ANNUAL REVIEWS

Annual Review of Resource Economics

Sustainability-Related Food Labels

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Annu. Rev. Resour. Econ. 2020. 12:171–85

First published as a Review in Advance on June 12, 2020

The *Annual Review of Resource Economics* is online at resource.annualreviews.org

https://doi.org/10.1146/annurev-resource-100518-094103

Keywords

sustainability-related food labels, effectiveness, supply, demand, regulation, discussion

Abstract

The past decades have seen the development of a multitude of sustainability-related food labels aimed at reducing the existing information asymmetry between food practitioners and consumers regarding the sustainability impact on the food supply chain. Sustainability-related food labels can correct market failures and contribute to a more sustainable world. This review discusses the effectiveness of sustainability-related food labels in promoting more sustainable food consumption around the world. We start by discussing the sustainable development goals in the food area and the challenge of defining these labels. We then investigate the demand- and supply-side issues related to the effectiveness of such labels in promoting the sustainable development goals that the labels serve. Finally, we discuss the questions raised by the state of research and their implications for food practitioners, consumers, and policy makers. We then identify future research avenues.

INTRODUCTION

Sustainability, one of the most important societal issues of our time, has continually had an effect on the entire food chain in the last few decades (Alves & Edwards 2008, Grunert 2013, FAO 2014, Grunert et al. 2014). There is a growing consensus on the need for more sustainable food production and consumption to sustain and support an increasing world population (Godfray et al. 2010). Data from the European Union and United States show that sustainability-related concerns strongly contribute to consumer behavior; thus, information can be an effective tool in encouraging sustainable choices (Czarnezki 2011). Consequently, in the last few decades, a multitude of sustainability-related food labels (sometimes referred to as ecolabels) have emerged to help consumers make more informed food purchasing decisions by considering the environmental, ethical, and social impacts of their food choices (Annunziata et al. 2019). Specifically, sustainability-related food labels increase transparency by reducing the information asymmetry that exists between food chain stakeholders (e.g., producers, retailers) and consumers along the food chain and informing consumers in a way that can promote sustainable consumption (Loureiro & Lotade 2005, Czarnezki 2011, Grunert et al. 2014). To date, according to cataloger ecolabelindex.com, approximately 463 ecolabeling schemes are available in 199 countries, of which 148 are related to food products. Notably, given the increasing presence of sustainability-related labels for food products, there has been a significant jump during the last 10 years in the number of research articles focused on them (**Figure 1**).

One primary concern related to sustainability is the effectiveness of food labels in reducing information asymmetry between consumers and producers as well as in promoting sustainable consumption. To the best of our knowledge, there has been no discussion of the effectiveness of sustainability-related food labels in achieving their main purposes. This question is of primary importance for policy makers, food practitioners, and consumers interested in having a more sustainable world.

This review aims to discuss the economics of sustainability-related food labels, as examined in the recent literature, by investigating the demand- and supply-side issues related to the

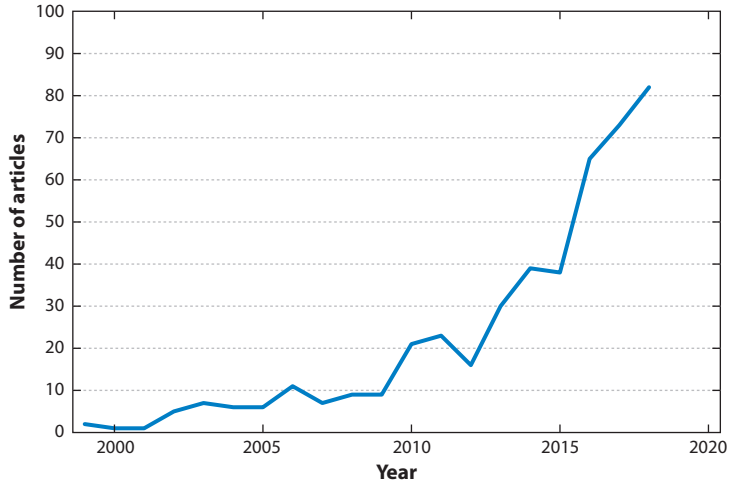

Figure 1

Number of research articles on the topic of "sustainability-related food labels" from the Web of Science (**https://www.webofknowledge.com**) database (search terms: economics, sustainability, food, labels).

effectiveness of such labels in promoting more sustainable consumption. Implications, recommendations, research gaps, and future research avenues are identified and discussed. Our focus is on well-known sustainability-related food labels in the market, such as organic or fair trade and the extent of carbon and water footprints.

The article is organized as follows. First, we define sustainability, its role in the food chain, and sustainability-related food labels. Second, we discuss the role of sustainability-related food labels from the demand side. Third, we evaluate the impact of sustainability-related food labels from the supply side. Finally, we address questions raised by the state of research and discuss the implications for food practitioners, consumers, and policy makers. Our review concludes by identifying future research avenues.

SUSTAINABILITY AND THE FOOD CHAIN

Over the last four decades, the sustainability concept has constantly increased in importance in the global society due to environmental concerns and climate change (Strange & Bayley 2008). Sustainability in various languages is defined as a situation, object, or management meant to sustain, bear, and hold. The original idea arose in the seventeenth and eighteenth centuries with the need for sustaining yields in forestry in an efficient and economical manner (Grober 2010). The most commonly cited definition of sustainability, called Our Common Future (also known as the Brundtland Commission), originates from the UN Commission's report that discussed sustainable development by allowing equal fulfillment of the needs of all members of the current and future human population, given resource limitations (WCED 1987). Thus, this definition introduced both the intra- and intergenerational equity aspects of sustainable development that focused on social justice and the temporal aspect of long-term stability. Since then, however, the notion of sustainability has reincorporated the economic thought, and it is now widely understood to be characterized by three pillars: environmental, social, and economic. This is exemplified by the term "triple bottom line" (Elkington 1998), reflecting this three-dimensionality, which has been exhibited in subsequent world summits (Visser 2009) and has also been expressed in today's definition of corporate social responsibility (CSR) (Eur. Comm. 2018). However, Zilberman (2014) argues that there is a difference between sustainable development as defined by the Brundtland Commission and the notion of sustainability that is implemented in practice. This is because sustainable development is subject to constraints related to intergenerational equity (e.g., that the welfare of future generations would not decline just because of an increase in welfare of the present generation). As a consequence, economists have included sustainability in economic growth models with intergenerational equity constraints (Stavins 1990, Pezzey 1992).

However, a number of conflicts and critical questions have been raised in relation to sustainability. The greatest conflict arises from the question of how to bring the three aspects, i.e., environmental, social, and economic, together in synergy, and whether one of these aspects should be prioritized over the others. Many authors argue that instead of having three separate pillars, these should be embedded with each other, with one sustaining the other—consequently, with the natural basis being the most important, and the economy, the least (Belz & Peattie 2009). This is reflected in the quote "there is no business to be done on a dead planet" attributed to David Brower of the Sierra Club (Casey 2007). In relation to this view of the natural basis being under threat, some authors note that there seem to be two different schools of thought regarding sustainability: a weak conservative view (i.e., full substitutability of natural capital) versus a strong transformative view (i.e., full substitutability of natural capital should be severely limited because it has critical elements for humanity and well-being) (Belz & Peattie 2009). One criticism is that efforts made in the understanding of the first concept are not sufficient, and it is not able to satisfy the goal of

sustainable development (Clifton 2012). Another discussion is whether there are disregarded aspects in the sustainability definition. For example, the sustainability definition does not grant the right to any "need fulfillment" to the biosphere in its own right; thus, animal rights and welfare are not included. Furthermore, it has been argued that "culture" should be regarded as another important pillar of sustainability (Belz & Peattie 2009). In summary, while there is rather strong agreement about the major aspects that should be included under the concept of sustainability (i.e., environmental, social, and economic), there is still ongoing debate and uncertainty about the priorities and whether other aspects should be considered and added to the definition.

Among the different activities affected by the sustainability concept in society, food production and consumption are the most relevant (Godfray et al. 2010). Indeed, sustainability is one of the three major food trends, along with health and convenience, that guide the entire food chain (Grunert 2013). In addition, the projected increase in world population in the near future necessitates more sustainable food production and consumption (Godfray et al. 2010), which also includes a greater diversity of the food we eat (Aschemann-Witzel et al. 2019). Agriculture contributes to direct[1] and indirect[2] greenhouse gas (GHG) emissions and between 17% and 32% of the total anthropogenic GHG emissions, including land-use changes (Bellarby et al. 2008). Agriculture is also responsible for 70% of the global freshwater consumption (Hoekstra & Chapagain 2006). The importance of sustainability in the food chain is also indicated by the large amount of financial resources that public and private operators spend every year in sustainability practices as well as the large number of research publications dedicated to this topic (see, for example, Tagbata & Sirieix 2008, Gadema & Oglethorpe 2011, Krystallis et al. 2012, Tencati & Zsolnai 2012, Grunert et al. 2014, Hartikainen et al. 2014, Van Loo et al. 2014, Bazzani et al. 2016, Pomarici et al. 2018).

The Western world has witnessed a growing popularity of food products that seek to embody sustainable consumption by focusing on environmental and socially responsible practices that can help meet the needs of future generations (Sirieix et al. 2012). This trend is signaled by the increasing consumer demand for sustainable food products, such as organic (FIBL 2017) or natural food products (Asioli et al. 2017). However, to achieve a fruitful social and environmental policy and reach a more sustainable world, it is important to achieve a far-ranging behavioral change in many respects. The interest in sustainability has increased pressure on the food chain (Sirieix et al. 2012, Tzilivakis et al. 2012). In economics terms, sustainability concerns can influence both the food demand driven by consumers and the food supply driven by food practitioners (i.e., farmers, food industry, and retailers).

Because sustainability concerns come primarily from the demand side, consumer behavior is of primary importance. Over the last three decades, a large variety of public and private initiatives have started communicating sustainability-related information to consumers by using labels in-store and on food packages (Grunert et al. 2014). Sustainability-related food labels aim to increase transparency by reducing the information asymmetry that exists between producers and consumers along the food chain, informing the consumer in a way that can promote sustainable consumption (Loureiro & Lotade 2005, Grunert et al. 2014). There are different types of sustainability-related food labels. A useful categorization could divide the sustainability-related food labels into those primarily tackling environmental, social, or ethical concerns. Environmental food labels refer to food labels indicating that the food product has been produced with care for the environment, such as organic labeling or information on its carbon and water footprints. Social or ethical food labels, on the other hand, have a social or ethical dimension such as animal welfare and fair trade.

[1] GHG emissions from soil and livestock.
[2] GHG emissions through fossil fuel use, agrochemical production, and land conversion to agriculture.

DEMAND FOR SUSTAINABILITY-RELATED FOOD LABELS

From a demand and consumer perspective, there are essentially four contributions that sustainability-related labels provide. First, labels provide information that consumers otherwise might not have. Thus, they can correct the market failure of information asymmetry and lack of full information and move the market to a more efficient status of full information (Zilberman et al. 2018). This is done to alleviate environmental and social problems caused by food production. Once consumers have the information and knowledge about the contribution of the labeled product, they can then form an informed opinion on their willingness-to-pay (WTP) for this additional benefit of the product and act accordingly. This knowledge on the actual costs then allows them to fix the problem of externalities (Tietenberg & Lewis 2018) not included in the normal product price.

Second, labels can provide information in a format that is understandable and quickly comprehensible for most consumers. They can tackle the problem of information and choice overload that consumers typically face within today's consumption society (Mick et al. 2004). Third, labels and the related complex system of standard regimes (Gustafsson & Hallström 2018) are tools that can foster trust from the side of consumers, both in that the information they receive is factually correct and measures have been taken to present the label in an understandable way. Hence, the label becomes a credence quality signal, which consumers could value and be willing to pay for (Grunert 2005). Of course, third-party certification is the key element for this contribution as well as the distinction between standards, certification, and accreditation (Gustafsson & Hallström 2018).

Fourth and most importantly, the sustainability-related labels can empower consumers. The labels allow consumers to express their individual value perception of product characteristics, including the credence quality attributes and which characteristics they prefer when comparing different product alternatives. This then transfers into whether and which environmental and social problems should be tackled based on consumers' preferences. Without sustainability-related labels, consumers might only feel the concern, benevolence, and care for others who are distant in space and time; with the labels, consumers can also enact this care as beneficence (Chatzidakis & Shaw 2018). From a marketing management point of view, the result is a pull effect on the market because companies observe consumer demand moving in a certain direction and follow up with an even greater offer of the respective products (Galarraga 2002).

Overall, research indicates that sustainability-related food labels appear to fulfill the four contributions discussed above. There is a strand of research showing that consumers value the labels and the information they provide (Yenipazarli 2015, Schäufele & Hamm 2017). This holds even when considering that there is often a certain discrepancy between stated and revealed preferences (Horne 2009, Grunert et al. 2014). However, there is also some evidence that the WTP is not always sufficient for the label to be an economically fruitful endeavor (Yenipazarli 2015). Research shows that simpler and more directive labels perform rather well in the market (Delmas et al. 2013), for example, the organic logo in a number of countries (Thøgersen 2010). Some studies also indicate that more informative labels with multiple levels of information are particularly valued (Weinrich & Spiller 2016). This might suggest that consumers are torn between desiring the depth of information on the one hand and the simplicity in which the information is presented to them on the other. One example is the front-of-pack nutrition labeling (Grunert et al. 2012). Consumers might also perceive that the information on the various issues of sustainability is complex but prefer to collapse it into a single more sustainable characteristic to simplify choice (van Dam & van Trijp 2011). Moreover, research points to the crucial role of trust in food labeling (Tonkin et al. 2016), showing that it is essential that consumers trust the authenticity and credibility of the food labels (Gustafsson & Hallström 2018).

As previously mentioned, there are a number of concerns about sustainability-related labels. On the demand side, the following issues could potentially hamper the effectiveness of sustainability-related labels in terms of improving and achieving the sustainable development goal. First, the increasing proliferation of sustainability-related food labels could result in competing labels in the market that can potentially confuse consumers and undermine their trust in the labels and underlying system (Horne 2009, van Dam & van Trijp 2011). Second, there are issues linked to the potential intended or unintended misinformation that might happen when considering the overall goal of sustainability-related food labels. For instance, in a complex yet demand-driven market, there is the risk of intended misinformation (i.e., fraud or deception), which is in stark contrast to the aim of food labels providing factual and correct information to consumers. There is also a tendency for consumers to overinterpret labels. This occurs in a broader sense than actually communicated (Tonkin et al. 2016), where inferring characteristics that have little or nothing to do with the labels is strongly linked to the lack of clear definition of the terms used in sustainability-related food labels (e.g., green, natural). Therefore, a consumer can get confused or be misled about what it means (Alves & Edwards 2008). Indeed, research has found that the so-called halo effect could occur when foods carry certain labels, most prominently the organic label (Sörqvist et al. 2015), and that this halo effect can even extend to favorable taste perceptions (Bratanova et al. 2015, Apaolaza et al. 2017, Asioli et al. 2018).

Third, sustainability-related food labels might or might not deviate consumer action and effort toward what is relatively less relevant. When considering that consumers would like to think that they indeed would engage in positive buying and contribute to sustainable development by choosing sustainability-related food labels, the question that then arises is whether their choice of action in favor of the label lives up to this expectation. This is not without challenges. For example, in the discussion of green washing, one of the issues raised is that some sustainability-related food labels might signal a characteristic not necessarily being the most important aspect of the respective product; thus, it might highlight a symbolic rather than a substantive action toward sustainability (Horne 2009, Walker & Wan 2012).

Apart from green washing, which could also be considered a deception, there are also well-meaning sustainability standards that are nevertheless contested by other experts. For example, some attested favorable effects of organic farming form the basis for recommending it for sustainable consumption (Reisch et al. 2013). However, there is also extensive discussion on whether or not organic production as such is the optimal strategy to ensure a sufficient and secure food supply (Connor 2018) or whether it should rather be some form of sustainable intensification farming (Foley et al. 2011). More specifically, various authors have argued that in many situations and contexts, organic production does not suitably address the goals of sustainable development, although it is able to reduce land degradation and soil erosion (Meemken & Qaim 2018). For example, Meemken & Qaim (2018) stated that in terms of environmental and climate effects, although organic production is less polluting than conventional production per unit of land, it is less efficient per unit of output. The lower efficiency of organic agriculture is due to bans on the use of synthetic fertilizers, pesticides, and genetically modified organisms (GMOs) that make controlling pests and improving plant nutrition more challenging and often less effective (Meemken & Qaim 2018). Although GMOs are prohibited, they can have significant social benefits for farmers and consumers, especially those from developing countries, as it is possible to produce wider aggregate welfare gains (Qaim 2009). Thus, it is not only the existence of a sustainability-related food label but also the type of technology used in producing the food that can be important in achieving sustainability goals.

Looking at other examples of major sustainability-related food labels such as fair trade, there is a similar discussion on their advantages or disadvantages and whether the label fulfills the intended

goal. However, some of the particularly impactful unsustainable products or consumption areas are not tackled by sustainability-related labels. This can be explained by their controversial role or harmful image that none of the competing labeling programs might want to be associated with (Horne 2009).

Fourth, and following the abovementioned point, we must consider an important effect to which sustainability-related food labels contribute, namely, increasing a potential rebound effect in consumers' minds. The rebound effect is defined as a reduction in the expected efficiency of resource use due to, for example, a shift in consumer behavior. A consumer who buys sustainability-labeled products might perceive that he or she has done his/her share, even though this is a misperception, because engaging in one type of action might not sufficiently solve the problem. Rebound effects are widely studied, particularly in terms of a system effect and often in relation to energy use, but research shows that consumer behavior is rather crucial (Bjelle et al. 2018) and thus an issue when considering which policies are the best (Thøgersen 2010).

Fifth, some attention should be given to the observed segment-specific appeal of sustainability-related labels among distinct consumer groups. The fact that consumption is also used to express identity and has a signaling value in social relations has consequences for how consumers use sustainability-related food labels in the marketplace. There are underlying values associated with labels and even political directions connected to purchasing. For instance, for a specific consumer segment, the choice of products labeled as organic and fair trade could depend on what is seen as politically correct. The higher price of labeled products also allows these products to be used for social distinction related to social class. Hence, sustainability-labeled food products might potentially be considered items of conspicuous consumption. The observation of consumer segment-specific appeal does not necessarily contribute to sustainable development if market shares stagnate at a certain level. If the product is better for sustainability, the long-term goal should likely be that all products in the food market at some point achieve specific characteristics that are labeled in order to achieve the large-scale change needed for sustainable transformation.

The abovementioned five issues potentially hampering the effectiveness of sustainability-related food labels call for these labels to be assessed on how well they achieve the ultimate goal. Some have suggested that the criteria of sufficient coverage, uptake, and outcome be used for this purpose (Horne 2009). From a sustainable development perspective, sustainability-related food labels are deemed more effective if they increasingly improve products and increase market share. In addition, labels are best when they have an effect that goes further than the purchase act, e.g., in awareness raising or habit change, and are embedded in a much broader set of policy efforts toward sustainable consumption (Horne 2009, Thøgersen 2010). Furthermore, labels that accelerate technology innovation and improvement in the market might as well offset some of the issues connected to consumption of ecolabels, as it has been found that much of the change in the market is less due to the label but more due to the technological advancement during the same time frame (Horne 2009).

The underlying reason for why food labels and their policy context need to change overall consumption is that a label on a product says little about consumption levels, and labels are rarely used for a zero-impact product or to promote de- or anticonsumption. Criticism has been raised that sustainable consumption somehow is a contradiction in itself because consuming involves using something up while sustainability indicates the opposite (Lim 2017). Positive buying of a product with a sustainability-related food label in most cases is coupled with resource use, and the overall idea behind it follows a continuous growth economy idea (Jackson 2017), coupled with a view of consumer sovereignty as the indicator of freedom of choice (Lim 2017). In short, sustainability-related labels need to be connected to a redefinition of consumption and shift toward a variety of sustainable consumption concepts to achieve the sustainable development goals.

SUPPLY OF SUSTAINABILITY-RELATED FOOD LABELS

Food practitioners adopt sustainability-related food labels for two main reasons: (*a*) economic-market benefits and/or (*b*) mandatory legislation (UNEP 2005). More specifically, sustainability-related food labels could provide several benefits to food practitioners. First, they can provide larger business opportunities and more profit for food practitioners that adopt such labels to increase their business (UNEP 2005, Cohen & Vandenbergh 2012). This is because the increasing consumer interest in sustainability issues (Grunert 2013, Grunert et al. 2014) creates new market segments that food practitioners can serve with their sustainable food products. They could also sell their food products at higher prices than their conventional counterparts, due to the consumers' higher WTP for such products (Shiers & Keeping 1996, UNEP 2005, Potts & Haward 2007, Horne 2009, Miranda-Ackerman & Azzaro-Pantel 2017). For example, farmers that produce fair trade products could achieve higher market prices (Dragusanu et al. 2014).

Second, the adoption of sustainability-related food labels could encourage food operators to continuously innovate by improving and differentiating their food products from competitors (Testa & Iraldo 2010, Grolleau et al. 2016, Prieto-Sandoval et al. 2016), for example, by reducing the carbon content of production inputs so the ultimate product can have a lower carbon emission impact (Cohen & Vandenbergh 2012). This in turn also may indicate that food producers have a long-term vision, are flexible, anticipate market expectations, and create sustainability value for their products (Hart 1995). Third, sustainability-related food labels could increase consumer trust in food operators that adopt such labels, which in turn could improve their reputation, image, and brand impact (Shiers & Keeping 1996, Shi 2010, Sharp & Wheeler 2013, Testa & Iraldo 2010), ultimately increasing profitability and the survival of these companies (Collins 1994).

Fourth, similar to the abovementioned contributions, by adopting sustainability-related food labels, food practitioners could differentiate their brand by adding value to their food products related to sustainability (Horne 2009, Verghese et al. 2012). Fifth, the adoption of sustainability-related food labels could imply a strong corporate governance that is linked to the improvement of the relationships between food operators and other stakeholders as well as regulators (Shiers & Keeping 1996, UNEP 2005, Cohen & Vandenbergh 2012). Sixth, the adoption of sustainability-related food labels can help with risk mitigation and management, for example, crisis avoidance, defense of existing markets, risk reduction in business disruption, and avoidance of fines for environmental pollution (Shiers & Keeping 1996, UNEP 2005). Seventh, the adoption of sustainability-related food labels could potentially reduce cost related to such factors as waste minimization, efficiency improvements, and/or insurance costs (Shiers & Keeping 1996, UNEP 2005). Eighth, the adoption of sustainable labels on food products that are easy to certify can lead to small or no changes in production practices (Karlsen et al. 2012), which can be a strategic opportunity for food practitioners to adopt sustainability-related food labels at lower costs and challenges. Ninth, food producers can have greater access to credit if they put in place sustainability-related food labels (e.g., fair trade labeling) (Dragusanu et al. 2014). Finally, the adoption of sustainability-related food labels practices could increase the producers' knowledge of sustainability issues and thus motivate them to engage in environmentally friendly practices (Ruini et al. 2013, Dragusanu et al. 2014).

Although sustainability-related food labels could potentially provide different benefits to food practitioners as discussed above, a number of challenges may impede or limit their effectiveness when defining effectiveness as improving and achieving sustainable development. First, the adoption of sustainability-related food labels is not a cost-free option because the more stringent the production and management mandatory standards that are imposed, the more challenges and additional costs there will be for food operators (Lewis et al. 2010, Annunziata et al. 2019). This is

especially true for complex supply chains with limited current data available, which will increase the costs of data provision (Sengstschmid et al. 2011). In addition, the frequent innovation of recipes, products, ingredients, and raw materials, as well as formulations and variability in sourcing the ingredients, will result in frequent changes in the sustainable/environmental characteristics, which will make the implementation of sustainability-related food labels challenging (Sengstschmid et al. 2011). According to French et al. (1992) and Nimon & Beghin (1999), several different cost categories linked to the adoption of sustainability-related labels could be identified: (*a*) costs for applications and annual fees to the labeling organization; (*b*) costs of producing and administrating the data and information; (*c*) costs of designing and producing packaging, labels, and consumer information as well as provision of ongoing support and website costs, etc.; (*d*) production costs because of changes needed in the production methods (e.g., use of alternative pest control management practices or environmentally friendly pesticides for organic production); and (*e*) costs that food producers incur when converting from conventional to sustainability-related methods (e.g., it is not possible to use organic labels in their products during the first years of conversion from conventional to organic agriculture).

Second, and linked to the first challenge, the lack of uniform regulations and standards in different markets and regions/countries could create organizational and bureaucratic challenges to serve different markets because the sustainability-related food labels are regulated by different institutions and/or certification bodies, and this can have different restrictions/requirements focusing on various aspects of the product/production life cycle (Horne 2009, Miranda-Ackerman & Azzaro-Pantel 2017). For example, the European Union's organic label regulation shows a broader and more ambitious model than its US counterpart (Counc. Eur. Union 2007, Czarnezki 2011). Third, another challenge that food operators face is the increasing competition from different sustainability-related food labeled products, the large amount of sustainable information, and the lack of independent, readily accessible, and understandable information about environmental performance (Horne 2009). Fourth, the success of the sustainability-related food labels strongly depends on the target market. For example, in Switzerland, sustainability-related food labels are generally successful (Engels et al. 2010) mainly because of higher environmental awareness of Swiss citizens (Franzen 2003), while in other markets they may not be so successful. Fifth, several sustainability-related food labels also provide insufficient information and recommendations, are ambiguous, and lack assurance to consumers about the ecological impact of the purchase that can damage food practitioners (Van Amstel et al. 2008). Sixth, one key challenge of sustainability-related food labels is the lack of awareness and understanding of carbon labeling, which limits the social and cultural influences of the labels, as indicated by UK supermarket giant Tesco's data (Hornibrook et al. 2015). Seventh, a big challenge for food operators who adopt sustainability practices is that the boundary of responsibility often extends beyond the reach of a corporation's ownership and direct control where a larger level of environmental performance achieved by one company can be brought to naught by its suppliers' poor environmental management (Faruk et al. 2001). Eighth, there are large differences in terms of market share and price premiums for sustainability-related food labels, which could vary depending on the country and products. For example, 37% of US consumers indicated that they are willing to pay up to 10% for ecolabeled fresh vegetables, whereas 70% of Dutch consumers would pay up to 5% more (Bougherara et al. 2005). Ninth, in the long run, sustainability-related food labels may reduce the incentives for food producers to invest in new technologies (Galarraga 2002) because of the likelihood of technological lock-up effects on food practitioners due to the labeling schemes (Morris 1997). Tenth, since sustainability-related food labels may distort prices and other relevant information used by consumers when purchasing food products, they may also distort resource allocation and create inefficiencies (Galarraga 2002). Eleventh, according to Liu et al. (2016), some

researchers have found that for food practitioners, the cost of cheating to get a certified label is lower than the cost of reducing carbon emissions. Thus, fake labels can emerge, which could then also distort the market (Upham et al. 2011). Twelfth, according to Annunziata et al. (2019), the lack of consumers' knowledge of ecolabels, dearth of clear policy regulation, and large availability of ecolabeled food products in stores negatively affect the effectiveness of sustainability-related food labels and consequently companies' profits. Finally, although the government regulation of sustainability-related food labels is of crucial importance, the partnership between regulators and food practitioners is key, with the government setting up a private entity to administer the environmental information and ensure that sustainability goals that need to be placed on the label are achieved (Alves & Edwards 2008).

Finally, an important issue is whether or not to make sustainable-related food labeling mandatory (Roe et al. 2014, Messer et al. 2017, Waterfield et al. 2020). According to Roe et al. (2014), the importance and arguments in favor of mandatory labeling are linked to several reasons. First, there is an increasing number of consumers who have strong preferences for the labeled attributes. Second, there is an improvement of consumer's ability to understand, trust, and use label information given that clearer and more accurate information in labels is becoming available. Third, a priori perceptions of the attributes are increasingly flawed (e.g., new safety thresholds for ingredients are not recognized).

Results from a recent study that investigated consumers' WTP for GMO products and willingness to vote in favor of a ban or mandatory labeling suggest that the political decision to support labeling is driven by income and uncertainty about the safety of GMO food products (Waterfield et al. 2020). Sustainability could be also attained using mandatory labeling in two ways, by labeling food products that are sustainable using terms such as "made with" (e.g., organic production) or by requiring nonsustainable products (e.g., conventional or nonorganic production) to be labeled using terms such as "free from." The use of mandatory labeling could increase consumers' awareness of the labeled attributes, which may then lead to long-run changes in consumers' preferences and raise familiarity with the label (Roe et al. 2014). These effects in turn may lead to increased credibility for the label (Teisl & Roe 2005). However, mandatory sustainable-related food labels can be expensive because of the need to segregate the assembly, processing, and distribution in the entire supply chain (Messer et al. 2017). Other drawbacks of mandatory labeling are discussed by Roe et al. (2014).

CONCLUSIONS, IMPLICATIONS, AND FUTURE RESEARCH AVENUES

Sustainability issues in food production and consumption have been at the forefront of the most important discussions and policies related to food and agriculture. There is no denying that agricultural production systems are facing unprecedented challenges from increasing demand for food owing to increasing world population, natural resource constraints, and climate change. Due to sustainability concerns, there has been a proliferation of sustainability-related food labels in the market, with the aim of differentiating food products and helping consumers make more informed purchasing decisions. As discussed in this review, these sustainability-related food labels not only help food manufacturers streamline their processes but also help consumers understand how their food choices affect the environment.

Although sustainability is an issue of increasing interest to consumers, sustainability-related labels compete for consumers' attention with other types of food labels and other issues of interest to them such as taste, food safety, and health. While there have been numerous public and private initiatives focused on communicating food sustainability-related information to consumers, there is a need to examine how consumers are using these labels in relation to other food values

of importance to them (see Bazzani et al. 2018) and how consumers' level of understanding of sustainability-related labels can be enhanced.

Another challenge in the future is how to make these sustainability-related food labels more informative so that consumers can more easily and quickly compare the sustainability of the food products within and across product groups. This is a challenging endeavor because the current sustainability-related metrics are mostly focused on carbon emissions and do not include other important environmental concerns related to, among others, land and water usage, nitrogen emissions, packaging, transportation, postharvest losses, and food waste. Hence, future initiatives and research should examine the feasibility of developing a more multifaceted measurement that can integrate many or most of these important factors affecting the environmental impact of food production and consumption. The development of such a measure would likely require a great deal of research, time, and money, as well as partnerships between industry, government, and consumer groups. Although this is obviously a monumental challenge, the development of a multifaceted label that consumers can easily comprehend and use to compare the sustainability aspects of products within and across product categories could have significant impact on the market for sustainable food products: It could further draw the attention of food producers and consumers to the environmental impact of products, and it could also incentivize the food industry to improve the overall sustainability of their products.

If such a multifaceted label is possible to create, it would also be important for researchers to evaluate how consumers would value such a label as well as the types of educational messages that can increase consumers' comprehension and use of such a label. Given the complexity and the amount of information that can be represented in such a multifaceted label, it would be important to test the usability of different label formats with consumers to determine which format is most helpful in guiding consumers to make sustainability-minded food choices.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

ACKNOWLEDGMENTS

Special thanks to the journal's Co-Editor David Zilberman for suggestions made to the authors of this manuscript.

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