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Consumers' perceptions on food-related sustainability: A systematic review

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ABSTRACT

Consumers play a crucial role in reducing the burden on the environment through their food choices. Currently, food choices are mainly determined by price, convenience, taste and health. To change eating patterns to more sustainable eating patterns, it is essential to understand how consumers interpret "sustainability" in relation to the food supply chain. The aim of this systematic review is to categorize and to describe consumer perceptions of food-related environmental sustainability in general. We conducted a systematic literature review of quantitative and qualitative studies published between January 2010 and June 2020. This resulted in 76 articles; 49 quantitative, 21 qualitative and 6 mixed-method studies. Open coding (grounded theory) was used, and codes were subsequently categorized into subcategories, categories and domains (domain analysis). In total, 834 codes were categorized into 118 subcategories. These subcategories were clustered into 30 categories describing seven different overarching domains: 1) production, 2) transportation, 3) product, 4) product group, 5) consumer, 6) waste and 7) contextual factors. The domains production (31%), transportation (19%) and product (14%) were the largest domains identified in quantitative studies, and in qualitative studies these were production (25%), consumer (20%) and product (20%). Environmental impact, (locally and organic) food choices and ethical production are the most frequent categories mentioned by consumers. However, this literature review also showed that consumers still lack key knowledge on some other specific food-related sustainability topics. In particular, consumers have difficulty defining the concept "sustainability" and to estimate the environmental impact of their food choices. Consumers believe that sustainability does not (yet) influence their food choices. Currently, consumers consider price, taste and individual health more influential than sustainability. It would be useful for policymakers to communicate sustainability knowledge in a transparent, evidence-based and controlled way and to guide consumers by designing a highly regulated and controlled sustainability label.

1. Introduction

Food choices are mainly determined by price, convenience, taste and health (Allès et al., 2017). Currently, consumers rate environmental concerns as 'not important' (Lehikoinen and Salonen, 2019). However, within the food system, consumers play a crucial role in reducing the burden on the environment through their food choices (FAO, 2010). Consumers nowadays might even be more aware of environmental issues and the effect their food choices have on the environment, as sustainability receives more attention in the media.

The FAO defines sustainable diets as "*diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources*" (FAO, 2010). This definition is highly complex, and includes environmental, social and economic considerations. Consumers' food choices play a key role in the shift to more sustainable diets. It is therefore of great importance to understand how consumers interpret the concept "sustainability" in relation to their eating patterns.

Environmental sustainability indicators, including the use of natural resources such as water, land, energy, and emissions of greenhouse gases (GHGEs), are often used to assess environmental sustainability (Jones et al., 2016). These natural resources are used and greenhouse gases are produced throughout the supply chain, which comprises agricultural production, food processing and packaging, transportation and consumption (Bradbear and Friel, 2011). The supply chain contributes about 25 percent of the total amount of GHGEs produced worldwide (Vermeulen et al., 2012), of which about 60 percent is produced by

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livestock (Gerber et al., 2013). In comparison, processing, packaging, transportation and waste disposal in total contribute around 5 to 12 percent of the total GHGEs (Vermeulen et al., 2012). Furthermore, social sustainability (e.g., social equity, human rights, decent working conditions and community resilience) and economic sustainability (e.g., long-term economic growth without compromising the environment or communities) are important indicators of sustainability, however these are considerably ignored compared to the environmental sustainability (Jones et al., 2016). Thus, the need to shift to more sustainable consumption patterns and production systems is evident, but challenging to achieve as cultural and economic factors should be taken into account (FAO n.d.).

As consumers have a key role in the transition to a more sustainable food system, it is essential to understand how consumers interpret "sustainability" in relation to the food supply chain. These insights are vital to improve quantitative consumer research on sustainability issues, while taking into account the consumer point of view. Furthermore, these insights can be used to guide policymakers in making informed guidelines and recommendations that align with the consumers' understanding of food sustainability.

Consumers' understanding of food-related sustainability has been reviewed in the context of local and organic foods (Feldmann and Ulrich, 2015, Hartmann and Michael, 2017; Schleenbecker and Hamm, 2013). However, consumer understanding of food-related sustainability in a general context has not been reviewed. Therefore, the aim of the present review is to categorize and describe consumer perceptions of food-related environmental sustainability in general. We define perceptions as 'ideas, beliefs or images consumers have as a result of how they understand or see food-related sustainability' (Oxford Dictionary, 2021). The focus of this review is on adults in high income countries, the users of the formal markets in the urban food system. A systematic literature search was conducted, and extracted data were categorized and described using grounded theory and domain analysis (Borgatti, 1994; Corbin and Strauss, 1990).

2. Methods

2.1. Search strategy

A systematic search was conducted using the databases Web of Science, PsychInfo, CABabstracts and Scopus, which provide high quality, peer-reviewed journal articles in the social domain. The following search terms were defined on the presented research aim and research boundaries, and combined with the Boolean operators OR and AND: (("sustain*" OR "ecological perspective" OR "environment*" OR "footprint" OR "carbon" OR "green consumption" OR "environmental impact*" OR "climate change*" OR "greenhouse gas*" OR "gas emission*" OR "waste" OR "land use" OR "global warming" OR "energy" OR "biodiversity" OR "local" OR "organic" OR "ethic*" OR "environmentally-friendl*" OR ("perceived environmental impact" OR "perceived environmental activit*" OR "perceived environmental effect"))) AND ALL FIELDS: (("consumer perspective" OR "consumer opinion" OR "consumer view" OR "consumer behavi?r" OR "consumer*")) AND ALL FIELDS: (("food consumption" OR "sustainable consumption" OR "green consumption" OR "sustainable diet" OR "sustainable product*")) AND ALL FIELDS: ((defin* OR knowledge OR understand*)). Wildcards were used to broaden the terms. The asterisk (*) was applied after a word stem to retrieve articles that include words starting with this word stem. The question mark (?) was used to search for alternative spellings of a word. The search was restricted to title, abstract and keywords and limited to the last ten years, that is January 2010 to December 2018. We finished the search on the December 12, 2018. An updated search was performed on the June 3, 2020, extending the timespan to June 2020. A flowchart of the systematic search is presented in Fig. 1. Articles had to be original scientific papers published in scientific journals, conference proceedings or governmental reports and written in English or Dutch. The first search in Web of Science (n = 260), PsychInfo (n = 88), CABabstracts (n = 184) and Scopus (n = 494) yielded 946 unique articles. The second search in Web of Science (n = 1107), PsychInfo (n = 320), CABabstracts (n = 1010) and Scopus (n = 1786) yielded 3569 unique articles. In total, we identified 4515 articles.

After identification, 4354 articles were excluded based on the following exclusion criteria: not related to consumers (e.g., the main focus on producers, retailers or policy, supply chain, plants or no consumer perceptions, n = 1516) or not related to food-related sustainability (e.g., electricity savings, smart savings or food safety, n = 1016) or both (e.g., other science fields, health, media, only about foods, non-food, n = 777). Furthermore, we excluded studies conducted in low- and middle-income countries (World Bank, 2019), because we assume that high income countries have a predominant urban food system with a

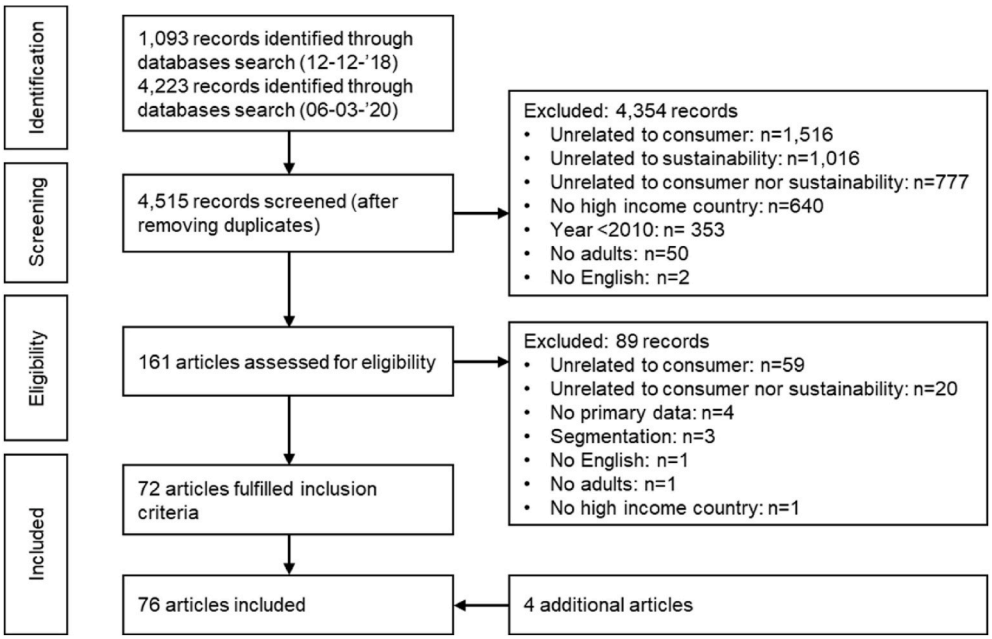

Fig. 1. Flowchart of the systematic search.

formal market (n = 640), and we excluded articles published before 2010 (n = 353). In addition, articles that focused on children or teenagers (n = 50), or were written in other languages than English or Dutch were excluded from analysis (n = 2). This resulted in 161 articles, including 33 from the first search, and 128 from the second search. We included two articles in Dutch.

The full text of these 161 articles was read in detail and again screened against the eligibility criteria. Articles that were not related to consumers (n = 59) or were not related food-related sustainability and/or both (n = 20) were excluded. In addition, articles from the same research group, in which identical data were repeated were excluded (n = 4). In case of segmentation of the study population, we excluded articles that did not present the results from the total population (n = 3). Additionally, articles that were written in a language other than English or Dutch (n = 1), focused on children or teenagers (n = 1) and were conducted in low- or middle-income countries (n = 1) were excluded. Overall, our systematic search led to 72 eligible articles. Next, snowballing (forward and backward) was used to find articles that we had missed in our search (n = 3). Last, an expert provided a governmental report that met the inclusion criteria. In total, we included 76 articles in this review. The included articles were read and the aim, the study approach (i.e., qualitative, quantitative or mixed-method), data collection method, operationalisation, sample size, sex distribution, age range and country were extracted (Appendix A and Appendix B).

2.2. Coding and analysis of data

In the present review we used an iterative and an inductive process to code and to cluster codes using grounded theory and domain analysis. In section 2.2.1, we briefly explain how we applied grounded theory and domain analysis in the present review. In section 2.2.2 we describe how we processed papers with qualitative, quantitative and mixed-method designs.

2.2.1. Grounded theory & domain analysis

In the present review, we used both grounded theory and domain analysis to code and analyse the data. Grounded theory aims to develop and explain a phenomenon by identifying the key elements and explaining the relations of these elements to the context (Corbin and Strauss, 1990). Domain analysis aims to understand how communities structure their world by searching for larger units of cultural knowledge, which are called domains (Borgatti, 1994). We followed the four steps in domain analysis, as described by Coffey and Atkinson (1996).

The first step of domain analysis was to code the result sections of the selected papers (open coding strategy in grounded theory). We searched for statements and citations that described consumers' ideas, perceptions, actions or understandings about food sustainability. These statements or citations were then captured in a code that identified the underlying issue and phenomenon. For example, the statement "local foods are environmentally friendly" was coded as 'local' and 'environmentally friendly'. All (combinations of) codes were subsequently listed in the form of unstructured codes. In the second and third step of the process, we clustered the codes into subcategories based on proximity in meaning and refutation (axial coding strategy in grounded theory). The second and third step was an iterative process in which terms were introduced one by one and clustered by hand. This process involved two researchers (LvB, MM). For each code it was decided 1) to cluster it with other terms, based on proximity or 2) to create a new list of codes, based on refutations. These two steps were repeated with the subcategories to form cover terms (categories). The cover terms that described the same phenomenon were then grouped into domains, which described the same phenomenon. For instance, the domain waste included the categories food waste and recycling. Step four, the final step, was to identify semantic relationships between the subcategories and categories, and between the categories and the domains (selective coding in grounded theory). Codes that did not have clear relationships between the subcategories and the categories were discarded. A number of three different codes was used as a minimum for a subcategory.

2.2.2. Qualitative and quantitative coding

Slightly different coding approaches were used for coding the results of quantitative and qualitative studies. In quantitative studies, which included survey questions, three different outcome measures were extracted, namely frequencies, percentages and means of the Likert scale used. These results were only coded when the frequency was at least one, the percentage of the mentioned answers (among the responders) was $\geq$10% and the means were in the lowest or highest tertile of the total scale. Qualitative studies included results from interviews or focus groups in which results were coded whenever a participant mentioned a belief or perception of food-related sustainability. Mixed-method approaches were split into the qualitative and quantitative result section, and were separately coded as described above.

The results of the coding and clustering (domain, category, subcategory) were used to create two separate datasets, one for quantitative studies and one for qualitative studies. The frequency of each domain, category and subcategory was then calculated. The domains, categories and subcategories with their corresponding frequency are displayed in figures in the result section.

2.3. Overview of the selected studies

In total, 49 quantitative, 21 qualitative and 6 studies with mixed-methods were included in the present study. Only a small number of studies (n = 12) was published before 2014. Most studies were conducted in the US (n = 16), and European countries (n = 93), most of these were conducted in Germany (n = 12), Italy (n = 12), and the UK (n = 10). Other countries included Australia (n = 3), New Zealand (n = 1), Canada (n = 1) and United Arab Emirates (n = 1). Note that some studies are conducted in multiple countries (Appendix A and Appendix B).

3. Results

In this section, we briefly describe the results of the coding (section 3.1). In sections 3.2-3.8, we describe the domains in more detail. The overview of the studies and their role in the domains and categories can be found in the Supplementary files.

3.1. Domains, categories and subcategories

In total, 986 citations and statements were coded using open coding (step 1). The codes were clustered into 118 subcategories. These subcategories were clustered into 30 categories describing 7 different overarching domains (axial coding, step 2 and 3). The seven domains that were identified were 1) production, 2) transportation, 3) product, 4) product group, 5) consumer, 6) waste and 7) contextual factors. A total of 152 codes had no clear relationships to the categories, and were therefore discarded (part of selective coding, step 4). Overall, we included in total 834 codes, 459 codes from quantitative studies and 375 from qualitative studies.

The formed domains, categories and subcategories are presented in figures separately for quantitative studies and qualitative studies (Figs. 2–8). The domains production (31%), transportation (19%) and product (14%) were the largest domains derived from quantitative studies, and in qualitative studies these were production (25%), consumer (20%) and product (20%). For the quantitative studies, we found that the most frequent categories were "local", "organic food production" and "environment". For the qualitative studies, the largest categories are "ethical production", "organic food production" and "labelling in general".

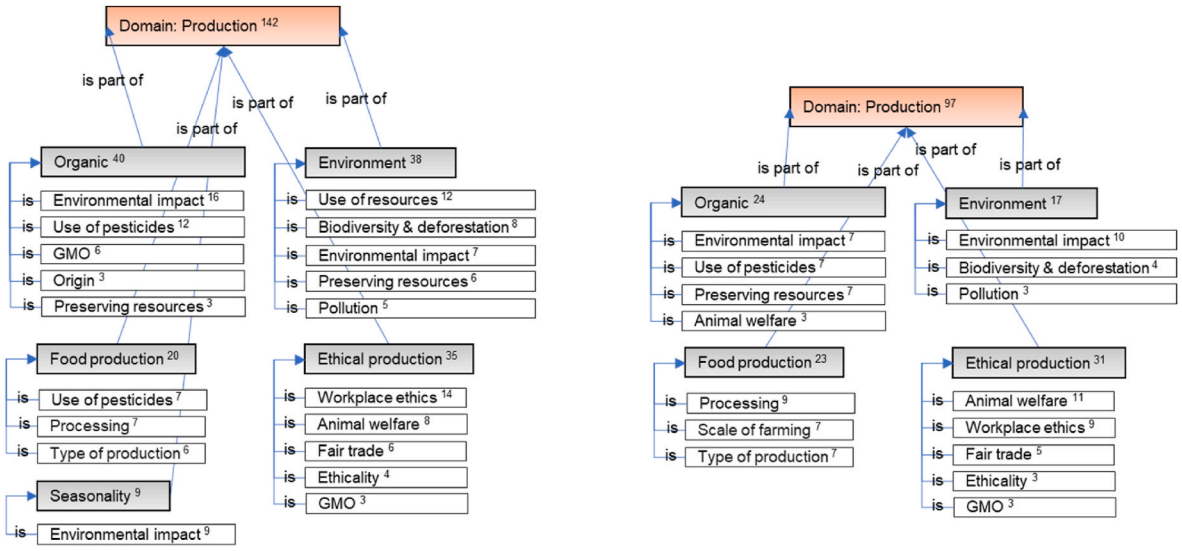

Fig. 2. Domain production with subcategories (uncolored boxes), semantic relationships (labels on the arrows) and categories (filled boxed) for quantitative studies (left) and for qualitative studies (right). Number of codes in the subcategories, categories and domains are in superscript.

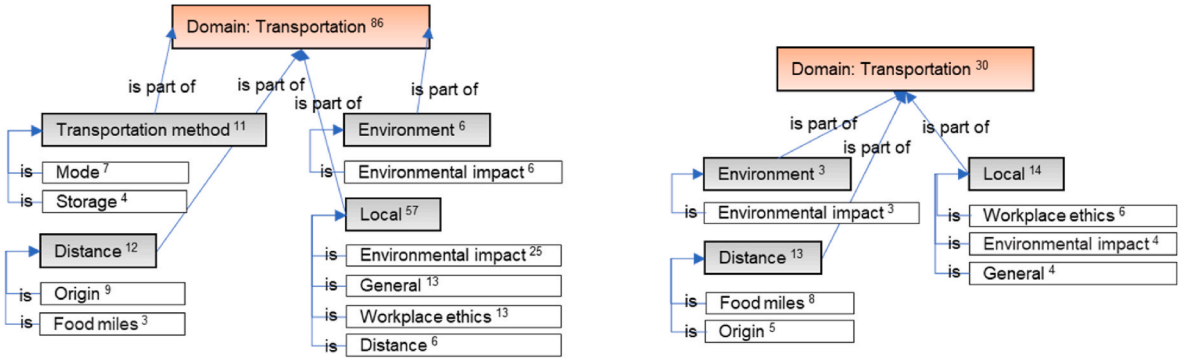

Fig. 3. Domain transportation with subcategories (uncolored boxes), semantic relationships (labels on the arrows) and categories (filled boxed) for quantitative studies (left) and for qualitative studies (right). Number of codes in the subcategories, categories and domains are in superscript.

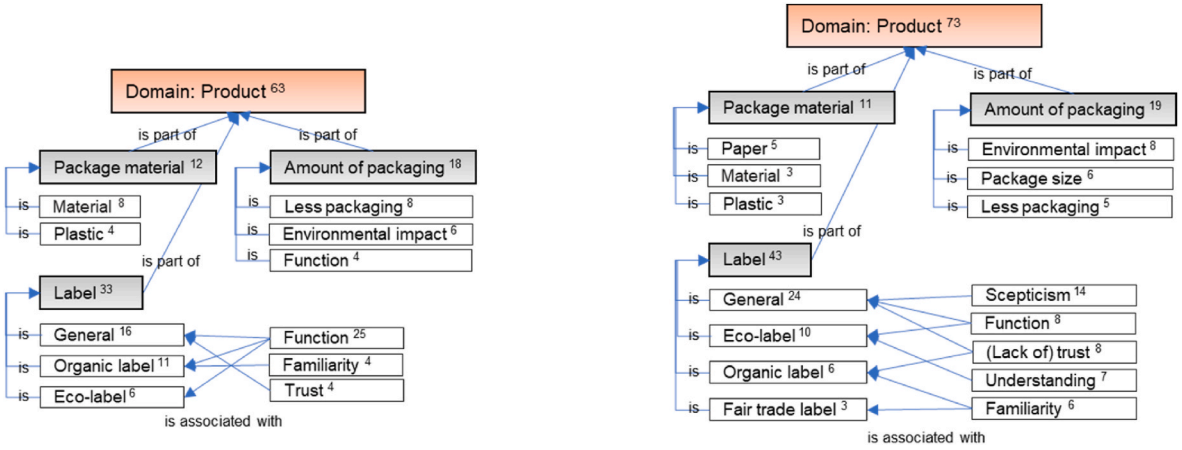

Fig. 4. Domain product with subcategories (uncolored boxes), semantic relationships (labels on the arrows) and categories (filled boxed) for quantitative studies (left) and for qualitative studies (right). Number of codes in the subcategories, categories and domains are in superscript.

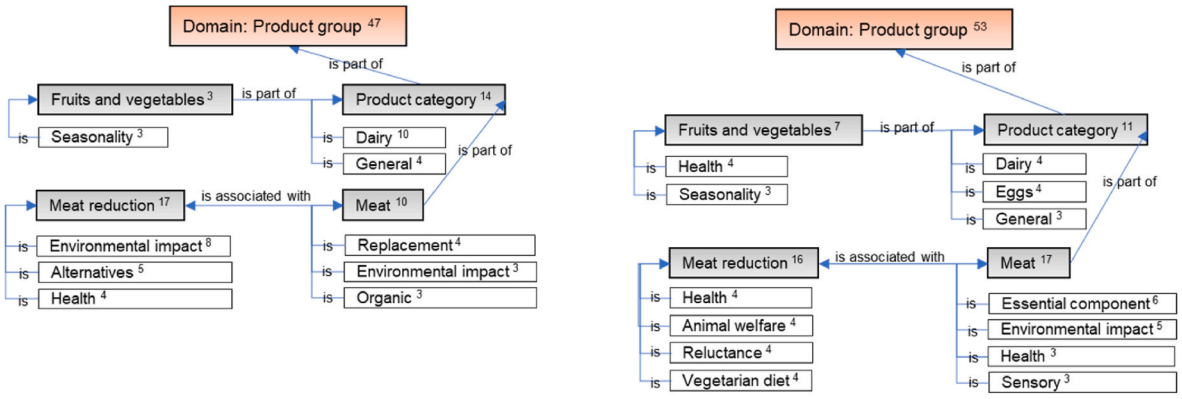

Fig. 5. Domain product group with subcategories (uncolored boxes), semantic relationships (labels on the arrows) and categories (filled boxed) for quantitative studies (left) and for qualitative studies (right). Number of codes in the subcategories, categories and domains are in superscript.

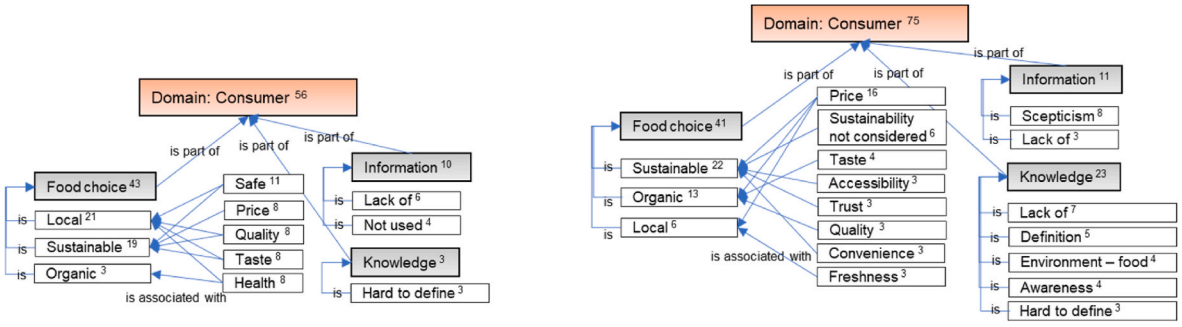

Fig. 6. Domain consumer with subcategories (uncolored boxes), semantic relationships (labels on the arrows) and categories (filled boxed) for quantitative studies (left) and for qualitative studies (right). Number of codes in the subcategories, categories and domains are in superscript.

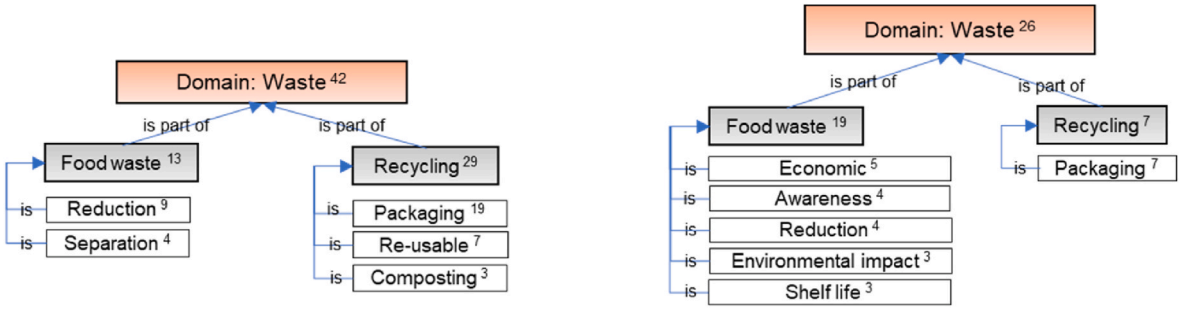

Fig. 7. Domain waste with subcategories (uncolored boxes), semantic relationships (labels on the arrows) and categories (filled boxed) for quantitative studies (left) and for qualitative studies (right). Number of codes in the subcategories, categories and domains are in superscript.

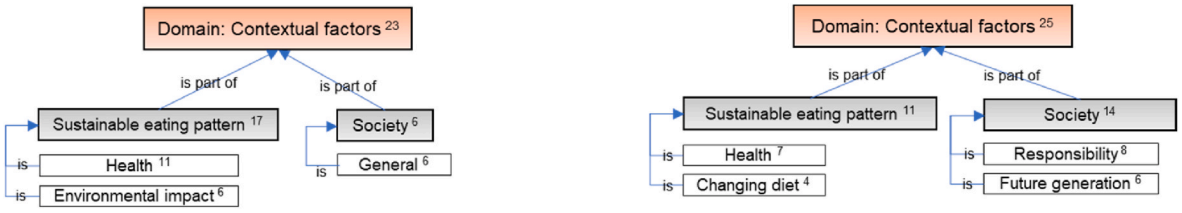

Fig. 8. Domain contextual factors with subcategories (uncolored boxes), semantic relationships (labels on the arrows) and categories (filled boxed) for quantitative studies (left) and for qualitative studies (right). Number of codes in the subcategories, categories and domains are in superscript.

3.2. Domain production

Consumers mainly referred to organic food production, the environment, ethical production, food production and seasonal production when talking about the domain "production" (Fig. 2). In quantitative studies and qualitative studies, organic food production was described as environmentally friendly ($n_{quantitative}$=16, $n_{qualitative}$=7), without the use of pesticides ($n_{quantitative}$=12, $n_{qualitative}$=7) while protecting natural resources ($n_{quantitative}$=3, $n_{qualitative}$=7). In addition, in quantitative studies organic food production was described without genetically modified organisms (GMOs) ($n_{quantitative}$=6) and in qualitative studies in relation to humane treatment of animals ($n_{qualitative}$ = 3).

The category environment was, in both quantitative and qualitative studies, described in terms of greenhouse gas emissions (environmental impact) ($n_{quantitative}$=7, $n_{qualitative}$=10, pollution ($n_{quantitative}$=5, $n_{qualitative}$=3) and biodiversity degradation and deforestation ($n_{quantitative}$=8, $n_{qualitative}$=4). Furthermore, from quantitative studies, the use of land, water and energy ($n_{quantitative}$=12) and the protection of natural resources ($n_{quantitative}$=6) were also part of the category "environment". Consumers referred to ethical production through the ethical dilemma of slaughtering animals ($n_{quantitative}$=8, $n_{qualitative}$=11), the working conditions and wages for food producers and the use of child labor ($n_{quantitative}$=14, $n_{qualitative}$=9), and fair trade, ecological production and the discussion whether GMO was morally right or wrong ($n_{quantitative}$=13, $n_{qualitative}$=11). For the category food production, consumers specified the use of pesticides in food production ($n_{quantitative}$=7), the degree of processing ($n_{quantitative}$=7, $n_{qualitative}$=9), whether foods should be grown in their own garden ($n_{quantitative}$=6, $n_{qualitative}$=7) and the scale of farming (shorter chains) ($n_{\text{qualitative}}$ = 7).

3.3. Domain transportation

When talking about "transportation", consumers referred to locally produced foods, the distance, the environment and transportation method (Fig. 3). Locally produced foods were seen as environmentally friendly ($n_{quantitative}$=25, $n_{qualitative}$=4), sold directly from the farm and better for the local economy ($n_{quantitative}$=13, $n_{qualitative}$=6), and with shorter transportation distances ($n_{quantitative}$=6). The distance of foods was related to the origin of a product ($n_{quantitative}$=9, $n_{qualitative}$=5) and determined by the so-called food miles ($n_{quantitative}$=3, $n_{qualitative}$=8), i.e., the distance food travels. In addition, the environmental impact of transportation was mentioned ($n_{quantitative}$=6, $n_{qualitative}$=3). Moreover, the mode of transportation was mentioned in quantitative studies ($n_{quantitative}$=11). The mode of transportation discussed was transportation by plane, ship or truck, of which transportation by plane was associated with the greatest environmental impact.

3.4. Domain product

Regarding the domain "product", consumers pointed out sustainability labels of food products ($n_{quantitative}$=33, $n_{qualitative}$=43) and packaging ($n_{quantitative}$=30, $n_{qualitative}$=30) (Fig. 4). With regards to labelling, consumers referred to sustainability labels in general ($n_{quantitative}$=16, $n_{qualitative}$=24), and more specifically to eco-labels ($n_{quantitative}$=6, $n_{qualitative}$=10), organic labels ($n_{quantitative}$=11, $n_{qualitative}$=6) and fair-trade labels ($n_{qualitative}$=3). In quantitative studies, the function of labels (e.g., useful in food choices, or source of information), familiarity of the labels and lack of trust in labels were discussed. In qualitative studies, consumers seemed to be more sceptical of labelling. Terms that were mentioned in these studies included 'greenwashing', 'doubts about the criteria used to claim sustainability' and 'more transparency needed'. Moreover, it was mentioned that official certification was required to make the consumers trust the labels, and more knowledge was needed to understand the meaning of the labels. In contrast, consumers also pointed out that a label could assist to make more climate-friendly food choices, as it contains information about sustainability. Organic and fair-trade labels were mentioned as the most well-known labels ($n_{qualitative}$=6). Regarding packaging, we distinguished two categories, namely package material ($n_{quantitative}$=12, $n_{qualitative}$=11) and amount of packaging ($n_{quantitative}$=18, $n_{qualitative}$=19). Consumers referred to the use of different types of package material, including plastic and paper, of which plastic was seen as the least environmentally friendly alternative ($n_{quantitative}$=4, $n_{qualitative}$=3). Moreover, consumers stated that it was environmentally beneficial to have the minimum amount of packaging, but on the other hand they mentioned that to some extent packaging was necessary to protect the food products ($n_{quantitative}$=1).

3.5. Domain product group

When consumers talked about food groups in the context of sustainability, they referred to meat ($n_{quantitative}$=10, $n_{qualitative}$=17), dairy ($n_{quantitative}$=10, $n_{qualitative}$=4), (free-range) eggs ($n_{qualitative}$=4) and (seasonal) fruits and vegetables ($n_{quantitative}$=3, $n_{qualitative}$=3) (Fig. 5). The categories meat and meat reduction were associated. In the qualitative studies, consumers perceived meat to be savoury ($n_{qualitative}$=3), healthy ($n_{qualitative}$=3) and an essential component of the meal ($n_{qualitative}$=6). Consumers tend to underestimate the impact of meat, and consumers were not aware about the impact of meat consumption ($n_{quantitative}$=3, $n_{qualitative}$=5). On the contrary, some consumers were aware of the idea that reducing meat was environmentally beneficial ($n_{quantitative}$=8), healthier ($n_{quantitative}$=4, $n_{qualitative}$=4) and more animal friendly ($n_{qualitative}$=4), but consumers stated that they were reluctant to reduce their meat consumption (smaller portions or one meat-free day) ($n_{qualitative}$=4), or to become vegetarian ($n_{qualitative}$=4).

3.6. Domain consumer

Categories related to information ($n_{quantitative}$=10, $n_{qualitative}$=11), knowledge ($n_{quantitative}$=3, $n_{qualitative}$=23) and food choice ($n_{quantitative}$=43, $n_{qualitative}$=41) were captured in the domain "consumer" (Fig. 6). The category 'food choice' contained perceptions about sustainable, locally and organic food choices. In quantitative studies, when consumers talked about their motives for or barriers to sustainable food choices, they referred to food safety, higher prices, better taste and higher quality foods. Similar to sustainable food, locally produced products were also characterized by food safety, better taste and higher quality foods. In addition, consumers considered locally and organic foods to be healthy. In qualitative studies, motives for sustainable, locally produced and organic foods were more diverse. Consumers believed that sustainable foods were hard to find, inconvenient in use, more expensive and more reliable. However, sustainable foods were not much considered. Organic foods were chosen for their taste and higher quality, but the higher price was perceived as a barrier. Locally produced foods were perceived as fresher. Perceptions of price in locally produced foods were inconclusive, both cheaper and more expensive were mentioned.

With regards to information on sustainability, consumers agreed that there was a lack of available information ($n_{quantitative}$=6, $n_{qualitative}$=3), however, if information was available, it was not used much ($n_{quantitative}$=4) and the information sources were distrusted ($n_{qualitative}$=8). Terms used were "questioning the existence of a problem", "nobody reads guidelines on climate-friendly choices" or "can we really trust it when one says it is environmentally friendly?". Moreover, consumers also agreed that sustainability was difficult to define ("difficult to identify climate-friendly foods", "lack of concrete idea what climate-friendly means" or "hard to explain sustainable consumption"). Adequate knowledge about the environmental impact of their food choices was lacking in most consumers. Some consumers mentioned that there was no connection between their food choices and environmental sustainability ($n_{qualitative}$=4).

3.7. Domain waste

When consumers talked about the domain "waste", they referred to food waste ($n_{quantitative}$=13, $n_{qualitative}$=19) and recycling ($n_{quantitative}$=29, $n_{qualitative}$=7) (Fig. 7). In quantitative studies, reducing food waste and separating waste into different containers were considered to be sustainable by consumers. In qualitative studies, consumers mentioned that throwing food away was considered a waste of money. Moreover, consumers were not aware of the extent of the food waste problem, except for their own household. Consumers stated that reducing food waste was perceived as environmentally beneficial, however, consumers thought that throwing food scrapes away was sometimes unavoidable due to a shorter shelf life (e.g., fruits and vegetables).

3.8. Domain contextual factors

The domain "contextual factors" included factors outside the food production chain (Fig. 8). Health was most often mentioned as the main reason why consumers followed a sustainable eating pattern ($n_{quantitative}$=11, $n_{qualitative}$=7). A term that has been mentioned is "Health affects oneself and sustainability is a bonus." Terms related to the categories future generation and responsibility included "sustainability is a future issue", "feel responsible for the future generations", "sustainability is a public concern", "society as a whole is responsible", "consumers alone cannot solve such a major issue" and "I feel powerless to change".

4. Discussion

The aim of this systematic review was to categorize and describe consumer perceptions of food-related environmental sustainability in general. This is the first review to provide an overview of the beliefs of consumers on food-related sustainability. We provided insights that are important to better target food related sustainability policies to the consumer. In the following sections we discuss the main results (section 4.1), the methodology used (section 4.2) and opportunities for policy makers to steer consumers toward sustainable food consumption practices (section 4.3) and, lastly, our conclusion (section 4.4).

4.1. Main results

We found that consumers referred most frequently to 'the environmental impact' when thinking about food-related sustainability. We noticed that the terms related to the environmental impact were 'environmentally friendly', 'environmental beneficial' and 'environmental impact'. The percentage of codes related to the 'environmental impact' was 17% and 11% in quantitative studies and qualitative studies, respectively. These results indicate that consumers recognize that using too much of the world's resources, such as land, water and energy, pollution, the carbon emissions, the loss of biodiversity and deforestation are a sustainability concern. Crippa et al. (2021) calculated that food production is responsible for 34% of total greenhouse gas emissions, with the largest contribution coming from agriculture and land use (71%). Food production, packaging, processing, transportation, retail, consumption and waste management accounted for the remaining 29% (Crippa et al., 2021).

However, based on this review, we can conclude that consumers are not aware of the actual impact of food production, and in particular livestock production. Some consumers recognize that there is some impact involved in food production, while others believe there is no connection between food production and the environment at all. Locally produced foods, organic food production, seasonal foods and reducing food packaging are all considered to be environmentally friendly. Interestingly, we know that organic food production is not necessarily more sustainable than conventional consumption, as organic food production requires more land (Redlichová et al., 2021). In addition, we observed that consumers are not fully aware of the environmental impact of meat production. Some consumers doubt that meat production negatively affects the environment. They need more evidence to be convinced that reduction of meat consumption is needed for the environment. Objective data show that animal production is a larger contributor to greenhouse gas emissions compared to plant-based food production (Poore and Nemecek, 2018). Therefore, it is pivotal that policy makers provide information and knowledge to consumers in a straightforward, trustworthy, evidence-based way to communicate the environmental impact of food production, and in particular animal production.

Another main remark relates to the high contribution of codes related to locally produced ($\%_{total}$ = 12%) and organic foods ($\%_{total}$=10%). Our results showed that consumers believe that local and organic foods are part of a sustainable diet (e.g., low environmental impacts). Both locally produced and organic foods were rated as tastier ($n_{quantitative}$=5, $n_{qualitative}$=4) and healthier ($n_{quantitative}$=5, $n_{qualitative}$=3). Consumers stated intent to change towards a more (environmentally) sustainable diet for health reasons. Health reasons can be categorized as self-centred reasons, as it only benefits their own health. Environmental reasons can also be categorized as altruistic, as they benefit the well-being of future generations and the planet in the long term. Since individual health and taste are one of the main determinants of food choice (Steptoe et al., 1995), it is of interest for marketers to use individual health and taste as important aspects to promote more sustainable foods. However, it should be noted that sustainable food choices cannot be translated one to one with healthy food choices (Macdiarmid, 2013). Consumers need nutritional guidance to choose healthy and sustainable foods, including better access to and availability of sustainable alternatives.

This review summarized barriers mentioned by consumers in relation in sustainable food consumption. Consumers perceived sustainable foods as inconvenient ($n_{quantitative}$=3) and expensive ($n_{quantitative}$=8, $n_{qualitative}$=16). Yet, beliefs about prices are not necessarily true. Donati et al. (2016) calculated that a healthy and sustainable diet is not necessarily more expensive than current Western diets. This may be useful for policy makers to remove price as a barrier in sustainable food consumption.

We found that sustainability is little or not considered when making food choices. One explanation might be the lack of knowledge and understanding of the concept of food sustainability. For consumers, the concept of food sustainability covers a wide range of terms. For example, terms that are frequently used are carbon footprint, climate change, climate-friendly, environmentally beneficial, environmental impact or environmentally friendly. These terms are used interchangeably, and consumers have difficulties to define sustainability in open-ended questions. We found a large range of terms that are related to food sustainability, considering the whole supply chain. Nonetheless, we can state that consumers lack knowledge about what is relevant for food-related sustainability. Therefore, it is highly important to use clear and consistent terms to communicate sustainability-related information to consumers.

It was also noted that consumers are sceptical about food sustainability, in particular with respect to information on labels and the existence of climate change. Sustainability is not yet perceived as a major concern; sustainable (food) consumption is considered to be a secondary effect of a (healthy) diet and consumers do not feel responsibility to change their eating patterns. However, consumers who want to change feel powerless to achieve environmental change (individual efforts vs. collective actions). Since consumers are aware of environmental labels, this can be a useful tool to increase people's awareness of the sustainability issue and the impact of food choices on the climate. On the other hand, some consumers show distrust towards sustainability labelling as a communication strategy. Lack of certification and control in food labelling, lack of transparency, and greenwashing have been briefly touched upon by consumers. It is therefore crucial for policy makers to address these consumer criticisms by communicating in an unambiguous and transparent way. This may be done by designing a universal sustainability label that is transparent, and regulated and controlled by the government.

4.2. Methodology

We used grounded theory and domain analysis to code and analyse the results. Domain analysis allowed us to answer questions about how consumers generally structure thoughts of food sustainability. Through open coding we efficiently identified statements and citations of consumers. Decisions on clustering of codes and subcategories, and semantic relations between subcategories and categories required subjective judgement. For example, we could have opted for the domain 'environmental impact', with subcategories related to the supply chain. The decisions made in this review are difficult to replicate, however, two researchers were involved in the categorization of subcategories and categories. Each code was discussed one by one to be clustered in other subcategories (based on proximity) or placed on a new list.

This systematic review included studies that used different methodologies (e.g., questionnaires, focus groups or interviews). Quantitative study approaches (e.g., web-based or face-to-face questionnaires) have the advantage of large sample sizes that which enhances target population representativeness, if sampled in a decent matter. However, the disadvantage of quantitative study approaches is that they are bounded to a limited number of items in the questionnaires. Research items are selected, structured and formulated by the researcher, and thus the selected questions are biased by the perspective of the researcher. In contrast, qualitative study approaches (e.g., focus groups or interviews) have the advantage to unravel the underlying perceptions of consumers, for example, the (lack of) knowledge on food-related sustainability or the sceptical notes, but they have only limited sample sizes. In the current review we used the advantages of both study methodologies; the large sample sizes of quantitative study approaches and the open-ended questions and discussions of qualitative study approaches.

One of the challenges in both quantitative and qualitative study approaches is obtaining the 'true' perceptions of consumers. Some perceptions are prone to social desirability, for instance participants may overreport engagement in sustainable behaviors and give higher rates of importance to ethical behaviors (e.g., use of child labor, working conditions, and animal welfare). Emotions such as guilt may play a role in these ethical dilemmas. Although consumers believe that ethical production and sustainable consumption are important, market shares of sustainable foods are relatively low. Social desirability might therefore result in overrepresentation of certain subcategories, and thus biased subcategories.

The quantitative studies included in this review had different study outcomes and presented the results in different ways (means, frequencies and percentages). We systematically coded the outcomes using predetermined cut-off points and therefore approached each study in the same way. Using these predetermined cut-off points we excluded three additional quantitative studies that met the inclusion criteria. However, none of the outcome measures in these three studies fell within the cut-off points (Liobikiene et al., 2016; Merle et al., 2016; Pohjolainen et al., 2016). Each study in this literature review was weighed equally, so we did not consider the number of participants when summarizing the results. In this review we aimed to give a complete overview of all perceptions regarding food-related sustainability, and therefore, weighing was not appropriate.

In this review we excluded articles that focused exclusively on a selected target groups (e.g., vegetarians) or on other segmented groups (e.g., sustainers vs. unsustainers). This makes it difficult to generalize our results. However, we were particularly interested in the 'general' consumer, to be able to advise policy on the largest consumer group. As a next step, it would be of great interest to study the perceptions of food-related sustainability in selected target groups and segmented groups. Moreover, locally produced and organic foods are highly represented in this review. We observed that some articles only focused on one aspect of sustainability, with organic foods ($n = 10$) and locally produced ($n = 7$) being the most extensively studied.

Moreover, we focused only on adults. When considering the demographics of the study populations, it became clear that age ranged from 16 to over 80 years old. Only two studies included participants younger than 18 years (Al-Taie et al., 2015; Bryła, 2016). Older participants in studies might have different perceptions of sustainability, compared to the younger participants. However, as the results on perceptions in these papers were presented for the entire sample we could not stratify by age. Moreover, the majority of participants in the included studies were female (in at least 63% of all studies). Research suggests that women are more likely than men to engage in sustainable consumption, which may be explained by different lifestyle practices and social norms (Bloodhart and Swim, 2020). In this review it was not possible to stratify by gender as results were only presented for the entire sample. We still believe that the perceptions of food-related sustainability are captured for both men and women, as most studies included both men and women.

In total, we included 76 articles conducted in 25 different high-income countries, which can be considered a good representation of the high-income countries. We assumed that high income countries have a predominant urban food system with a formal market. It would be interesting to examine the perceptions of consumers in low-income countries regarding food sustainability, as their food system is often more rural based. This could provide new insights on how consumers can shift to a more sustainable food system, with equal access to food.

4.3. Opportunities

This review points out several opportunities to facilitate consumers towards more sustainable behaviour. Consumers need to understand the importance of the environmental impact of food production on planetary degradation and other sustainability-related factors, such as packaging, waste and transportation. To this end, consumers need guidance to shift to sustainable food consumption. We believe that clear guidance and criteria should be used to label sustainable foods, as consumers believe that labelling can be beneficial to make more sustainable food choices (Ekelund and Spendrup, 2015; Klein and Menrad, 2016; Laureati et al., 2013; Valor et al., 2014).

More importantly, consumers must feel the urgency to shift to a sustainable diet. Currently, consumers do not consider food sustainability of high importance. Some concerns need to be addressed. First, consumers indicated that they feel powerless to combat climate change individually and they need governments to initiate collective actions. Second, sustainability is still seen as a future issue. However, we need to combat climate change now for future generations. It is therefore essential that governments take collective actions as soon as possible, and policymakers should communicate the urgency of environmental sustainability in a transparent, concise and evidence-based manner.

Beliefs of the next generations should also be considered, as its urgency increases for future generations to consume in a more sustainable way. As mentioned, little is known about food sustainability related perceptions of children or adolescents. A few studies introduced educational programs on sustainable consumption, aimed at raising awareness for ethical consumption (Schmid, 2012) or making better decisions concerning sustainable consumption (Hadjichambis et al., 2015). Only Francis and Davis (2015) studied sustainability concerns and reasons for not consuming sustainably among adolescents, although they did not specifically focus on food-related sustainability. Therefore, it would be of great importance to monitor younger populations and examine their beliefs on environmental issues. Especially as climate change will greatly affect the next generation.

To reduce overall GHGEs from livestock production, it is key to reduce meat consumption. This review shows that consumers do believe that meat reduction is environmentally beneficial. We believe that producers can, for example, contribute by reducing the portion sizes of meat products, as a first step toward a more sustainable food system. Reynolds et al. (2019) showed that diets with reduced GHGEs are affordable in different income groups, and Goulding et al. (2020) showed that a healthy and sustainable diet cost less than a conventional Western diet. Policymakers can use price as a facilitator for a more sustainable diet. In addition, it would be useful for consumers to receive

assistance in preparing and consuming more sustainable foods, as reducing meat consumption may involve new cooking techniques. One hurdle to overcome is that some consumers are sceptical about reducing their meat consumption. Consumers mentioned that meat is an essential component of a meal, that meat is part of a healthy diet, and that consumers like the sensory properties of meat (e.g., satiating value and taste). As such, these perceptions should be recognized, and healthy meat alternatives should be recommended.

It is also clear from this review that, in general, consumers do embrace certain collective initiatives to reduce the burden on the environment. Consumers find it important to minimize the amount of packaging, especially plastic packaging; or to manage their waste, such as recycling, reusing food packages, composting and separating waste. A review of Nemat et al. (2019) concluded that visual cues could motivate consumers to sort waste or to recycle food packaging. Furthermore, consumer initiatives, such as reducing plastic packaging by consumers and sorting waste show that consumers are capable of changing toward more sustainable behaviours, and these initiatives could be encouraged to take more steps toward a sustainable food system.

4.4. Conclusion

This review showed that consumers have a wide range of perceptions of food-related sustainability, covering the whole supply chain. Environmental impact, (locally and organic) food choices and ethical production are the most frequent categories mentioned by consumers. However, this literature review also showed that consumers still lack key knowledge on some other specific food-related sustainability topics. In particular, consumers have difficulty defining the concept "sustainability" and to estimate the environmental impact of their food choices. Overall, consumers believe that sustainability does not (yet) influence their food choices. Currently, consumers consider price, taste and individual health more influential than sustainability. It would be useful for policymakers to communicate sustainability knowledge in a transparent, evidence-based and controlled way to consumers.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix C. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2022.130904.

Appendix A. Demographics of qualitative study approaches

Table 1
Demographics of qualitative study approaches

Author(s), year	Title	Sample size	Gender (% female)	Age range (mean)	Country	Method	Operationalisation
Alevizou et al. (2015)	The well(s) of knowledge: the decoding of sustainability claims in the UK and in Greece	8 × 12	unk.	20–65	GR, GB	Focus groups	The perceptions of different claims and logos were investigated
Austgulen et al. (2018)	Consumer readiness to reduce meat consumption for the purpose of environmental sustainability: insights from Norway	4 × 6	50%	25–45	NO	Focus groups	Three themes are discussed: everyday food consumption (habits, food preferences, food procurement, cooking), group work (to come up with meat-free dinner recipes, climate labels), willingness to change to less or no meat
Campbell-Arvai (2015)	Food-related environmental beliefs and behaviours among university undergraduates. A mixed-methods study	40	58%	students	US	Focus groups	What factors are import for students when choosing meals, why these factors were important, the connections they made between their own food choices, food production practices and the health of the environment, actions to minimize potential negative environmental outcomes were discussed
de Carvalho et al. (2016)	Accessibility and trust: the two dimensions of consumers' perception on sustainability purchase intention	20	unk.	unk.	PT	Semi-structured interview	The question "What can be considered to be a sustainable product?" was answered
Eldesouky et al. (2020)	Perception of Spanish consumers towards environmentally friendly labelling in food	4 × 9	53%	18-55+	ES	Focus groups	Food purchase decisions, social and environmental labels, information on labels and reasons for purchase, willingness to pay and certified labels were discussed

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Table 1 (*continued*)

Author(s), year	Title	Sample size	Gender (% female)	Age range (mean)	Country	Method	Operationalisation
Fernqvist et al. (2015a)	What's in it for me? Food packaging and consumer responses, a focus group study	3 × 6	unk.	20-40+	SE	Focus groups	Six different packaging options were presented, immediate responses were written down, then the discussion started on these packages
Fernqvist et al. (2015b)	Changing consumer intake of potato, a focus group study	6x4-8	68%	20-40+	SE	Focus groups	Main meal choices last three days, attitudes to fresh potato, knowledge and association to brands, buying behaviour, potato packaging, sensory experiences, future scenarios of potato consumption
Feucht and Zander (2018)	Consumers' preferences for carbon labels and the underlying reasoning. A mixed methods approach in 6 EU countries	32	FR: 70% GB: 82% DE: 64%	18-50+	FR, DE, IT, NO, ES, GB	Interview	Activities to combat climate change (yes-maybe-no), knowledge and information of climate change (e.g. global food trade, deforestation, livestock framing, reduction of meat, food waste, reduction of overproduction) were discussed
Gruber et al. (2014)	Inferential evaluations of sustainability attributes: Exploring how consumers imply product information	23	unk.	unk.	AT	Interview	In-depth understanding of the meanings ascribed by consumers to product attributes, evaluation of products, consumers' shopping behaviour, decision-making criteria
Gutierrez and Thornton (2014)	Can consumers understand sustainability through seafood eco-labels? A U.S. and UK case study	28	71%	22–78	GB, US	Interview	The question "What does the word sustainable mean to you?" was answered
Hanss and Bohm (2012)	Sustainability seen from the perspective of consumers	123	±50%	18-82 (35 ± 16)	NO	Face-to-face interview	What comes to your mind when you hear 'sustainability'? 14 product attributes: the importance of these attributes for sustainable groceries (7-point scale); familiarity of 19 labels on a 7-point scale, indicative of sustainable products were rated
Hartikainen et al. (2014)	Finnish consumer perception of carbon footprints and carbon labelling of food products	33	unk.	24–65	FI	Focus groups	Own criteria for grocery shopping, how environmentally conscious participants are in general and related to food consumption, main environmental burdens of food, carbon footprint and carbon labelling of food products were discussed
Hoek et al. (2017)	Shrinking the food-print: a qualitative study into consumer perceptions, experiences and attitudes towards healthy and environmentally friendly food behaviours	29	62%	18–64	AU	Web-based interview	Associations, current behaviour and the level of knowledge related to a healthy meal and an environmentally friendly meal. Hedonic response, associations, emotions and feelings, subjective knowledge and perceptions, current level of motivation, involvement and awareness of the four food-related behaviours. Perceived beneficial impact on health and environment were asked
Klein and Menrad (2016)	Climate-friendly food choices regarding fruit and vegetables: how German consumers perceive their competency and what supporting measures they would prefer	12	75%	unk.	DE	Focus groups	Evaluation of the basic understanding of consumers' preferences for different information strategies on climate effect of food were discussed
Macdiarmid et al. (2016)	Eating like there's no tomorrow: public awareness of the environmental impact of food and the reluctance to eat less meat as part of a sustainable diet	87	54%	25-56+	GB	Focus groups Interview	Perceptions on climate change, awareness of the environmental impact of foods, participants' willingness to eat less meat for environmental benefits. Two statements: Some people think what we eat is contributing to climate change" and "Some people think that eating less meat would be good for the environment" (agree or disagree) were discussed
Mancini et al. (2017)	Which are the sustainable attributes affecting the real consumption behaviour? Consumer understanding and choices	2 × 12	unk.	unk.	IT	Focus group	Discussing the degree of sensitivity of participants towards environmental impacts of food choices
Mann et al. (2018)	Australian consumers' view towards environmentally sustainable eating pattern	24	54%	19-69 (40)	AU	Telephone-based interview	Open questions on themes: participants' knowledge, attitudes and perceived effectiveness of participating in a sustainable eating pattern, current behaviour, barriers and facilitators to engage in these behaviours and sources of information were questioned

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Table 1 (*continued*)

Author(s), year	Title	Sample size	Gender (% female)	Age range (mean)	Country	Method	Operationalisation
Palmer et al. (2017)	Between global and local: exploring regional food systems from the perspective of four communities in U. S. Northeast	51	78%	25–93	US	Focus group	Perceptions on local and global food systems were discussed
Risius et al. (2017)	Consumer preferences for sustainable aquaculture products: evidence from in-depth interviews, think aloud protocols and choice experiments	18	67%	unk.	DE	Interview	Explore consumers' perception of sustainable aquaculture and their understanding and acceptance of claims and labels for fish products from sustainable aquaculture
Sacchi (2018)	The ethics and politics of food purchasing choices in Italian consumers' collective action	6x (4–5) = 28	64%	20–65	IT	Focus groups	The values behind sustainable buying behaviour were obtained using four topics: buying/non-buying (habit and frequency), value-based labels (awareness and motivation), participation in food cooperatives (participation and involvement) and consumption behaviour and ethical products
Sattari et al. (2017)	Understanding consumers' perception of sustainable consumption: A ZMET approach	52	unk.	unk.	SE	Focus groups	Define the term 'sustainability' in general and express associations with the concept
Sijtsema et al. (2012)	Interplay of sustainability and health? Sustainable food from a consumer's perspective	3 × 6	50%	27-57 (39)	NL	Focus groups	Using pictures to give insights in an average meal, discuss which products are typically healthy and sustainable, perceptions to shift towards a more plant-based diet
Simpson and Radford (2012)	Consumer perceptions of sustainability: a free elicitation study	45	67%	25–65	CA	Free-elicitation	Understand whether consumers are aware of the three pillars of sustainability, and if they further associate sustainability with the notion of persistence
Sirieix et al. (2013)	Consumers' perception of individual and combined sustained food labels: a UK pilot investigation	16	unk.	20–60	GB	Focus groups	Participants' criteria for fruit and vegetable selection, their response to 13 labels/ messages, their preferred/rejected combinational of labels/messages, and what participants thought about sustainable labels were discussed
Valor et al. (2014)	The influence of knowledge and motivation on sustainable label use	289	66%	18-65+	ES	Interview (structured)	Recognition of 12 sustainable graphic labels, knowledge on these recognized labels (product category, meaning and label use. Motivation: importance of labels on purchase decision, rank of three important attributes when buying food or beverages
Vega-Zamora et al. (2014)	Organic as a heuristic cue: what Spanish consumers mean by organic foods	4 × 8	53%	25–52	ES	Focus groups	Discussion topic on organic foods in general, and olive oil
Wakefield and Axon (2020)	"I'm a bit of a waster": Identifying the enablers of, and barriers to, sustainable food waste practices	10	70%	20–57	GB	Focus groups	Food waste: understandings, attitudes, relative importance of sustainable food waste management and current food waste practices were discussed

AT = Austria; AU = Australia; CA = Canada; DE = Germany; ES = Spain; FI = Finland; FR = France; GR = Greece; GB = United Kingdom; IT = Italy; NL = the Netherlands; NO = Norway; PT = Portugal; SE = Sweden; US = United States.

Appendix B. Demographics of quantitative study approaches

Table 2
Demographics of quantitative study approaches

Author(s), year	Title	Sample size	Gender (% female)	Age range (mean)	Country	Method	Operationalisation
Adams and Adams (2011)	De-placing local at the farmers' market: consumer perceptions of local foods	97	60%	18-65+	US	Survey	15 questions on attitudes towards local versus non-local food on a 5 point scale (mean)
Aertsens et al. (2011)	The influence of subjective and objective knowledge on attitude, motivations and consumption of organic food	529	53%	<25–65+	BE	Survey	17 possible motivations to buy organic foods on a 7-point Likert scale, 12 potential barriers to purchase organic vegetables (mean)
Al-Taie et al. (2015)	Exploring the consumption of organic foods in the United Arab Emirates	266	36%	16–65	AE	Survey	7 statements on consumers' perceptions on the impact of organic foods on the environment (agree or disagree); 8 statements on barriers of organic foods (agree or disagree) (percentages)

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Table 2 (*continued*)

Author(s), year	Title	Sample size	Gender (% female)	Age range (mean)	Country	Method	Operationalisation
Annunziata and Scarpato (2014)	Factors affecting consumer attitudes towards food products with sustainability attributes	300	53%	18-65+	IT	Survey	Questions on food habits and lifestyle, attitudes and purchasing behaviour with respect to sustainable food such as organic, fair trade and typical food on a 5-point scale (percentages)
Annunziata et al. (2019)	Effectiveness of sustainability labels in guiding food choices: Analysis of visibility and understanding among young adults	305	52%	(22 ± 3)	IT	Survey	Personal values and food sustainability concerns, visibility and understanding of sustainability labels on a 5-point scale (means)
Aprile et al. (2016)	Consumers' preferences and attitudes towards local food products	200	63%	18–74	IT	Survey	11 statements about consumer perceptions and definitions on local foods on a 5-point scale (percentages)
Austgulen et al. (2018)	Consumer readiness to reduce meat consumption for the purpose of environmental sustainability: insights from Norway	1532	50%	18–89	NO	Survey	12 statements about climate change, hard to reduce meat consumption or have reduced meat consumption on a 5-point scale (percentages)
Boesen et al. (2019)	Environmental sustainability of liquid food packaging: is there a gap between Danish consumers' perception and learnings from life cycle assessment?	197	62%	25–35	DK	Survey	Characteristics that are typical for a sustainable package, 12 statements (percentages)
Borrello et al. (2019)	Sustainability of palm oil: drivers of consumers' preferences	291	56%	(40.7)	IT	Survey	10 sustainability concerns on a 5-point scale (from Grunert et al.), environmental impacts of palm oil on a 5-point scale (means), frequency of reading information on a label
Bryła (2016)	Organic food consumption in Poland: Motives and barriers	1000	50%	15-65 (40)	PL	Survey	13 statements on organic food compared to conventional food on a 5-point scale (percentages)
Campbell-Arvai (2015)	Food-related environmental beliefs and behaviours among university undergraduates. A mixed -methods study	320	53%	students	US	Survey	12 statements describing food-related actions to capture participants' food-related environmental beliefs on a 5-point scale (percentages)
Chen et al. (2018)	Eco-labelling in fresh produce market: not all environmental labels are equally valued	2525	57%	18-80+	US	Survey	11 statements on the importance of extrinsic strawberry attributes on a 5-point scale (percentages)
de Boer et al. (2016)	Help the climate, change your diet: A cross-sectional study on how to involve consumers in a transition to a low-carbon society	NL: 527 US: 556	NL: 50% US: 50%	18–65	NL, US	Survey	Frequency of meat eating, perceived relevance of mitigation; importance of the issue on climate change and perceived effectiveness ratings of different mitigation options on a 5-point scale (means)
de Carvalho et al. (2015)	Consumer sustainability consciousness: a five dimensional construct	992	61%	18–80	PT	Survey	20 statements on sense of retribution, access to information, labelling and peer pressure, health and crisis scenario on a 7-point Likert scale (means)
Dzene and Eglite (2012)	Perspective of sustainable food consumption in Latvia	82	100%	19–35	LV	Survey	Attitudes and opinions on sustainable food consumption, to which extent consumers actively seek the more sustainable produced foods (percentages)
Ekelund and Spendrup (2015)	Climate labelling and the importance of increased vegetable consumption	184	unk.	unk.	SE	Survey	Ranking of different recommendations and views on GHE reduction actions (percentages)
Feucht and Zander (2018)	Consumers' preferences for carbon labels and the underlying reasoning. A mixed methods approach in 6 EU countries	6007	FR: 51% GB: 50% DE: 50% ES: 50% IT: 51% NO: 51%	18–70	FR, DE, IT, NO, ES, GB	Choice experiment	Activities to combat climate change, knowledge and information of climate change (percentages)
Ghvanidze et al. (2016)	Consumers' environmental and ethical consciousness and the use of the related food products information: the role of perceived consumer effectiveness	821	GB: 53% DE: 51% US: 52%	18-64+	GB, DE, US	Survey	Perceived consumer effectiveness environmental conscious behaviour, ethical concerns on a 5-point scale (means)
Goossens et al. (2017)	Qualitative assessment of eco-labels on fresh produce in Flanders (Belgium) highlights a potential intention - performance gap for the supply chain	553	68%	18-66+	BE	Survey	Extent of consuming sustainable, reasons for environmentally friendly purchasing, environmental information provision, eco-labels (percentages)

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Table 2 (*continued*)

Author(s), year	Title	Sample size	Gender (% female)	Age range (mean)	Country	Method	Operationalisation
Grunert et al. (2014)	Sustainability labels on food products: consumer motivation, understanding and use	4408	GB: 51% FR: 51% DE: 55% ES: 48% PL: 51% SE: 51%	18-55+	GB, FR, DE, ES, SE, PL	Survey	Sustainability concerns related to food of 14 items on a 7-point Likert scale (means)
Halldorsdottir and Nicholas (2016)	Local food in Iceland: identifying behavioural barriers to increased production and consumption	120	56%	unk.	IS	Survey	Rate the importance of statements concerning local foods and product attributes (percentage)
Hartikainen et al. (2014)	Finnish consumer perception of carbon footprints and carbon labelling of food products	1010	50%	18–65	FI	Survey	List three factors that contribute most to the environmental load of food, their understandings and interest in carbon footprint labels, describe product carbon footprint in their own words, importance on food carbon footprints (open questions)
Herbes et al. (2018)	Consumer attitudes towards biobased packaging - a cross-cultural comparative study	FR: 443, DE: 948, US: 610	FR: 53% DE: 58% US: 50%	<30–59+	FR, DE, US	Survey	Consumer perceptions of the environmentally friendliness of food packaging on a 5-point scale (means)
Hiroki et al. (2016)	Consumer perceptions about local foods in New Zealand, and the role of life cycle-based environmental sustainability	240	67%	18-65+	NZ	Survey	11 key attributes associated with local foods (percentages)
Jerzyk (2015)	Sustainable packaging as a determinant of the process of making purchase decisions from the perspective of Polish and French young consumers	161	67%	17–30	PL, FR	Survey	18 expressions related to sustainable packaging, rated on a 5-point scale (means)
Kause et al. (2019)	Public perceptions of how to reduce carbon footprints of consumer food choices	627	59%	18–80	GB	Survey	Characteristics that are typical for produce/dairy/protein-rich products with a low carbon footprint (percentages)
Klein and Menrad (2016)	Climate-friendly food choices regarding fruit and vegetables: how German consumers perceive their competency and what supporting measures they would prefer	413	69%	16-50+	DE	Structured interviews	Perceived behavioural competency regarding different climate-friendly food choices on a 5-point scale (means)
Lang et al. (2014)	Consumers' evolving definition and expectations for local foods	277	64%	unk.	US	Survey	Consumer definition of locally sourced and produced foods (10 items) on a 5-point scale (means)
Laureati et al. (2013)	Sustainability and organic production: How information influences consumer's expectation and preference for yogurt	157	64%	20–42	IT	Survey	Questions on which statements fits the respondents' experience on a 5 point scale and actual behavioural items (percentages)
Lazzarini et al. (2016)	Does environmental friendliness equal healthiness? Swiss consumers' perception of protein products	85	51%	20-64 (39 ± 13)	CH	Ranking test	Perceived environmental friendliness & perceived healthiness of 30 food products, placing them on a 3m long line ranging from unhealthy - healthy and from not environmentally friendly - very environmentally friendly
Lehikoinen and Salonen (2019)	Food preferences in Finland: Sustainable diets and their differences between groups	2052	51%	<30–70+	FI	Survey	9 statements regarding sustainable food consumption on a 5-point scale (means)
Lindh et al. (2016)	Consumer perceptions of food packaging: contributing to or counteraction environmentally sustainable development?	157	46%	20-60+	SE	Survey	Consumer perceptions of packaging functions and material and consumer perception of what environmentally sustainable packaging is (open questions), consumer perceived importance of environmentally sustainable packaging (percentages)
Mäkiniemi and Vainio (2014)	Barriers to climate-friendly food choices among young adults in Finland	350	80%	(24 ± 7)	FI	Survey	11 barriers to consume climate-friendly on a 5-point scale (means)
Mancini et al. (2017)	Which are the sustainable attributes affecting the real consumption behaviour? Consumer understanding and choices	240	unk.	unk.	IT	Face-to-face interviews	Consumption habits, intrinsic and extrinsic attributes that affect food choice, understanding of labels (frequencies)
Meyerding and Trajer (2019)	Consumer preferences for local origin: is closer better? The case of fresh tomatoes and ketchup in Germany	541	50%	18+	DE	Survey	Respondents' general purchase behaviour and their perspective on locally grown produce, and food-related lifestyle statements on a 5-point scale (means)

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Table 2 (*continued*)

Author(s), year	Title	Sample size	Gender (% female)	Age range (mean)	Country	Method	Operationalisation
Meyer-Hofer and Spiller (2014)	Characteristics and barriers of sustainable food consumption in Germany	300	52%	(45)	DE	Survey	How important it is to that the food you buy has been produced/traded according to the 4D (Environment, Climate protection, Fair trade, animal welfare) and Barriers on a 5-point scale (means)
Mohr and Schlich (2016)	Socio-demographic basic factors of German customers as predictors for sustainable consumerism regarding foodstuffs and meat products	1040	63%	18-66+	DE	Survey	Closed (means) and open questions (frequencies) on associations with sustainable food consumption, meat reduction and consciousness for sustainable purchase behaviour
Nagyova et al. (2016)	Sustainable consumption of food: a case study of Slovak consumers	300	81%	15-50+	SK	Survey	Application of sustainable consumption (e.g. economical packages, ecological production, recycling of waste), factors leading to these purchases, including price and quality (percentages)
Panzone et al. (2016)	Socio-demographics, implicit attitudes, explicit attitudes, and sustainable consumption in supermarket shopping	895	55%	18-65+	US	Survey	Explicit attitudes on a 5-point scale to generate general attitudes towards sustainability (means)
Peano et al. (2019)	Sustainability for food consumers: Which perception?	804	55%	<21–60+	IT	Survey	Implementation of best-worst scaling methodology on consumers' perception about the concept of sustainability
Pearson (2011)	Consumer concerns: is organic food important in an environmentally responsible diet?	163	75%	11-55+	AU	Survey	The importance of different product features on a 5-point-scale (percentages)
Petrescu et al. (2020)	Consumer understanding of food quality, healthiness, and environmental impact: a cross-national perspective	797	64%	(26)	BE, RO	Survey	Cues (n = 59) that are often used for the evaluation of the food impact on the natural environment on a-7 point scale (means)
Rejman et al. (2019)	Do Europeans consider sustainability when making food choices? A survey of Polish city-dwellers	600	62%	21–70	PL	Survey	Factors influencing food choice measured on a 5-point scale (means)
Rood et al. (2014)	Nederlanders en duurzaam voedsel. Enquête over motieven voor verduurzaming van het voedselsysteem en consumptiegedrag	1105	unk.	18–70	NL	Survey	Motives that are contributing to a more sustainable food system (frequencies)
Schösler et al. (2014)	Fostering more sustainable food choices: can self-determination theory help?	1083	50%	18-75+	NL	Survey	Reasons for (not) frequently eating meat (max 3)
Shi et al. (2018)	Consumers' climate-impact estimations of different food products	226	unk.	unk.	CH	Survey	Rating the environmental impact of a product on a scale from 0 to 100, compare it with similar product with the smallest and highest environmental impact
Siegrist and Hartmann (2019)	Impact of sustainability perception on consumption of organic meat and meat substitutes	5586	52%	56 ± 17	CH	Survey	Perceived environmental impact of various foods on a 7-point scale (means)
Siegrist et al. (2015)	Factors influencing changes in sustainability perception of various food behaviours: results of a longitudinal study	2600	54%	58 ± 14	CH	Paper-and-pencil survey	Perceived environmental benefits of 6 ecological consumption patterns, willingness to reduce meat consumption and eating only seasonal fruits and vegetables, diet-related health consciousness on a 6-point scale (means)
Tobler et al. (2011)	Organic tomatoes versus canned beans: how do consumers assess the environmental friendliness of vegetables?	79	70%	19-82 (49 ± 16)	CH	Choice experiment Survey	Pairs of vegetable products were repeatedly shown and the participants were asked to choose the one that is more environmental friendly during the winter season. Environmental friendliness (19 statements) on a 7-point scale (means)
Van Loo et al. (2013)	Consumer attitudes, knowledge, and consumption of organic yogurt	774	62%	18-65+	BE	Survey	Perceived differences among organic and conventional yogurt were identified on a 7-point scale (means)
Vanhonacker et al. (2013)	Flemish consumer attitudes towards more sustainable food choices	221	64%	18-60+ (41 ± 17)	BE	Survey	Personal concerns, perceived consumer effectiveness, ethical food choice motives on a 5-point scale (means and percentages)

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Table 2 (*continued*)

Author(s), year	Title	Sample size	Gender (% female)	Age range (mean)	Country	Method	Operationalisation
Verain et al. (2015)	Sustainable food consumption. Product choice or curtailment?	942	50%	18-65 (42.3)	NL	Survey	Sustainable food behaviour was measured with 9 items (means)
Wunderlich et al. (2018)	Consumer knowledge about food production systems and their purchasing behavior	123	83%	18–77	US	Survey	Participants selected a statement that best reflected their beliefs regarding how producing GMO, organic or conventionally grown food impacts the environment (percentages)
Zakowska-Biemans and Tekień (2017)	Free range, organic? Polish consumers preferences regarding information on farming systems and nutritional enhancement of eggs: a discrete choice based experiment	935	50%	<34–65+	PL	Survey	Items on subjective knowledge and perception of prices for organic and nutritionally enhanced food, food related lifestyle on a 7-point scale (means)
Zander et al. (2015)	EU organic logo and its perception by consumers	3000	67%	18-59+	EE, FR, DE, IT, PL, GB	Survey	Knowledge on the EU organic logo, other organic labels, organic farming principles, perception of organic food, relevance of origin (frequencies)

AE = United Arab Emirates; AU = Australia; BE = Belgium; CH = Switzerland; DE = Germany; DK = Denmark; EE = Estonia; ES = Spain; FI = Finland; FR = France; GB = United Kingdom; IS = Iceland; IT = Italy; LV = Latvia; NL = the Netherlands; NO = Norway; NZ = New Zealand; PL = Poland; PT = Portugal; RO = Romania; SE = Sweden; SK= Slovakia; US = United States.

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