101, p=.05, n=412) about the food production practices in Australia investigated.

Analysis of the five food-related behaviours found most (83%) respondents did not regularly (>5x) shop at local farmers' markets or buy locally produced vegetables (59%). These behaviours were insignificant in comparison to having Food-Concerns. Contrastingly, buying organic vegetables (.133, p=.01, n=403) and meat (.182, p=.00, n=404), and having Food-Concerns correlated; Figure 3 illustrates many respondents purchased organic, yet those unconcerned about food for environmental reasons bought them more frequently.

This was supported by chi-square tests revealing significant associations between lack of Food-Concerns related to environmental sustainability and buying organic meat, c2 (3, n=404) = 13.453, p=0.00, or organic vegetables, c2 (3, n=403) = 7.554, p=.01. Overall, 19% (n=78) never bought organic vegetables (56%/n=229), compared with 37% (n=150) never purchasing organic meat. Education was the only demographic variable associated with organic food-buying behaviour; higher education weakly correlated with buying organic vegetables (.126, p=.05, n=396), but no corre-

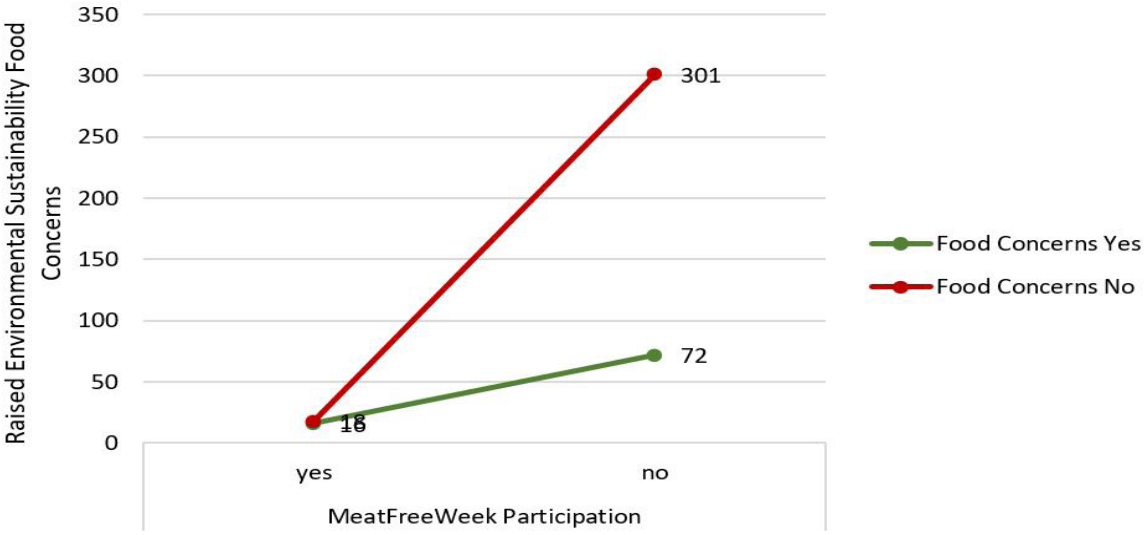

Figure 2. Food concerns and meat-free week participation

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lation existed between higher education and buying organic meat.

More (45%/n=187) respondents had environmental sustainability concerns about water than food (22%/n=89). Figure 4 illustrates respondents' Water-Concerns.

The need for Water Conservation was the most common (15%) concern, followed by Unspecified (11%) or Pollution and Drinking Water Quality (11%) concerns. Fewest raised Ocean or Environmental (4%) or Rivers, including Catchment Management (5%), issues. Water-Concerns were not associated with awareness of Meat-Free Week, nor campaign participation. No demographic variables (Table 1) were significantly associated with having Water-Concerns. Respondents expressing Water-Concerns about the key environmental sustainability issue affecting their lives did not significantly differ from the rest of the sample's actions/behaviours for buying bottled water, using water refilling stations, or choosing environmentally sustainable landscaping at home.

4. Discussion and Conclusions

Amid any conceivable Environmental Sustainability issue survey, respondents could self-identify as affecting their lives, qualitative content analysis found a minority (22%/n=89) identified Food-Concerns. Research reports Australian urban consumer preferences shifting towards conscious-consumption food selection, namely heightened organic and local food interest and minimising supply chains (Kelly & Rewhorn, 2019). This study found Food-Concerns did not factor largely into respondents' awareness of, or actioning pro-environmental issues/behaviours, despite 45% (n=186) being born, or residing in, urban locations prior to affiliation with the rural-regional organisation researched.

The only food-related behaviours significantly associated with having Food-Concerns was buying organic meat and vegetables. Those most frequently buying organics, however, did not express environmental sustainability Food-Concerns. This suggests reasons beyond environmental sustainability underscore organic food purchases. Widely perceived human health benefits that organics are more nutritious (Ditlevsen *et al.,* 2018; Vigar *et al.,* 2019), despite empirical evidence (Vigar et al. 2019; Roberts & Mattoo, 2018), may explain this finding. Buying organics, however, is recommended to reduce individual carbon emission contributions (UNEP, 2020). Hence, findings show the need to increase environmental literacy given agricultural production's prominent role in environmental health or degradation (Roberts & Matto, 2018; Climate Transparency, 2020). This is particularly worthwhile since more respondents (45%/n=187) discussed Water-Concerns without mentioning in-

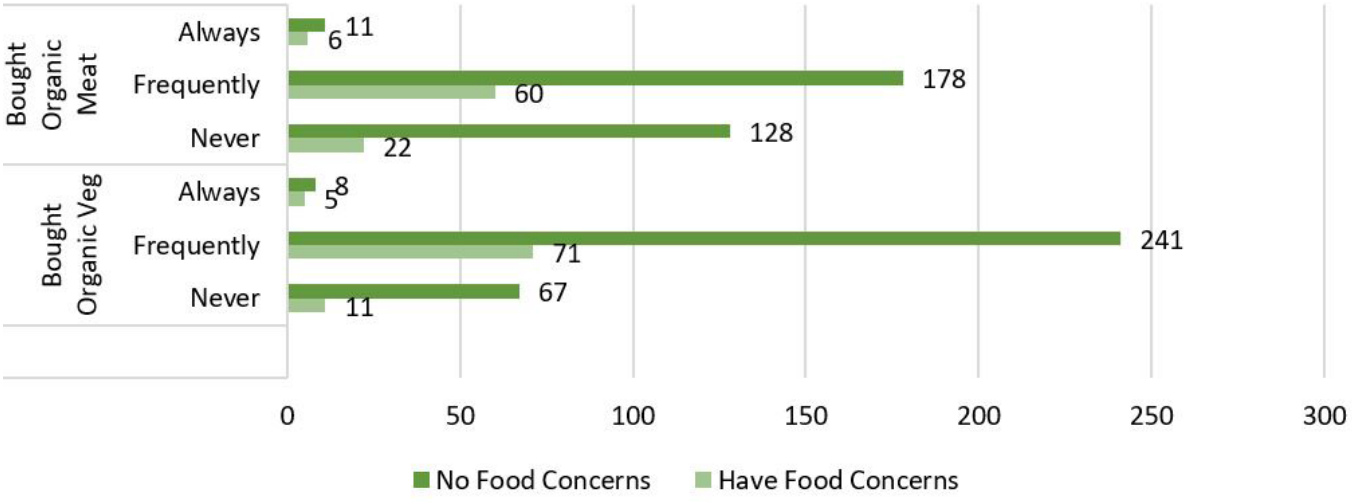

Figure 3. Enviromental sustaiability food concerns & organic purchasing behaviours

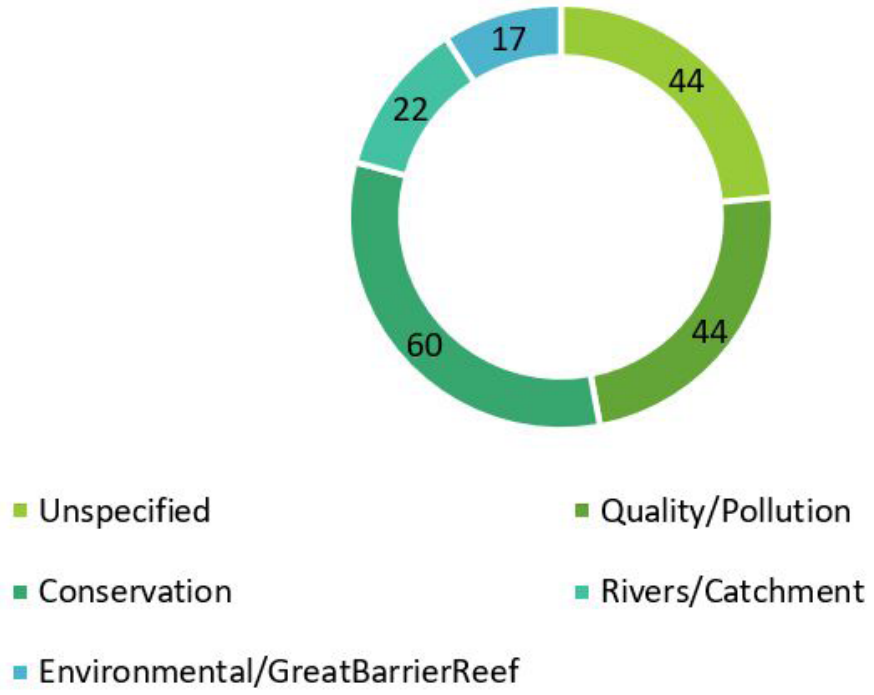

Figure 4. Enviromental sustaiability water concerns

dustrial production systems, including food/agriculture. Improving food-water security/health connections is necessary and supports environmental and sociological research evidencing industrialised agricultural production's entanglement with social norms, including environmental sustainability sociocultural perceptions (Longo & Clark, 2016; Foster *et al.,* 2010; Liu *et al.,* 2007).

Social psychology describes human values as driving individual decision-making/actions (Schwartz ,1994; Feather, 1995; Steg *et al.,* 2014). With 34 respondents (<1%) raising Environmentally unsustainable Production or Agriculture issues as key Food-Concerns, whilst 42% failed to regularly shop at farmers' markets, 46% never bought organic meat, and 30% never purchased organic vegetables (despite listing general environmental sustainability issues), shows limited social value or awareness exists about how agricultural production affects environmental sustainability. Social psychology finds individuals seek information aligned with their values (Steg, Goda, *et al.,* 2014).

Seeking environmentally sustainable agricultural production information thus appears devalued given the low environmental science literacy manifesting for food products; 8% knew no meat, dairy, or fair-trade coffee products were environmentally sustainable in the research location. Lack of knowing meat is unsustainable, whilst being affiliated with a rural-regional organisation in primary production landscapes is surprising given the agricultural sector's self-recognition that the industry is environmentally damaging. Extensive research documents the poor energy transition, water pollution/usage, and land degradation accompanying livestock production. For instance, more than two-thirds of the energy used to feed livestock soybeans and corn is wasted and supports water and land pollution (Kleinman *et al.,* 2018), contributing to greenhouse gas production (Climate Transparency, 2020).

No respondents with formal environmental science education correctly answered the environmental sustainability question about agricultural products. This may be partially due to the organisation's focus on river flows/catchment and natural resource management research, or alternatively reflect normative, sociocul-

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tural biases disassociating or deemphasising human dietary choices with pro-environmental sustainability priorities. Global trends marketing plant-based diets for sustainability reasons (Fernandez, 2020; IPCC, 2019) remain marginalised in rural-regional Australia, supporting high meat and dairy production/consumption, despite the necessity for the agricultural industry and community change to support environmental sustainability (Beltran-Peña *et al.,* 2020). Respondents were concerned about poor agricultural conditions, namely poor soil or water shortages. The weak association between having Food-Concerns explicitly for Environmental Sustainability reasons and illiteracy about specific agricultural products' environmental impact, documents the need for scientific literacy about animal production and environmentally intensive crops, such as coffee. Findings further evidence consumer confusion around certification labels, specifically fair-trade coffee. The socio-economic benefits of fair-trade production come at the expense of environmentally sustainable production (Vanderhaegen *et al.,* 2018). Hence, clearer communication about industry priorities in sustainable production is required to improve transparency and accountability.

Valuing environmental sustainability differs from its enactment. Despite research documenting human values affect pro-environmental actions/behaviours (Ünal *et al.,* 2017; Maio, 2010; Crompton & Kasser, 2009; Rohan, 2000; Stern & Dietz, 1994; Dunlap *et al.,* 1983), listing Food/Water-Concerns as key Environmental sustainability Issues affecting one's life insignificantly affected the eight food/water behaviours investigated. Only completing higher education significantly increased environmental literacy. Research finds values/action gaps persist for environmental beliefs/behaviours (Mairesse *et al.,* 2012). Thus, investigating how knowledge about agricultural production's environmental impact affects environmental values and behavioural change remains pressing.

Overall, findings suggest the salience of costs, particularly social, affecting pro-environmental behaviour, such as encouraging agricultural irrigators to sell water back to the government for environmental reasons (Haensch *et al.,* 2019), requires further research. Likewise, if higher commodity prices (Morgan, 2018; Mairesser *et al.,* 2012) decrease pro-environmental actions and how much consumers will pay for environmentally sustainable food production/food security, compared with agricultural costs (Kleinman *et al.,* 2018) remains necessary given respondents' reported low organics buying despite raising food production concerns about soil salinity, agricultural runoff and chemical usage, packaging, food mileage, genetic modification, and food security to feed growing human populations worldwide.

Respondents were concerned about agriculture production and food security to support humanity's sustainability, not sustainability for the environment or non-human species. Focus on global food security coincides with Australia's reputation as a food-secure country continuing abundant production, despite a severe drought, ranking in the top ten nations for food affordability and availability, lowest for undernourishment, and high (70%) exportation of food produced (ABARES, 2020; Beltran-Peña *et al.,* 2020). Queensland research shows even low socioeconomic households in Brisbane report low food insecurity (<20%), less than similar American households (McKechnie *et al.,* 2018). The present sample's high education (65% have at least a bachelor's degree) and low environmental concern and literacy about national agricultural production impacts/issues, including food security (whilst those having Food Security concerns focused on human-centred issues), further Tasmanian survey research finding higher socioeconomic status and university-educated individuals less likely to consider food security an issue (Kent *et al.,* 2020). This literature does not investigate nutritional aspects of food choices or economic realities that quality Australian food (i.e., fresh produce, quality protein sources, etc.) is more expensive. Hence, future food security research is needed to see if highly nutritious agricultural products produced in environmentally sustainable ways affect affordability perception. Such investigation would determine if food security perceptions reflected illiteracy about Australian agricultural production intensification driven by "the financial bottom line" with "little factoring of environmental and social costs" (Kelly & Rewhorn, 2019, p. 122).

Meat-Free Week participation's positive association with having Food-Concerns, without significant association manifesting for any demographics (age, gender, education) or those reporting Water-Concerns, suggests less awareness/concern about the role meat production plays in environmental sustainability. No respondents raised Water-Concerns related to animal-based food production systems. Water-Concerns

about quality/scarcity manifested as drought and natural resources requiring physical and political management. Catchment and reliance on river water for mains water on the Murray River example implicitly connected water health to agriculture and natural environment sustainability. The research location long exhibits tension about river water flows determining the quality and quantity of water/food production and environmental assets (Murray-Darling Basin Authority, ND). Although 45% of respondents listed Water-Concerns as key environmental sustainability issues affecting their lives, the qualitative analysis found concerns were vague or pollution/production-directed. Four percent of Water-Concerns considered water for the environment. Having Water-Concerns failed to correlate with demographics or water-conserving behaviours (home landscaping choices, food purchasing/consumption decisions, and water purchasing/consumption actions such as refilling water bottles/buying bottled water). Expressing concerns, without translating concern into action, is consistent with growing literature examining the impacts values/attitudes have, or fail to have, on behaviour/action-taking (Wolters *et al.,* 2019).

Quantitative determination of what changes are necessary to meaningfully address Water-Concerns related to the environment, agricultural production, and food/drinking water behaviours affecting production/consumption practices is needed because this study's findings are exploratory and non-generalisable. Future researchers may build upon the Food/Water-Concerns found by investigating willingness to pay (Wolters *et al.,* 2019) and perceived convenience (Morgan, 2017; de Luca & di Pace, 2015), factors intervening with ideological value-expression. Further, individual willingness to change, particularly by primary producers, requires policy support. American agriculture and climate sensitivity research found water use/access (e.g., irrigation practices) required policy change to allow crop specialisation shifts in responding to climate changes affecting food production (Ortiz-Bobea *et al.,* 2018). With over 70% of global freshwater used for crop irrigation, and the negative environmental impact of intensive agribusiness, and its irrigation, create (Roberts & Mattoo, 2018; Harris *et al.,* 2019; Courard-Hauri, 2020; IPCC, 2019), however, personal willingness may become irrelevant if environmentally sustainable agricultural practices become physically necessary.

Finally, this study furthers research (Paillé *et al.,* 2020; Dzhengiz & Niesten, 2020) arguing knowledge acquisition is needed to facilitate the societal transition towards environmentally sustainable action-taking, driven by organisational and/or personal values. Although respondents were highly educated, knowledge specialisation may explain why, as others have found, even highly educated individuals fail to identify environmentally sustainable options (Vicente-Molina *et al.,* 2013). Likewise, having environmental concern/awareness did not necessarily promote pro-environmental action-taking (Helm et al. 2018). What nationally, and globally, prevents environmental knowledge transfer from scientists to broader populations urgently is required because a sizable literature documents traditional agriculture negatively affects the environment and quantity/quality of water/land utilised, and wildlife's future (Harris *et al.,* 2019; Courard-Hauri, 2020; IPCC, 2019). Improving public science/health literacy about relationships between water/food scarcity, agricultural production, and true costs is vital since long-term environmental gains demand broad stakeholder participation from producer to consumer, council to composter (IPCC, 2019).

Conflict of interest

The authors declare no conflict of interest

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