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Review of Agricultural, Food and Environmental Studies (2022) 103:143–160
https://doi.org/10.1007/s41130-021-00156-w

NEWS AND VIEWS

Sustainable food labelling: considerations for policy-makers

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Received: 26 March 2021 / Accepted: 29 September 2021 / Published online: 22 November 2021

Abstract

Improving the sustainability of the global food system is a policy priority. There are multiple types of sustainability labels in the food market, and policy-makers need to know what constitutes an effective label. We discuss the use of labels to inform consumers about the economic, social and environmental sustainability implications of their food purchasing choices. We categorise these sustainability labels and explain the opportunities they offer and the challenges they pose to be effective. Improved consumer information on the sustainability of food products can serve as an incentive for operators in the food supply chain to increase their sustainability. Specific choices made on the type of food label used are likely to affect their. A comprehensive mandatory labelling and certification scheme is a promising course of action from a policy perspective, if it covers the multiple dimensions of sustainability, and uses scoring and evidence-based criteria.

Keywords Sustainability · Labelling · Food products · Food supply chain · Transparency · Consumers

Introduction

The sustainability of the global food system is high on the political agenda. The General Assembly of the United Nations included the goal of ensuring sustainable food production systems in its 2030 Agenda for Sustainable Development (UN, 2015). The Organisation for Economic Co-operation and Development (OECD) described the objective of feeding a growing population, providing a livelihood for farmers and protecting the environment, as the "triple challenge" of food systems

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(Brooks et al., 2019). More recently, the European Commission published its "Farm to Fork" strategy for a more sustainable food system. One of its goals is to create a sustainable labelling framework that covers the nutritional, climate, environmental and social aspects of food products (EC, 2020). The European Economic and Social Committee also called for food labelling to improve transparency and to guide consumer choices towards healthier and more sustainable options (EESC, 2020).

In this context, a critical review summarising the current state of knowledge on sustainability labelling of food products can support decisions by policy-makers and stakeholders in the food supply chain. In particular, we focus on how sustainability labelling can guide consumer choice, while allowing operators in the food supply chain to add value to their products. We present an overview of theoretical and applied aspects of sustainability labels and discuss the elements that would need to be taken into account by policy-makers when designing a comprehensive and ambitious labelling framework.

We describe the implications of sustainability labelling, in particular of agri-food products, following a narrative approach. We review the literature based on an open selection of studies, given the wide field of research, where diverse methods are used in different contexts (Ferrari, 2015; Tallontire et al., 2012). We start by explaining how sustainability labels can be defined and how they can be differentiated and categorised. We then explain the purpose and limitations of sustainability labels, how they have evolved over time and how common they are. We also briefly address the business opportunities presented by sustainability labelling. We then describe the current state of the research on sustainability labels, focusing on the impact of labels on consumer choice and on suppliers, before discussing the sustainability concerns of consumers. We conclude by describing the elements needed for an effective labelling scheme, both in terms of label design and in terms of governance of the scheme.

Purpose and the evolution of sustainability labels

Sustainability labels are seals or ratings issued by a private or public body to inform consumers (Kijek, 2015). As such, they indicate that the labelled products fulfil the respective label's sustainability criteria. Sustainability labelling schemes can be categorised using a wide range of criteria, for instance, whether schemes indicate actual outcomes, use rigorous evaluations, are set by an external certifier, are independently audited, are publicly owned, are mandatory, cover multiple sustainability dimensions, focus on products or processes, are sectoral in scope, target businesses or consumers and are national or international (Prag, 2016).

Defining "sustainability" adds to the challenge of categorising such labels. A clear, fixed meaning of what is "sustainable" remains elusive, and there are dozens of alternative definitions offered by scholars and practitioners (Robert et al., 2005). While sustainability is generally described using a "three-pillar" concept with an environmental, economic and social dimension, there is no rigorous theoretical description of these pillars. This adds complexity to the development of sustainability policies in general (Purvis et al., 2019), which is compounded by the presence of trade-offs between the different dimensions (Asioli et al., 2020). Coming to a precise

and generally accepted definition of sustainability labels has proven to be difficult, but given the complexity of human diets, a holistic approach to categorising foods, which considers the health and welfare of people, animals and the planet, is needed to facilitate the transition towards more sustainable diets (Knorr & Augustin, 2020).

Given the focus of this review on agri-food products, we did not specifically include literature on fisheries or forestry products. We neither explicitly included studies on organic labelling. While some consumers may associate organic production with positive attributes related to sustainability, these have not been scientifically demonstrated ("halo effect") (Messer et al., 2017). From a nutritional, environmental and human health perspective, organic food is not demonstrably better than conventional food and, because organic farming is lower yielding, it may contribute to natural habitat loss and food price increases (Asioli et al., 2020; Meemken & Qaim, 2018; Suciu et al., 2019).

Sustainability labels aim to satisfy consumer demand for more sustainable goods by reducing information asymmetry (Asioli et al., 2020; Kehlbacher et al., 2012; Kijek, 2015; Rubik & Frankl, 2017). As most sustainability characteristics are not embodied in a product, without labels buyers cannot observe the sustainability dimension of a product, with the implication that consumers cannot effectively demand products that are more sustainable (Rubik & Frankl, 2017; Weinrich & Spiller, 2016). Similarly, producers of more sustainable products cannot market these in a credible way without adequate labels (Leach et al., 2016). Retailers are increasingly setting private sustainability standards that go beyond legal requirements to meet consumer demand for more sustainable products (Schulze et al., 2019; Shah & Thaning, 2019).

On the one hand, a proliferation of labels on the market ("standards inflation") can have negative consequences, such as confusion or apathy by consumers who feel overloaded by the information, or struggle to compare products across schemes (Barreiro-Hurle et al., 2010; Brécard, 2014; Drugova et al., 2020; Earley & Kneale Anderson, 2003; Giner & Brooks, 2019; Harbaugh et al., 2011; Leach et al., 2016; Nguyen et al., 2004; Rubik & Frankl, 2017; Storcksdieck et al., 2020; Strom, 2017; Yokessa & Marette, 2019). A degree of proliferation of labels in an unregulated market is likely to occur. Whenever a first label is introduced into the market, in an attempt to differentiate a product by pursuing a stringent or a lax approach to sustainability, this creates room for rivals to enter other labels that pursue alternative strategies of stringency (Fischer & Lyon, 2014). However, for businesses in the supply chain, the multiplication of labels can mean that investments made to achieve the certification required by one buyer may not be useful for the requirements of another, causing compliance costs to rise, and making switching buyers more costly (Prag, 2016). When too many producers supply certified products into the market, because meeting the standard is too easy, prices for these products can be depressed and a scheme's viability can be undermined (Potts et al., 2014).

On the other hand, more and differentiated labels can give greater choice to buyers to source products that address the issues they specifically care about (Barreiro-Hurlé et al., 2010; Eldesouky et al., 2020; Potts et al., 2014; Rondoni et al., 2020). Consumers may consider different labels to be complementary, rather than substitutes (Gracia et al., 2014). If buyers know and trust labels, these can serve

as marketing tools—and give direct market advantages to businesses, including to small and medium-sized enterprises. These advantages include accessing higher-value niche markets, securing long-term supply contracts or creating barriers to entry for rival firms (Prag, 2016; Rubik & Frankl, 2017; Weinrich & Spiller, 2016). To the extent that there are different standards with different stringency (or "gradual" labels that accommodate a range of scores), the lowest performing operators may have incentives to "graduate" from easier standards or scores to more profitable, but more demanding, ones (Potts et al., 2014; Strom, 2017).

The earliest sustainability labelling schemes were designed to distinguish products with better environmental characteristics, often sectoral "single-issue" certification (Prag, 2016). These labels were not primarily market-driven but emerged following pressure from environmental groups (Gulbrandsen, 2006). They were also generally binary "endorsement" labels, indicating only whether a product exceeded certain minimum requirements, but not showing the degree to which the product is sustainable (Weinrich & Spiller, 2016).

Over time, there has been a proliferation of sustainability label schemes. The Ecolabel Index lists over 450 public and private environment-focused labels in almost 200 countries and 25 sectors (Big Room, 2020). Quantitative outcome-based "footprint" schemes that indicate actual impacts have emerged, as well as multi-criteria labels that in some cases cover more dimensions than just the environmental one (Prag, 2016). Some food supply chain operators already produce information on their carbon footprint and work actively to reducing it, or at least to compensate for it, indicating that doing so can be a viable business strategy (Liebrich, 2020; PBN, 2019; Port, 2020). In addition, ever more data on the climate impact of food is made available to the public (CONCITO, 2021).

Still, given the lack of a clear definition of what a sustainability label is and given the diversity of labels, determining their relative importance or market share is difficult. One study found that twelve major voluntary sustainability standards for crops covered little more than 1% of global cropland, but that certification reached 10% or more for certain heavily traded commodities (coffee, cocoa, tea, palm oil) (Tayleur et al., 2017), while another study reports that 16 and 17% of coffee and ocean-captured fish production is certified (Auld, 2014).

Effectiveness of sustainability labelling schemes

In this discussion, we do not investigate whether labels have an actual impact on the sustainability dimension they purport to cover, which would require comprehensive life cycle assessments and modelling work for a large number of different labels. Rather, we focus on whether labels can have an impact on consumers and suppliers, which is a necessary step for labelling to work at all.

Several reviews and meta-analyses, covering various aspects of sustainability, find that consumers can change their shopping behaviour, consumption patterns and diets due to labelling, or expressed a willingness to do so, including by accepting to pay more for more sustainable products (Supplementary Table 1). Studies also

found "halo effects" in sustainability labelling, for example, when consumers claim that labelled products taste better (Asioli et al., 2020; Sörqvist et al., 2015).

Still, the literature suggests that the potential impact of food labelling on sustainability is limited. For instance, less than one-third of consumers really look at labels when shopping (Storcksdieck et al., 2020). Some consumers may actively avoid information on the sustainability of their actions, to not be confronted by the implications of less sustainable choices (Thunström et al., 2014). Consumers who purchase labelled products may believe they have done enough and engage in "moral licensing", for example, by increasing their overall consumption or behaving in other ways that negatively affect sustainability (Asioli et al., 2020; Engel & Szech, 2020; Yokessa & Marette, 2019).

Still, a significant number of consumers respond to sustainability labels. In some markets, demand for sustainable products is increasing strongly, and industry is adapting to meet this demand (Lusk, 2011; Schulze et al., 2019; Shah & Thaning, 2019; Storcksdieck et al., 2020) This has an influence on upstream suppliers. Manufacturers and retailers increasingly demand proof of their suppliers' sustainability (Tébar Less, 2005).

Producers participating in labelling schemes in some cases achieve higher prices and benefit in terms of learning, empowerment, reputation and consumer trust (Asioli et al., 2020; Carlson & Palmer, 2016; Eldesouky et al., 2020; Mook & Overdevest, 2018; Noblet & Teisl, 2015; Schleifer & Sun, 2020; Weinrich & Spiller, 2016). For these effects to materialise, the labelling schemes need to be well designed and monitored, to ensure that retail price premiums are returned to producers or farmworkers, if that is the advertised objective of the scheme (Dragusanu et al., 2014).

By providing better information, sustainability labels reduce transaction costs on markets (Rubik & Frankl, 2017). When complemented with additional measures, such as "green" public procurement, the potential positive effects of labels can further increase (Tébar Less, 2005). Sustainability labels can raise public awareness of the environmental and climate impacts of consumption, facilitate the emergence of more environmentally conscious market demand, help set standards for product development and manufacturing, contribute to more systematic decision-making by players in the food supply chain (e.g. through life-cycle assessments) and overall help transition to more healthy, sustainable and climate-friendly systems (CCAFS, 2020; Eldesouky et al., 2020; Leach et al., 2016; Tébar Less, 2005).

Consumer perception of sustainability

In a recent survey in the European Union, respondents demanded clearer food labelling and more sustainability, in particular regarding climate change, biodiversity, soil degradation, use of pesticides and fertilisers and fair pay (EC, 2017). An earlier study found that 87% of consumers in Belgium would welcome the introduction of an EU animal welfare label (van Loo et al., 2014). However, consumer concern in the context of specific food products may be lower (Grunert et al., 2014). Possible price increases of labelled products or consumers' financial constraints can also affect actual demand (Nitzko, 2019; Pedersen

& Neergaard, 2006; Peschel et al., 2016). The success of labelling also depends on consumers' knowledge and understanding of sustainability. Consumer awareness is a key prerequisite for the emergence and growth of sustainability labels (Grunert et al., 2014; Kijek, 2015; Pedersen & Neergaard, 2006; Peschel et al., 2016; Thøgersen & Nielsen, 2016).

As a product's sustainability impact is generally a credence attribute for consumers, who are disconnected from production (one cannot see, taste or feel product compliance with labour standards or levels of carbon emissions), without further relevant information consumers cannot identify which products are more sustainable than others (Fischer & Lyon, 2019; Guenther et al., 2015; Kijek, 2015; Rubik & Frankl, 2017; Yokessa & Marette, 2019). In the absence of such information, consumers may use other cues and claims as—often imperfect—proxies to guide their food shopping, such as country of origin labelling, organic logos or "free from" claims, which may lead to sub-optimal decisions (Guenther et al., 2015; Nguyen et al., 2004; Rana & Paul, 2020).

Box 1: The example of origin labels and their use by consumers as proxy for sustainability

In the case of origin labels, consumers' search for sustainability proxies may be one reason why, in surveys, consumers state that origin is an important characteristic of food products, even if they rank it behind quality and price (Colmar Brunton, 2015; Loureiro & Umberger, 2003; TNS Opinion & Social, 2012). Studies on actual consumer behaviour have generally found origin to play less of a role on actual decisions, though, especially when other cues or direct indications of quality are available (Kemp et al., 2010; Loureiro & Umberger, 2007; Taylor & Tonsor, 2013). Consequently, operators in the food supply chain often do not use origin labelling on their products when such labelling is voluntary (Krissoff et al., 2004). Moreover, while providing information on origin can be a legitimate objective of labelling, policies on mandatory origin labelling can run afoul of trade rules (Greene, 2016).

Still, origin labelling is sometimes linked to sustainability in public discourse (Onozaka & McFadden, 2011). This is generally done by suggesting that importing food is inherently more wasteful and polluting than consuming local produce (Kemp et al., 2010). However, this underlying assumption is often incorrect. For example, the "food miles" concept does not hold as there are no systematic benefits to the environment or human health from the consumption of local versus imported food (Enthoven & van den Broeck, 2021; Stein & Santini, 2021). As the energy performance of production systems varies across locations, these differences can more than compensate for the environmental footprint of transportation. To improve products' sustainability, their overall carbon footprint, rather than food miles, needs to be reduced (Mundler & Rumpus, 2012; Saunders & Barber, 2008). Similarly, promoting a transition to more plant-based diets can decrease the emission intensity of food more than consuming domestic or locally produced food (Hartmann & Siegrist, 2017; Ritchie & Roser, 2020; Sandström et al., 2018). There is little reason to believe that a product that performs well on one characteristic, such as localness, origin or tradition, is necessarily also superior in terms of carbon footprint, nutrition, or animal welfare (Bellassen et al., 2019; Stein & Santini, 2021).

Only a small minority of consumers buy domestic products for environmental reasons. Consumers tend to see the meaning of "local" more in terms of identity, supporting their local economy or community traditions (Bazzani & Canavari, 2017; Gomez y Paloma et al., 2013; Kemp et al., 2010). And the *perceived* benefits of local food products can further include biodiversity protection, greater animal welfare, improved governance and resilience (Schmitt et al., 2017). A label that explicitly covers these aspects and verifies such supposed benefits exist could be more meaningful as a guide for consumers' purchasing decisions.

Label certification and design

Given that sustainability characteristics are generally credence attributes, ensuring that a label is credible is paramount for its success (Karl & Orwat, 1999; Rubik & Frankl, 2017). In the case of voluntary labels, if consumers cannot be certain of a claim, the labelled products will not be able to fully gain market share—and demand will not shift towards more sustainable products.

Generally, the more information is available about a label and its underlying standards, the better for the label's credibility and for consumers' trust (Kaczorowska et al., 2019; Karl & Orwat, 1999). This means that awarding a label must be based on sound evidence and robust methodologies (e.g. life cycle assessments). Labelling schemes should be outcome-based and scientifically substantiated, and compliance with requirements should be verifiable and verified (Kehlbacher et al., 2012; Notarnicola et al., 2017). The awarding bodies must be able to demonstrate independence from the parties seeking certification. Labelling is not credible without third-party or governmental involvement for standard setting, certification and auditing (Brécard, 2014; Karl & Orwat, 1999; Kijek, 2015; Rondoni et al., 2020). Online platforms play an increasing role in information dissemination and cross-product comparisons and may also potentially play a role in the certification and trustworthiness of labels. It is possible that such platforms may accelerate the sustainability impacts of labels, but this is an area where more research would be useful.

Labelling can create new opportunities for stakeholder participation. Whereas commercial relationships rely mainly on agreements between buyer and seller, labelling schemes can integrate non-traditional perspectives in their standard setting (Potts et al., 2014). The involvement of different stakeholders in the process can increase compliance and the diffusion and acceptance of a label (Rubik & Frankl, 2017; Weinrich & Spiller, 2016).

The design of a label is important for its effectiveness, as different consumers have different abilities and needs (Teisl & Roe, 1998). Still, even if some of the information on more complex labels (e.g. detailed nutrition labels) can be confusing to some consumers, it is appreciated by others, and most consumers are able to retrieve some useful information that allow them to make comparisons between products (Cowburn & Stockley, 2005; Erskine & Collins, 1997).

Labels that simply prescribe static technical minimum standards do not stimulate innovation and fail to generate a dynamic incentive to improve performance (de Boer, 2003; Rubik & Frankl, 2017). Contrary to this simple "hurdle principle", scoring systems allow producers to compensate for weaknesses on some criteria with stronger performance on others and give operators the possibility to improve their score over time (Asioli et al., 2020; Rubik & Frankl, 2017; Tébar Less, 2005).

For voluntary sustainability labels, criteria are typically set so that only a small share of products in a category qualifies for the label. If labels become more prevalent, they threaten to undermine mark-ups and their premium market (Tébar Less, 2005). While greater adoption is desirable for sustainability, operators need

to be able to charge premium prices to offset the costs of participating in the labelling programme, under voluntary schemes (Carlson & Palmer, 2016; Earley & Kneale Anderson, 2003). In contrast, mandatory public labels can be verified via official, risk-based controls and can therefore be more cost-effective for operators. Mandatory labels may also help overcome "free-riding" by consumers who are concerned about sustainability, but who rely on others to pay the premium prices for labelled products (Lusk, 2011). Mandatory (multi-level) labelling can ensure that operators not only adopt labelling on products that already perform well, but work on improving other products too (Bablani et al., 2020), and allows operators whose products are not in the worst-performing level to differentiate and dissociate their products from the unsustainable ones (Thøgersen & Nielsen, 2016; Weinrich & Spiller, 2016).

In markets where labels are not adequately regulated, there can be too many standards and too little useful information about their performance, which can lead to a "race to the bottom" that results in undemanding standards as operators choose less costly but also less credible certification systems, especially if consumers do not understand the differences between labels or when label proliferation contributes to lack of comparability and to consumer uncertainty and confusion (Drugova et al., 2020; Harbaugh et al., 2011; Marette, 2010; Prag, 2016). Private schemes tend to be perceived as less credible by consumers than public ones (Kelly & Jewell, 2018; Sullivan, 2013; Weinrich & Spiller, 2016). Trust is important for consumers' valuation of a label (Asioli et al., 2020; Janssen et al., 2016; Khachatryan et al., 2020; Tonkin et al., 2015). Consumers may feel limited in their own ability to act as a correcting force and may expect the government to be involved (Noblet & Teisl, 2015). Thus, regulated labels or those sponsored by governments can be preferable (Gracia & De-Magistris, 2016; Horne, 2009; Janssen et al., 2016; Jones et al., 2019; Kelly & Jewell, 2018; Nguyen et al., 2004). A label that is established by the government can also overcome conflicting interests within the food industry that prevent the establishment of a private label with sufficient market penetration (Weinrich & Spiller, 2016).

If a single, simple multi-level front-of-pack label is used across a broad range of food products and retailers, a labelling strategy can be more effective in stimulating consumers to make informed food choices and in driving suppliers to improve their performance (Supplementary Table 2). Therefore, a limited number of labels and mandatory, or at least harmonised, standards are more effective (Edenbrandt et al., 2021; Hagmann & Siegrist, 2020; Jones et al., 2019; Kelly & Jewell, 2018; Liu et al., 2016; Marette et al., 2019; Rubik & Frankl, 2017). Lack of harmonisation forces operators to cater to different labelling requirements in different markets, even within the same trading region, which increases transaction costs and can create barriers to market entry and loss of bargaining power (Thow et al., 2019).

Summary and recommendations

From the above, we conclude that a better definition of what a sustainability label should comprise would be useful. A multiplication of labels should be avoided, competition between suppliers on the sustainability dimension should be encouraged,

consumers should be empowered to buy products that perform well on issues they care about, and operators should not face market access restrictions, and have dynamic incentives to improve their sustainability performance.

A mandatory front-of-pack label could address these various conditions, using a single logo that nevertheless shows consumers in an understandable way how products score on various dimensions of sustainability, also to take into account different preferences, needs, and willingness-to-pay (Barreiro-Hurlé et al., 2010; Cornish et al., 2020; Heerwagen et al., 2015; Kehlbacher et al., 2012). A multi-dimensional and incremental logo would not exclude operators, as low-scoring products can still be marketed—while encouraging operators to work on improving the sustainability of their products (Giner & Brooks, 2019). A differentiated, well-known and trusted logo that shows degrees of sustainability could be a good tool for producers who operate more sustainably to communicate with consumers, which should increase their competitiveness.

Policy-makers can thus use information as an instrument to use market forces to strengthen demand for more sustainable products (Jalil et al., 2020). If products' sustainability credentials are conveyed in a clear and reliable way, consumers can choose sustainable products in line with their preferences (Eldesouky et al., 2020; Gomez y Paloma et al., 2013; Karl & Orwat, 1999; Pedersen & Neergaard, 2006). Suppliers can then adapt their production or assortment and sell more sustainable products to gain market share or obtain better prices (de Boer, 2003; Eldesouky et al., 2020; Shah & Thaning, 2019). This means that with adequate labelling schemes, the income of sustainable producers can increase through the market, while the overall sustainability of the food system also increases.

Variations of labels that would meet the above multi-dimensional criteria have been suggested in the past, or have been implemented as voluntary labels at smaller scales (Table 1). This demonstrates that the implementation of such labels is feasible from an economic and monitoring point of view. To achieve greater sustainability and drive necessary technological change, though, the criteria that are underlying such a scheme should be dynamic and become increasingly more demanding. To allow operators to anticipate such changes to label criteria and to adjust their production in a timely manner, changes should happen in a transparent and predictable way. Trade-related issues can be avoided by using evidence-based criteria that avoid discrimination between national and foreign producers, and by enhancing cooperation between countries (Jones et al., 2019; Liu et al., 2016; Rubik & Frankl, 2017).

Any sustainability labelling scheme must gain credibility among stakeholders to have an impact in the market place, and must create consumer awareness of the scheme to increase demand for labelled products (Earley & Kneale Anderson, 2003; Erskine & Collins, 1997). Therefore, education and communication strategies will be needed to explain the scheme once it is introduced and to boost awareness about related sustainability issues (Giner & Brooks, 2019; Kelly & Jewell, 2018; Kijek, 2015; Leach et al., 2016; Liu et al., 2016; Peschel et al., 2016; Storcksdieck et al., 2020; Thøgersen & Nielsen, 2016).

More research may be needed to substantiate the costs of a mandatory labelling scheme, both in terms of required data collection and of monitoring and control, and how cost-effectiveness can be improved without compromising the overall

Table 1 Examples of multi-dimensional labels

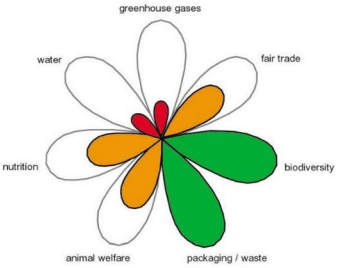
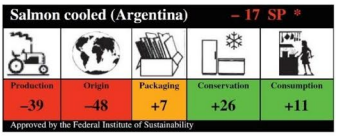
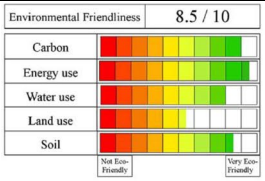
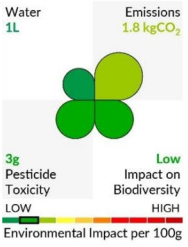
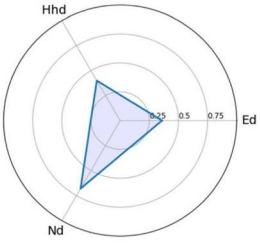
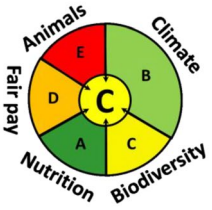
Label	Evaluation
 Sustain, 2007	a) The logo covers various sustainability dimensions, the criteria are self-explanatory, and the logo visually indicates on a three-step scale for each criterion in two different ways how sustainable the product is (intuitively via the size of the petals and via their colour). However, the product's overall sustainability performance is unclear, and the three-step scale is not very nuanced. The paper only provides an illustration of the label; the scores are not based on any underlying analysis of data that is relevant to the criteria.
 Engels et al., 2010	b) The product's overall sustainability performance is indicated and it visually depicts the stages of its life cycle for which the sustainability impact is measured on a numerical scale from -50 (poor) via 0 (neutral) to +50 (good), with the scoring also being reflected in a less differentiated traffic-light colour coding. However, reporting impact for stages of a product's life cycle rather than for the underlying criteria may make the information more useful for operators who want to identify where to improve a product's overall sustainability than for consumers who want to know how it performs on specific criteria such as health or fair trade; reporting numerical values is less intuitive than a visual presentation. The article provides an illustration of the label based on an underlying analysis of data for the various criteria for two exemplary products.
 Vlaeminck et al., 2014	c) The product's overall sustainability performance is indicated, the logo covers various sustainability dimensions, the criteria are self-explanatory, and the logo visually indicates on a ten-step scale for each criterion in two different ways how sustainable the product is (intuitively via the size of the bars and via their colour). However, the logo covers only one sustainability dimension (environment). The article provides an illustration of the label based on an underlying analysis of data for the various criteria for five exemplary products.
 Eaternity, 2014	d) The logo covers various sustainability dimensions, the criteria are self-explanatory, and the logo visually indicates on a three-step scale for each criterion how sustainable the product is (intuitively via the number of stars), with the underlying data also being reported (g CO_2, litres of water, certification status). However, the product's overall sustainability performance is unclear, and the three-step scale is not very nuanced nor very visual. This is not just an illustration but an actual label that is applied to products in the real world.
 Poore, 2018	e) The product's overall sustainability performance is indicated, the criteria are self-explanatory, and the logo visually indicates on a ten-step scale for each criterion in two different ways how sustainable the product is (intuitively via the size of the petals and via their colour), with the underlying data also being reported (kg CO_2, litres of water, pesticide use, biodiversity impact). However, the logo covers only one sustainability dimension (environment). The article provides an illustration of the label and links tentatively to tools for measuring products' impacts that could be used for its implementation.
 de Almeida Sampaio Guido et al., 2020	f) The criteria (if spelt out: Hhd = human health, Ed = environment, Nd = nutrition) are self-explanatory, and the chart visually indicates on a continuous scale from zero to one for each criterion how sustainable the product is. However, the chart is a bit technical and not very intuitive, and it does not indicate a product's overall sustainability performance. The article provides an illustration of the label based on an underlying analysis of data for the various criteria for two exemplary products.

Table 1 (continued)

 Colruyt, 2021; Southey, 2021	g) The logo covers various sustainability dimensions and it visually indicates on a five-step scale how sustainable the product is; it uses a scoring and colour scheme that consumers in several European countries are already familiar with from the "Nutri-score", but the underlying criteria that are considered for determining the rating (climate change, ozone layer, radiation, resource use, pollution, resource depletion) are not deducible from the logo itself, nor is the weighting. Thus, the contribution of the different criteria to the overall rating remains unclear and does not allow consumers to make more nuanced purchasing decisions based on their own preferences and trade-offs. While the calculation of the score is based on life cycle analyses, the incorporation of additional criteria to give certain products a head start potentially undermines its objectiveness. For instance, if transport or recycling and raw materials are already considered in the life cycle analysis, then giving plus points for origin (including pollution caused by transport) or the use of recycled packaging will only introduce double-counting. Or, if the assumption is that organic products are better for the environment, then they do not need a head start but their superiority should naturally flow from the life cycle analysis – and if not, then giving them bonus points is not warranted. Still, this is not just an illustration but an actual label that is applied to products in the real world.
 Foundation Earth, 2021; Iqbal, 2021	h) The logo covers various sustainability dimensions and it visually indicates on an eight-step scale how sustainable the product is (starting the ranking for an unexplained reason with A+, followed by A and then B etc.), but the underlying criteria that are considered for determining the rating (water usage, water pollution, biodiversity and carbon) are not deducible from the logo itself, nor the fact that they are weighted differently, and thus their contribution to the overall rating remains unclear and does not allow consumers to make more nuanced purchasing decisions based on their own preferences and trade-offs. This is not just an illustration but an actual label that will be applied to products in the real world as a pilot programme from autumn 2021.
 Authors	i) The product's overall sustainability performance is indicated (unlike logos a, d & f), as is the fact that the average score derives from various sustainability dimensions (unlike logos g & h) and that the dimensions have a different weight (unlike logos b, g & h), the criteria are self-explanatory (unlike logos g & h), and the logo visually indicates on a five-step scale for each criterion in two different ways how sustainable the product is (via letter scores and intuitively via the colour of each segment) (unlike logos d & f); the logo also uses a scoring and colour scheme that consumers in several European countries are already familiar with from the "Nutri-score" (SPF, 2020) (unlike logos d & f). However, the written descriptions of the covered criteria and the reporting of scores as letters is less intuitive than visual presentations (but these could be added, like logos b & d). This is only an illustration of a label; the scores are not based on any underlying analysis of data that is relevant to the criteria (but as other multi-dimensional labels are already implemented (logos d, g & h), this means necessary data can be compiled and the implementation of a label that combines their respective strengths could draw on the experiences of these initiatives).

effectiveness of labels. The growing experience with the first multi-dimensional labels listed in Table 1 can help better understand whether there is a risk of an "average effect", i.e. a risk that most products will be good in some of the dimensions and less strong in others and therefore all get a similar average total mark that fails to produce the necessary heterogeneity. This is less of an issue for those labels that also show how products perform in each dimension and thereby allow consumers to choose products that are more performant in the sustainability dimensions they care most about (like logos b, c, e and i in Table 1).

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s41130-021-00156-w.

Acknowledgements We would like to thank the reviewers for their comments that helped us to better structure the manuscript and to clarify its objective. Any remaining shortcomings are our responsibility alone.

Author contribution AJS: Conceptualization, investigation, writing, editing, supervision. MdL: Investigation, review, editing.

Data availability Not applicable.

Code availability Not applicable.

Declarations

Ethics approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

Disclaimer The information and views set out in this article are those of the authors and do not necessarily reflect the official position of the European Commission.

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