

Cutting Carbon from the Shopping Cart:
Consumer Perceptions of a Carbon Label on Food Products

Elizabeth J. Bedrick

University of Michigan

Abstract

There is a lack of transparency in the increasingly complex food system. Consumers tend to use environmental indicators, or eco-labels, to identify sustainable foods; however, many existing eco-labels do not clearly communicate the impact that food has on the environment. A carbon label conveying the amount of carbon emitted throughout a product's life cycle would be a better measure of the food's impact on climate change. While such a label does not yet exist in the United States, this research uses an online survey to determine how U.S. consumers would perceive a carbon label like those used throughout Europe. The findings from over 400 respondents suggest that consumers believe a carbon label would make it easier to compare the environmental impact of foods. Additionally, at least 45% of participants rated a carbon label as more important than five other eco-labels that do exist in the United States. Finally, participants reported that the source of the carbon label would not influence whether or not they would purchase labeled foods. Findings from this study support the potential for a carbon label to help consumers make knowledgeable decisions and influence purchasing.

Keywords: carbon footprint, eco-label, carbon emissions, environmental impact, purchasing behavior

Cutting Carbon from the Shopping Cart:

Consumer Perceptions of a Carbon Label on Food Products

One of the greatest challenges we face today is the threat of global warming and the impending burdens of a changing climate. The modern food system is one of the major contributors to climate change. Food journalist and New York Times bestselling author Michael Pollan once wrote, “the food system consumes more fossil fuel energy than we can count on in the future (about a fifth of the total American use of such energy) and emits more greenhouse gas than we can afford to emit...It will be difficult if not impossible to address the issue of climate change without reforming the food system” (Pollan, 2010). The environmental implications of our consumption habits encourages many individuals to reduce their carbon footprint—a measurement of the total amount of greenhouse gases produced during human activity in units of carbon. One of the many tactics individuals use to reduce their carbon footprint is changing their purchasing habits of food. Many foods, such as beef, have carbon footprints that exceed that of comparable foods, such as chicken, in both the nature of their production as well as in the amount of processing they undergo. It is often difficult to understand a product’s environmental impact, however, because the processes that many foods go through are too complex to follow. In an effort to navigate some of the complications and increase transparency in the food system, third-party entities have established several food certifications and labeling techniques, hereafter referred to as eco-labels, to indicate that a food is in some way environmentally friendly.

Conscious consumers, or individuals who buy products that align with their values and beliefs, tend to purchase eco-labeled foods with motivations of both health and environmental concern (Grankvist & Biel, 2001). In the United States, some of the most prevalent and widely used eco-labels are USDA Organic, Fair Trade Certified, and the Non-GMO Project (Ecolabel

Index, 2014). Though many of these labels provide consumers with the perception that a food product was produced in an environmentally friendly way, none offer insight into the carbon footprint of the food. In fact, our current system lacks an eco-label that clearly communicates to consumers how the product directly impacts climate change.

The present research aims to address this by determining how consumers would perceive a label indicating the food product's carbon footprint. Similar labeling schemes are emerging in various European countries, where assessments called life-cycle analyses track the amount of carbon emitted throughout the entire production process of any given product. Life cycle analyses account for all of the inputs and outputs of a product, typically beginning at raw material extraction and concluding at disposal (The Environmental Literacy Council, n.d.). Food packaging that indicates the amount of carbon emitted throughout the product's life cycle allows consumers to understand the degree to which products contribute to climate change and how much their individual carbon footprint would increase in purchasing and consuming those products.

Implementing a carbon label in the United States has the potential to inform consumers' purchasing decisions by clearly conveying food's impact on climate change. This research explores consumer perceptions of such a label to understand whether it would offer more information on food's impact on climate change as well as help to increase transparency in the food system.

Literature Review

This review will explore existing research on the effectiveness of eco-labels. Then, it will investigate emerging carbon labeling schemes in European countries to understand how such programs work. Next, it will examine the perceived importance of the label source, or the outside entity that certifies retailers to wield an eco-label on their products. Finally, it shall highlight the challenges of existing carbon labeling schemes thus far.

Consumer Perception of Eco-Labels

Many studies have found that eco-labels positively influence consumer behavior: in general, products with environmental claims help consumers understand the environmental implications of the products they are purchasing and are often preferred over products without eco-labels.

One study assessed the effects of eco-labeled seafood products on consumer purchasing habits through a series of interviews and surveys and found that consumers are significantly more likely to purchase seafood products that have eco-labels or environmental claims (Gutierrez & Thornton, 2014). Another study sought to determine whether the information conveyed in an eco-label changed consumer behavior in regards to purchases of canned tuna, however, unlike the 2014 study where survey and interview instruments were used, the authors of the 2002 study created a model to measure changes in consumer behavior with the presence of an eco-label. The model took a number of factors into account, including an assessment of individuals' environmental knowledge and behaviors, income, and the quality and price of the product. The 2002 findings were similar to that of the 2014 study: the eco-label on tuna positively affected consumer response and improved the market share of eco-labeled tuna (Teisl, Roe, & Hicks, 2002). Findings from both studies suggest that eco-labels help to inform consumers and increase

purchasing over non-labeled products. Though the present research does not pertain solely to seafood products, it is important to consider that eco-labeled products are well received by consumers in part because they desire transparency regarding the environmental impact of the goods they purchase.

A 2009 study administered a survey to understand the underlying motivations for conscious consumerism and found that among various demographic and descriptive categories, environmentalism was the most important in determining consumers' reported willingness to pay for an eco-labeled product (McCluskey, Durham, & Horn, 2009). The present study seeks to build upon this finding to determine whether reported environmental awareness is also predictive of the response to a proposed carbon label, or if other demographic indicators such as socioeconomic status are more predictive of whether consumers are likely to purchase such products.

The aforementioned studies demonstrate that existing eco-labels have a significant influence on consumer purchasing behavior. Given that these environmental indicators are positively perceived, the present research seeks to expand upon existing scholarship by evaluating the perceptions of a carbon label in particular.

Challenges with Existing Eco-Labels

There is clearly motivation behind purchasing foods with eco-labels; however, research has identified numerous issues with the clarity and value of information conveyed in many existing eco-labels. The meaning behind numerous eco-labels has been found to confuse consumers, while the proliferation of eco-labels in the marketplace today exacerbates this confusion. The present research aims to assess whether a carbon label would further confuse consumers or if it would instead help to provide some clarity that existing labels do not.

One study analyzed five Dutch eco-labels to understand the reliability of the information conveyed by examining their information on biodiversity and their trustworthiness amongst consumers. In so doing, the authors consulted annual reports by eco-labeling organizations and held interviews with representatives of different stakeholder groups involved in eco-labeling. Rather than finding any one label to be significantly more reliable than the others, all five failed to communicate adequate meaning and were ambiguous in terms of their environmental themes (van Amstel-van Saane, Driessen, & Glasbergen, 2008). The information displayed on the assessed eco-labels was inconclusive of the impact on the environment; and many eco-labels used seemingly vague terms such as 'sustainable,' which may have misled consumers into thinking the label was signatory of something it was not. In other words, this finding demonstrates that both the message and the meaning tend to be unclear in eco-labels.

A different study created a model to determine consumer uncertainties with label information in the United States and found that an overabundance of eco-labels and a lack of standards cause confusion amongst consumers when making purchasing decisions (Harbaugh, Maxwell, & Roussillon, 2011). The authors suggest that consumers would not be as confused if, rather than the sheer abundance of eco-labels that currently exist, there were a small number of nationally recognized eco-labels that each served individual purposes to reduce the superfluous amount of information in the marketplace.

These two studies together demonstrate that eco-labels tend to be both unclear in their message and overwhelming in number in the marketplace, both of which lead consumers to confusion and the inability to fully understand the implications of the products they buy. Though the former study was based in the Netherlands and the latter based in the United States, both studies likely apply to the United States, where the majority of eco-labels suffer the same

difficulties. To understand how consumers would perceive a carbon label, this research intends to discover whether consumers would find a carbon label similarly ambiguous or if it might convey more meaningful information than existing eco-labels regarding environmental impact.

Existing Carbon Labeling Schemes

A nation-wide carbon label in the United States does not exist; however, there is some scholarship on existing carbon labels in food systems outside of the United States. Carbon labels are offered by a variety of sources and exist in different formats: some labeling schemes are government initiatives, others are run by nonprofits, others are privately funded, and many are cross-collaborations (see Appendix 1). Labeling schemes can exist in a tiered rating system, such as the Climate Marketing scheme in Sweden, or as a measure of the product's carbon footprint, such as the carbon labeling pilot in France or the international Carbon Trust's Product Footprint Certification. Each of these entities works with retailers to provide the consumer with some indication of the amount of carbon the product emitted throughout its life cycle or the overall impact the retailer has on climate change.

An experiment by the Swedish Nutrition department led to a collaborative initiative involving the Federation of Swedish Farmers, a collection of dairy and meat co-operatives, and two eco-labeling companies, Swedish Seal and KRAV, to popularize a scale-based carbon label that aimed to help consumers choose climate-friendly food products over comparable products that are not climate-friendly (Tidaker & Richert, n.d.). The scope of the project includes setting and monitoring regulations for farm operations, crop production on the farm, greenhouse cultivation, transport, and packaging; with a focus on milk, beef, pig, egg and fish production (Klimatmarkning For Mat, 2010). Energy consumption, storage of food, and operations both on the farm and inside greenhouses are measured every five years, while nitrogen flows, use of

manure, fertilizer use, and crop rotation must be regulated during crop production. Other measurements include transportation from the processing phase to the packaging phase as well as the amount of packaging used. For all points of measurement, there are particular plans in place to reduce products' environmental impacts.

The guidelines for the Swedish label are quite comprehensive from the producer perspective, however there is a lack of measurement of consumer perception. Though a 2012 status report identified that 50% of Swedish consumers would be willing to pay more for a climate-friendly product, due to the fact that it is a fairly novel installment in the Swedish market, success monitoring must expand and continue into the future in order to get an accurate understanding of consumer perceptions (Klimatmarkning For Mat, 2012).

In France, a similar pilot program was started in 2010, when the government agency, Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME), called for proposals from retailers to conduct the necessary research on how to implement a carbon label (ADEME, n.d.). ADEME partnered with The Casino Group, a large French retailer, and worked with France's standards association to lay the groundwork and standards for the methodology to pilot the program. Unlike the Climate Marketing label in Sweden, the French labeling scheme disclosed the quantity of carbon dioxide emitted. While this labeling scheme has existed for nearly seven years, there is limited research on the progress of the program.

Carbon Trust began in the United Kingdom and now offers a variety of certification initiatives internationally. Like ADEME's carbon labeling scheme, the private company operates the Product Footprint Certification, which measures the sum of a product's carbon emissions throughout its life cycle and displays the quantity on the package. Footprints are measured from either cradle to grave—from the raw material extraction to consumer disposal—or from cradle to

gate—from one manufacturer to another for further processing—using guidelines laid out by Publicly Available Specification 2050 (British Standards Institution, 2011; International Trade Centre, 2011). Many retailers utilize this service to distinguish their products from others and offer consumers the ability to choose products that clearly convey the carbon footprint (“Carbon Trust Product Footprint Certification,” n.d.).

The Importance of Label Source

Studies have found that government supported labels are better equipped than privately owned labeling programs to communicate information and increase consumer understanding (Banerjee & Solomon, 2002; Sønderskov & Daugbjerg, 2010). This disparity is due in part to the fact that government-run programs are more widespread than private programs: they more easily gain credibility and long-term viability. Additionally, government-run programs have larger budgets than most private programs, allowing for a more extensive system to be used. Finally, government-run labels often have legislation backing them, which can mandate that certain labels are required on particular products (Banerjee & Solomon, 2002).

Boardman (2008) found several issues with Carbon Trust’s labeling scheme in particular. For one, the Product Footprint Certification label does not specify which gases are being accounted for in the quantification of “carbon” and may or may not include necessary greenhouse gases such as methane. Second, it does not identify where measurement begins and ends in the product’s life cycle; without such markers products would vary considerably in their carbon footprint. Third, its measurement metrics do not consider the source of energy used for processing, which could significantly alter emissions between products (Boardman, 2008). Thus, the Carbon Trust label arguably perpetuates the muddled information and confusion that eco-labels tend to cause.

The present research shall build upon research on label source to understand how consumers respond to carbon labels from a variety of different sources.

Challenges with Existing Carbon Labeling Schemes

Considering that most carbon-labeling schemes are only just emerging globally, minimal research has been done to measure their success. In the limited research that exists, scholars have found that carbon labels have similar drawbacks to other types of eco-labels: consumers are confused about the meaning behind carbon labels due to unclear information being conveyed. Given the findings of challenges with eco-labels, fewer renditions of carbon labels may increase clarity and legitimacy throughout a given food system.

When one study attempted to identify whether carbon labeled food products would help consumers in the United Kingdom make more environmentally friendly purchasing decisions, the results showed a strong demand for carbon labels and a correspondingly high percentage (89%) of confusion in interpreting the labels (Gadema & Oglethorpe, 2011). The authors deemed this to be due to poor communication as well as the overabundance of different carbon labels. Likewise, when a different study tried to identify consumer preferences amongst three types of carbon labels with differing designs and levels of detail, they found no preferences of one over another, concluding that labeling would be most effective if there were one integrated label (Leach et al., 2016). These two studies support the idea that having fewer, more integrated carbon labels on the market would be most successful.

While it is evident that the preliminary carbon labels on the market are limited in terms of their clarity and overall effectiveness, perhaps they will become more widely accepted over time. For instance, between 2005 and 2014, revenue from goods that were labeled 'organic' more than doubled, meaning that organic food consumption became increasingly widely accepted and

mainstream (USDA ERS, 2014). Perhaps the reason existing studies have found confusion surrounding carbon labels is simply because the labels are novel. Consumers may start to find them less confusing as they become more commonplace.

The literature review has examined both existing eco-labeling schemes as well as emerging carbon labeling schemes in Europe. The present research builds upon these international programs and reveals consumer perceptions of a carbon label in the United States by assessing environmentally conscious purchasing habits; discovering consumers' willingness to pay for carbon labeled products; and understanding whether consumers perceive a carbon label from a government source to be more credible than a private company or a nonprofit, such as an environmental group.

Methods

An online survey was administered in order to understand how consumers would perceive a carbon label. Participants were recruited through email list serves and social media, and were offered the incentive of being entered into a drawing for one of eight \$25 Visa gift cards. The first set of questions pertained to respondents' demographics, level of environmental awareness, the importance of various attributes in their food purchasing decisions, and whether or not they had seen and/or purchased a product with an environmental claim. The next questions were specific to the proposed carbon label, however no visualization was provided. Participants were asked whether a carbon label would make it easier to compare the environmental impact of products; the importance of visualizing a carbon footprint over other eco-labels; the likelihood that they would buy foods with lower carbon footprints over comparable products; and, the level of trust they had in potential label sources (see Appendix 2). Many questions were adapted from existing studies to enable the comparison of results and assess the reliability of findings (Gadema & Oglethorpe, 2011; Gutierrez & Thornton, 2014; Larceneux, Benoit-Moreau, & Renaudin, 2012).

Some questions pertained to three products in particular—bread, apples, and milk—to offer insight into whether consumers preferred to buy some foods with carbon labels and some without, as well as whether other factors surrounding these products were more or less important than a carbon label. These three foods were chosen over others in part because they are relatively inexpensive staple goods that are commonly found in the majority of American households. In fact, bread, apples, and milk are all included in the Consumer Price Index market basket of goods, a signal of their universality (Crawford, Church, & Akin, 2017). More specifically, bread and apples were chosen because in general, consumers do not perceive them to be produced with

misconduct or result in a significant environmental impact. On the other hand, milk was chosen because it is often value-laden: consumers often opt for organic or antibiotic-free milk over non-eco-labeled milk for its perceived health benefits (Petrescu & Petrescu-Mag, 2015). If participants are swayed by other eco-labels, perhaps they will be less likely to buy milk with a carbon label. Milk was included in the survey to offer insight into whether a carbon label would sway consumers who already prefer other eco-labels for milk. Results will also determine how a value-laden good such as milk is perceived relative to less controversial and value-laden goods such as bread and apples.

The survey was produced using Qualtrics and was available online for a three week period. The survey closed after at least 400 responses were recorded. Data were analyzed on IBM SPSS Statistical Software using a variety of statistical tests: one-way analysis of variance (ANOVA) was used to compare the means of continuous variables between categorical groups and chi-square tests were used to compare data in which both variables were categorical. Additionally, regressions were used to determine whether any combination of dependent variables predicted the independent variable.

Questions pertaining to the proposed carbon label were primarily analyzed using frequency tables to understand differences in perception between groups. Similar analyses were used to understand variance between levels of trust in a label sources. Further, the average importance of conscious consumption habits were analyzed in relation to reported environmental awareness and other demographic indicators. Finally, demographic indicators were tested to determine the representativeness of the sample.

Results

Survey data was imported into SPSS Statistics after over 400 responses were recorded.

Table 1 displays a summary of the descriptive statistics for demographics of those who responded to the survey. The dataset is not a representative sample, however data were treated as normal for analysis due to the size of the sample.

Table 1
Descriptive statistics of survey respondent demographics.

	Number of Respondents	Percent (%)
<i>Age</i>		
18-29 years old	241	56.4
30-49 years old	86	20.1
50-64 years old	83	19.4
65 years or older	16	3.7
Total	426	99.8
<i>Gender</i>		
Male	115	26.9
Female	306	71.7
Prefer not to Say	1	0.2
Gender Fluid	4	0.9
Total	426	99.8
<i>Ethnicity</i>		
American Indian or Alaska Native	4	0.9
Asian	33	7.7
Black or African American	5	1.2
Hispanic, Latino, or Spanish Origin	12	2.8
Middle Eastern or North African	5	1.2
Native Hawaiian or Pacific Islander	2	0.5
White	387	90.6
Other	7	1.6
Total	455	106.5
<i>Education</i>		
Some high school	1	0.2
High school graduate	11	2.6
Some college	156	36.5
Associate's degree	7	1.6
Bachelor's degree	133	31.1
Higher degree	118	27.6
Total	426	99.8
<i>Income level</i>		
Less than \$25,000	36	8.4
\$25,000 to \$49,999	45	10.5
\$50,000 to \$74,999	41	9.6
\$75,000 to \$99,999	49	11.5
\$100,000 to \$149,999	100	23.4
\$150,000 or more	150	35.1
Total	421	98.6

Proposed Carbon Label

The majority of participants thought that carbon labels would make it easier to compare the environmental impact of products (Figure 1, Appendix 3).

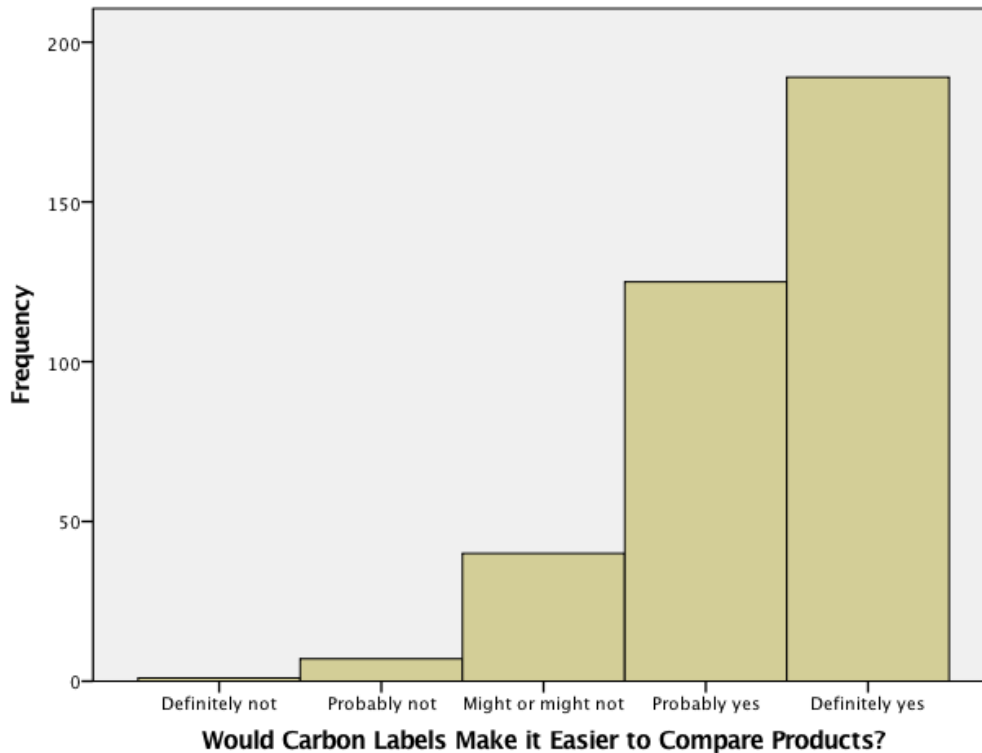


Figure 1. Do you feel that carbon labels would make it easier to compare environmental standards and products? Measure of frequency.

When asked how likely it was that participants would purchase carbon-labeled bread, apples, and milk over their non-labeled counterparts, 67% of participants said it was either “likely” or “extremely likely” that they would purchase carbon-labeled bread over non-labeled bread; 65.8% said the same for carbon-labeled apples; and 65.1% said the same for carbon-labeled milk.

When asked to rank carbon labels, nutrition facts labels, labels identifying points of origin, certified organic labels, certified non-GMO labels, fair-trade certified labels, and humane

treatment labels, the highest frequency of respondents said that nutrition facts labels were the most important (39.1% of respondents ranked this as 1 out of 7) (see Table 2).

Table 2

Frequency table of labels ranked as most important (1 out of 7).

	N Valid	N Missing	Frequency Most Important	Percent	Valid Percent	Cumulative Percent
Nutrition Facts	325	102	167	39.1	51.4	51.4
Carbon Label	321	106	28	6.6	8.7	8.7
Points of origin/sourcing	311	116	19	4.4	6.1	6.1
Organic	320	107	18	4.2	5.6	5.6
Non-GMO	322	105	48	11.2	14.9	14.9
Fair Trade	327	100	21	4.9	6.4	6.4
Humane Treatment	344	83	32	7.5	9.3	9.3
Total	/	/	333	77.9	102.4	102.4

The ways participants ranked the remaining labels were more widespread. Upon comparison amongst rankings, 21.2% of respondents ranked nutrition facts as most important and carbon labels either second or third most important. The carbon label was ranked higher than the label identifying points of origin by 48.6% of participants; higher than the certified organic label by 44.9% of participants; higher than the non-GMO label by 49.5% of participants; higher than the fair-trade label by 52.3% of participants; and higher than humane treatment labels by 48.6% of participants. Barring a significant difference between nutrition facts label rankings and carbon label rankings ($p < 0.01$), there were no significant differences between how carbon labels were ranked and how other labels were ranked.

Source of the Carbon Label

The majority of participants (87.8%) said they had purchased food products with an eco-label. Of these individuals, the source of those eco-labels came from a variety of organizations, indicated by Table 3 below. Over half of participants were unsure of the source of the eco-label.

Table 3

Eco-label purchases by organization. Percentages are of the 87.8% of participants who had purchased eco-labeled products.

Source	Percent (%)
Government	35.1
Industry	33.7
Retailer	30.2
Environmental Group	25.8
Unsure	50.9
None of the Above	34.9

When asked whether the source of the label would influence whether or not they would purchase carbon-labeled bread, apples, or milk, 42.6% of all participants said it was either “likely” or “extremely likely” (mean=3.38 out of 5.00) that the source would influence their purchase of bread; 44% said it was either “likely” or “extremely likely” (mean=3.44 out of 5.00) that the source would influence their purchase of apples, and 44.5% said it was either “likely” or “extremely likely” (mean = 3.48 out of 5.00) that the source would influence their purchase of milk.

When asked which organization or institution they would trust most to ensure the food they eat is sustainable, 40.7% of participants claimed they would trust environmental groups most, while 21.3% said they would trust the government most. The other 38% were spread across other sources (see Appendix 4). Analysis comparing those who had purchased products with eco-labels and those who had not showed no significant difference between the organizations they would trust most to label foods.

Environmental Awareness and Purchasing Behaviors

A variety of statistical tests were run to determine whether there were relationships between various demographics, reported environmental awareness, and reported purchasing

behaviors. Income, age, education, and gender identity were individually and collectively weak predictors (predicted 3.7%) of environmental awareness. Meanwhile, there was a significant difference ($p < 0.01$) between age groups regarding how environmentally aware participants claimed to be, on a scale from 1-10. On average, 18-29 year olds claimed to be more environmentally aware than participants in older age groups. There were only 39 participants who reported a level of environmental awareness between 1 and 5. For the purposes of simplifying and creating larger groups in data analysis, the scale of environmental awareness was recoded to 1-6, with the original levels of 1 through 5 transforming to 1, the original 6 transforming to 2, and so on. Further, there was a significant difference ($p = 0.004$) between education level and reported level of environmental awareness. Respondents with no education beyond high school self-reported the lowest level of environmental awareness; those who completed some college self-reported the highest environmental awareness; and thereafter, as education level increased, self-reported environmental awareness declined.

When asked about the importance of a product's environmental impact when shopping, a stepwise regression analysis with participants' level of environmental awareness and other demographics revealed that participants' reported level of environmental awareness was the biggest predictor (29.6%) of how important environmental impact is to participants when buying a product. Furthermore, participants' level of environmental awareness was the strongest predictor (15.6%) of the importance of location/origin of a product when shopping (see Table 4).

Table 4
Stepwise regressions of importance of various purchasing behaviors

Dependent Variable	R Square	Adjusted R Square	Standardized Coefficients (Beta) [^]
<i>Importance of environmental impact when purchasing</i>	0.298	0.296	Environmentally Aware
			0.546*
	0.314	0.310	Environmentally Aware + Gender
			0.127*
<i>Importance of location/origin when purchasing</i>	0.156	0.154	Environmentally Aware
			0.395*
	0.179	0.175	Environmentally Aware + Gender
			0.152*
	0.193	0.186	Environmentally Aware + Gender + Education
			0.117*

[^] Regressions were run with environmental awareness, gender, education, age, and income. Any variables excluded from this table were not statistically significant.

* Values are statistically significant ($p < 0.05$).

Participants were asked the degree to which their food purchasing habits have an impact on the environment; how important it is to source foods from sustainable sources; how important it is to shop at retailers that care how their products are produced; and how important it is for retailers to disclose their carbon footprints. Table 5 shows how respondents rated the importance of each shopping habit based on their level of environmental awareness. All differences between levels of environmental awareness and importance of purchasing behaviors were significant ($p < 0.01$).

Table 5

Shopping habits by level of environmental awareness. Means are on a scale from 1-5, 1 being least important, 5 being most important.

	Level of Environmental Awareness	Number of Respondents	Mean
Importance of environmental impact when making purchasing decisions	1-5	39	2.56
	6	54	3.07
	7	79	3.25
	8	99	3.63
	9	55	3.96
	10	34	4.41
	Total	360	3.47
Degree to which food has an impact on the environment	1-5	39	3.64
	6	54	4.20
	7	80	4.38
	8	99	4.52
	9	55	4.80
	10	34	4.74
	Total	361	4.41
Importance of sourcing food from sustainable sources	1-5	39	2.59
	6	52	3.21
	7	80	3.30
	8	99	3.60
	9	55	4.09
	10	34	4.47
	Total	359	3.52
Importance of shopping at retailers that care about how their products are produced	1-5	39	3.15
	6	52	3.31
	7	80	3.33
	8	98	3.64
	9	54	3.94
	10	34	4.47
	Total	357	3.59
Importance of retailers disclosing their carbon footprints	1-5	33	3.64
	6	51	3.94
	7	74	4.05
	8	93	4.32
	9	48	4.63
	10	31	4.61
	Total	330	4.21

Interestingly, there was not a significant difference ($p=0.11$) between participants' levels of income and the importance of shopping at retailers that care how their products are produced: on average, participants believed this to be "very important" (averaging between 3.48 and 3.81 out of 5.00).

Analysis of Demographic Indicators

There was a significant difference ($p<0.01$) between age groups and the importance of price in buying a product. On average, 18-29 year olds perceived price to be more important than the other two age groups. Likewise, there was a significant difference ($p<0.01$) between reported levels of income and the importance of price in buying a product. Those making less than \$49,999 a year on average perceived price to be between "very important" and "extremely important" (mean=4.39 out of 5.00), while those with higher income levels on average perceived price to be between "neutral" and "very important" (mean=3.93; 3.86; 3.52 respective to each income level). Based on a stepwise regression including age and income, income was the highest predictor (13.4%) of the importance of price in buying a product.

To test whether participants at different income levels perceived price to be more important for specific products than others, an analysis of variances was run between income and the average maximum price participants would pay for apples, bread, and milk. There were no significant differences between income levels and the average maximum price participants were willing to pay for any of these products ($p=0.873, 0.249, 0.579$ respectively). Participants were willing to pay, on average, between \$4.67 and \$4.88 for one loaf of bread, between \$6.23 and \$7.18 on average for a three-pound bag of apples, and between \$3.89 and \$4.25 on average for a half-gallon of milk.

According to Table 6, income level and age were not highly correlated, nor were education level and income level. Age and education level were strongly correlated, however.

Table 6
Crosstabs of age versus income; age versus education; and education versus income. Reported as counts.

		Age (years)					Education level			
		18-29	30-49	50-64	65 +	Total	Less than Associate's/ Bachelor's	Completed Associate's/ Bachelor's	Completed Higher Degree	Total
Income level	< \$49,999	68	9	3	1	81	23	51	7	81
	\$50,000 to \$99,999	45	19	21	5	90	34	23	33	90
	\$100,000 to \$149,999	54	28	13	5	100	46	31	23	100
	\$150,000 +	71	30	44	5	150	62	35	53	150
	Total	238	86	81	16	421	165	140	116	421
Education level	Less than Associate's/ Bachelor's	154	1	11	2	168				
	Completed Associate's/ Bachelor's	76	27	31	6	140				
	Completed Higher Degree	11	58	41	8	118				
	Total	241	86	83	16	426				

In fact, 28.6% of 18-29 year olds belonged to a household making less than \$49,999, while 29.8% belonged to a household making more than \$150,000. Of the 18-29 year olds, 63.9% had not begun or not yet completed a bachelor’s degree; 31.5% had completed an associate’s or bachelor’s degree; and 4.6% had completed a higher degree. By comparison, 92.4% of respondents over the age of 29 had completed a bachelor’s degree or higher. Of those who had not begun or not yet completed a bachelor’s degree, 13.9% belonged to a household making under \$49,999 annually, while 37.6% belonged to a household making over \$150,000.

Barring 18-29 year old participants, the data on age groups is relatively similar to the United States population: 9.6% of the total population is between the ages 18 and 24; 30.2% of the total population is between the ages 25 and 44; 22% of the population is between the ages 45 and 64; and 12.4% of the population is aged 65 or older (Howden & Meyer, 2011).

Discussion

Proposed Carbon Label

The majority of participants thought that carbon labels would make it easier to compare the environmental impact of products, which aligns with existing scholarship on consumer perceptions of carbon labels. To test whether there would be different results depending on the products being compared, consumers were asked how likely it is that they would purchase carbon-labeled bread, apples, and milk over their non-labeled counterparts. The majority of participants responded positively to this idea, without significant variation between average responses to each type of food. This could mean that a carbon label on each of these products would achieve reductions in carbon emissions through consumer influence.

One study used an estimation model to test the effect of carbon labels on 42 different products in an effort to determine whether different products would influence purchasing behavior to different degrees. Findings suggest that a carbon label on beef would achieve the largest decrease in carbon emissions across all products tested (Shewmake, Okrent, Thabrew, & Vandenberg, 2015). In this case, consumers were most influenced by a carbon label on beef because it had a jarringly high carbon footprint compared to many of the other products that were tested. The survey in the present research did not provide explicit carbon footprint information for apples, bread, or milk, preventing a distinction from being made between the degrees of influence on purchasing behavior.

The lack of differentiation in the likelihood that participants would purchase each of these carbon-labeled foods over their non-labeled counterparts is somewhat surprising, however. While bread and apples are not environmentally controversial, milk often has alternative eco-labels that typically sway certain types of consumers. In fact, one study found that the probability

of buying organic milk increases with education and income level, primarily due to perceived environmental and health benefits (Schröck, 2010). Given the demographic makeup of the sample in the present study, this tendency was thought to diminish the willingness to purchase carbon-labeled milk, since higher income and highly educated individuals are likely to opt for organic milk instead. Since there was no difference in the likelihood that participants would purchase carbon-labeled apples and bread over carbon-labeled milk, a much more value-laden product, the survey's attempt to distinguish between value-laden and non-value laden goods might have been unsuccessful. Participants may have perceived milk to have a carbon label in addition to another eco-label, rather than instead of a different eco-label. This confusion is impossible to determine given the nature of the questions asked, so a conclusion cannot be made regarding how a carbon label would sway consumers with value-laden goods.

Carbon Label Ranking

The majority of participants ranked nutrition facts labels as most important over the six other options: carbon labels, labels identifying points of origin, certified organic labels, certified non-GMO labels, fair-trade certified labels, and humane treatment labels. This is likely due to the notion that consumers tend to believe that they can improve their health more than they believe that they can improve the environment with the labels on the foods they purchase. In other words, it is possible that consumers are more confident about using nutrition facts labels to positively impact their health than they are about purchasing eco-labeled goods to positively impact the environment.

The finding that at least 45% of participants ranked the carbon label over all other eco-labels (with the exception of the nutrition facts label) could mean that a sizeable proportion of consumers perceive the carbon label to be more informative and important than other common

eco-labels, which further supports the need for a new type of label in the United States market. This finding opposes the result of the 2011 study from which the question was adapted: in that case, participants rated carbon labels as the second lowest among fourteen attributes (Gadema & Oglethorpe, 2011). The difference between the 2011 study and the present study is most likely due to the nature of the question: in the 2011 study, participants were asked to *rate* each of the fourteen attributes from 1-4; in the present study, participants were asked to *rank* each of the seven attributes from 1-7. The key distinction is that each attribute in the present study was mutually exclusive from the others: no two attributes could be ranked first. Perhaps the ranking constraint encouraged participants to think critically about the relative importance of each attribute.

Based on feedback from survey participants during the period in which the survey was being distributed, however, this question caused some confusion, which may have skewed the results. Some participants misunderstood that the options were mutually exclusive and only one eco-label could be ranked as first, in which case participants could have answered the question in a way that they did not originally intend.

While the carbon label was ranked higher than other eco-labels by at least 45% of participants, the remaining rankings were more widespread. This could indicate that people truly differ in how they value different eco-labels. Alternatively, perhaps certain eco-labels are important to consumers for particular foods but not others, such as humane treatment labels for eggs. The question did not ask for participants' preferred ranking of eco-labels in reference to a particular product and might have influenced how participants answered the question. A third reason that explains the widespread rankings is that consumers are overwhelmed with eco-labels in the marketplace and do not know how to navigate the meaning behind each of them, thus

preventing any consistent preferences from forming. If this were the case, it would support existing scholarship that suggests an overwhelming number of eco-labels in the marketplace diminishes the clarity of meaning and leads to confusion amongst consumers (Harbaugh et al., 2011). This explanation could also support the underlying purposes of this study: since eco-labels do not offer concise information about a product's environmental impacts, there is a need for a label that does. It could be argued that a carbon label has the potential to add to the confusion amongst consumers; however, the fact that 45% of participants preferred a carbon label over the other eco-labels suggests that it might help resolve existing confusion.

Given that these findings only reflect participants' perceived purchasing behaviors, preferences will likely change depending on the food in question and the associated costs. In fact, multiple studies have found that customers are only likely to purchase carbon labeled goods over other eco-labeled goods if the product is either below the price they are willing to pay or if the product is cheaper than other eco-labeled products (Akaichi, de Grauw, Darmon, & Revoredo-Giha, 2016; Vanclay et al., 2011). In other words, when there is a price premium on a carbon labeled product, studies have shown that consumers are more likely to opt for a similar product that is either labeled with a different environmental claim or is not labeled at all.

Source of the Carbon Label

The source of the label was analyzed to determine whether it sways consumers' trust in the environmental information conveyed; and, if that were true, whether certain organizations are trusted over others. When asked what labels consumers had seen and or purchased, more than half of participants were unsure of the source, while around 30% of participants had seen government, industry, and retailer labels. The fact that the majority of participants were unsure

of where the label was sourced could be indicative of the unimportance of the source of the eco-label.

Interestingly, despite the general lack of awareness of the sources of the labels participants had seen, there was some agreement about what source consumers would trust most to operate a carbon labeling scheme. Twice the number of participants said they would trust environmental groups than the number that said they would trust the government. This outcome was not expected, as existing research suggests that government supported labels are more trusted for communicating information (Banerjee & Solomon, 2002; Sønderkov & Daugbjerg, 2010). Perhaps consumers tend to believe that environmental groups hold more authority and expertise when it comes to transparency in the food system, and tend to rely on these entities to provide accurate and truthful information about the environmental impact of their foods. Alternatively, the results could be reflective of the increasingly divisive political climate in recent years: perhaps people are less likely to trust the government to convey truthful information. In fact, in 2015, only 19% of Americans trusted the government to do what was right some or all of the time (Pew Research Center, 2015). Perhaps there is skepticism surrounding the lobbying influence on government institutions to do what is right regarding environmental issues.

While participants trusted environmental groups most, preferences among the other options were fairly widespread. The widespread answers could indicate either a lack of trust in all entities or a general trust for all entities: it is unclear which is more likely. The survey instrument from which these questions were derived was difficult to interpret, which could have influenced the results. Both questions pertaining to the source of the labels (seen and/or purchased; trusted most) were adapted from Gutierrez & Thornton (2014), which used interviews

and surveys to determine whether consumers understand sustainability in their seafood purchases through eco-labels. In terms of which entities consumers trusted most in the 2014 study, results were also somewhat widespread, with environmental groups being the most trusted. This aligns with the results of the present study. It is relatively unclear in both the 2014 study and the present study why participants trusted environmental groups over other groups, yet had widespread answers for the other entities.

In order to determine whether the level of trust in the source of the eco-label differed between products, participants in the present study were asked if the source of the label would influence whether or not they would purchase carbon-labeled bread, apples, or milk over their non-labeled counterparts. The fact that less than half of participants felt that the source of the label would influence their purchase of all three of these products could be indicative of participants' general willingness to trust or distrust what is being advertised, regardless of the entity that is putting forth the information. Alternatively, perhaps this finding is indicative of participants' general lack of knowledge about the process of creating eco-labels and thus they are willing to trust all sources. In fact, when one study looked at the factors that determine the overall market impact of eco-labels, the authors determined that if consumers do not have adequate knowledge about the source of the eco-label, they tend to opt for products based on subjective interpretations of the eco-labels (Pedersen & Neergaard, 2005). For instance, the study gave the example that an eco-label with a tree on it would lead a consumer to believe the product is environmentally sound without knowing anything about the certification. Perhaps the finding that all sources of a carbon label are similarly accepted reveals an underlying lack of knowledge about sources of the eco-labels.

Environmental Awareness and Purchasing Behaviors

There were significant differences between reported levels of environmental awareness and the importance of various environmental purchasing behaviors: as environmental awareness increased, the importance of various shopping habits followed suit. In other words, those who claimed to be more environmentally aware were more inclined to believe that food has an impact on the environment; that it is relatively important to consider a food's environmental impact when making purchasing decisions; and that it is important to shop at retailers who offer foods that consider the environment. Considering that reported environmental awareness is not congruent to actual environmental knowledge, perhaps these findings are due to individuals' inclinations to appear environmentally aware. Indeed, it is possible that the purchase of environmentally friendly goods is not a marker of environmental knowledge but rather an indication of how much participants care about seeming environmentally knowledgeable.

In what is referred to as the Dunning-Kruger effect, individuals with less knowledge and education tend to be more confident in what they know, while individuals with more knowledge tend to be less confident in what they know (Kruger & Dunning, 1999). This corresponds with the finding from the present study: participants with minimal education are highly confident in their level of environmental awareness and those with higher education are less confident in their level of environmental awareness. This offers support for the inference that reported environmental awareness may not be the same as actual environmental knowledge and is to be considered when assessing the effects of environmental awareness on purchasing behavior.

In the present study, environmental awareness was fairly predictive of a variety of purchasing behaviors, while various demographics such as education, age, and income, were not. This finding aligns with that of a 2009 study in which environmentalism was the most important

factor in consumers' willingness to pay for environmentally friendly goods among other demographic variables (McCluskey et al., 2009). In the present study, those who reported themselves as environmentally aware tended to shop in ways that supported their environmental attitudes, while socioeconomic factors and other demographic indicators did not influence these shopping habits. Interestingly, another study revealed that education level and gender both independently have a significant positive effect on the purchase of environmentally friendly products, while income does not (Chekima, Chekima, Syed Khalid Wafa, Igau, & Sondoh, 2015). Though this finding differs somewhat from both the aforementioned 2009 research and the present study, both of the cited works support the present study's finding that income is not strongly predictive of environmental purchasing habits. In further support of this, the present study determined that there was no significant difference between income levels in regards to the relative importance of shopping in environmentally friendly ways. It is important to note, however, that all studies used survey instruments to obtain these results; and, expression of intent to purchase is not necessarily synonymous to actual purchasing habits.

These findings could indicate that environmentally aware consumers who are of lower socioeconomic status may make purchasing decisions that support their environmental views, despite any price differences. In other words, perhaps all consumers, even those with less ability to choose expensive foods are willing to pay price premiums for environmental goods. This supports the prospect of a carbon label on the market: even if carbon-labeled goods are more expensive than non-carbon labeled goods, environmentally aware individuals of all levels of income will likely purchase carbon-labeled foods.

It is interesting to compare these data to the finding that those with lower incomes perceive price in general to be highly important. To be clear, income and the importance of price

were inversely correlated, yet, as was discussed, income was not predictive of whether or not consumers would purchase environmentally friendly goods. Perhaps this means that while price is important to those of lower income levels overall, environmental awareness overrides this relationship when it comes to conscious purchasing habits. It is again necessary to consider the relative homogeneity of this sample, however. If the sample were more demographically diverse, these findings may be different.

Nonetheless, it is interesting to note that socioeconomic status is often perceived to be a limiting factor in making purchases that support the environment. In fact, Michael Pollan once alluded to this when he said, “consuming food that contributes both to the eater’s health as well as to the health of the environment...costs more than it does to eat poorly” (Pollan, 2006). It is true that low-income shoppers often lack access to fresh produce—due either to proximity to a grocery store or prices—and thus tend to purchase cheaper, more highly-processed snacks (Treuhaft & Karpyn, 2010). This does not necessarily mean that their purchases are worse for the environment as Pollan alluded to, however, because less expensive goods tend to be less energy intensive. In fact, one French study looked at the estimated greenhouse gas emissions associated with diet quality and found that diets consisting of more fresh fruits and vegetables were positively correlated with greenhouse gas emissions, while diets consisting of more sweet and salty snacks were negatively correlated with greenhouse gas emissions (Vieux, Soler, Touazi, & Darmon, 2013). This was largely due to the fact that fresh produce is more energy intensive than grains, which are the core ingredient of typical snack foods. These findings indicate that many low-income shoppers who purchase more snack foods have a lower environmental impact in their food purchases than high-income shoppers who more frequently buy fresh produce.

While findings from the present study suggest that there was no relationship between socioeconomic status and desired environmental impact when shopping, the 2013 study suggests that even if there were a relationship, those of lower socioeconomic status would likely have a lower carbon footprint due to the comparative amount of fresh produce they buy. This offers insight into the environmental impact of lower-income consumers and could inform future research seeking to identify the effect of socioeconomic status on personal environmental impact. The 2013 findings could also raise questions about how a carbon label might affect consumer health, should individuals shift their purchases away from fresh produce and more towards highly processed foods.

Demographic Indicators

The sample is not representative of the United States population and results cannot be generalized to make claims about the population as a whole. Most respondents were between 18 and 29 years old, white, and had a household income of \$100,000 or more. It is likely that a large percentage of participants currently attend school at the University of Michigan and still rely on their parents' income. In fact, this is supported by the lack of correlation between age and income coupled with the lack of correlation between income and education level. As participants aged, education level tended to be higher; yet, older participants did not necessarily have higher incomes, nor did those with higher levels of education. Perhaps this is due to the fact that many younger participants reported their parents' income level, rather than what would likely be a much lower, if not non-existent, personal income.

Many findings from comparisons between demographics were unsurprising. For instance, participants with lower income levels perceived price to be more important on average than those with higher income levels, which is to be expected. Likewise, those in younger age groups

perceived price to be more important than those of older age groups, likely because younger participants are less financially secure. These findings may play a role when consumers are faced with a choice between carbon labeled products and non-carbon labeled products. Should there be a price difference between such products, those with lower income and those who are younger than age 30 may be more likely to opt for the cheaper option.

Interestingly, the average maximum price participants were willing to pay for bread, apples, and milk did not significantly differ across income levels. The lack of difference could indicate that income does not predict consumers' willingness to pay a premium for these products. This research does not reveal whether this is true amongst all products, or if this is only the case with common, relatively inexpensive household items.

Conclusion

Individuals tend to develop personal strategies to navigate the complex food system: whether they value price, taste, origin, or environmental impact, consumers make purchases that satisfy some desire. Those who tend to value their environmental impact most often rely on eco-labels to convey information on the product's production practices; however, the vast quantity of eco-labels and the lack of clear information on each label send mixed messaging to consumers. Further, while eco-labels such as USDA Organic, Fair-Trade Certified, and Non-GMO Project Certified all serve different purposes, they do not directly convey products' impact on climate change through their carbon emissions. This paper contends that a carbon label conveying the carbon emissions of a product throughout its life cycle is a clearer and more informative way of comparing the environmental impact of foods. A carbon label could fill a gap in the market and allow consumers to make conscious decisions to reduce their individual carbon footprints.

This research sought to understand consumer perceptions of a proposed carbon label and understand the relationships between participants' general level of reported environmental awareness and their values when making food purchases. Overall, the majority of participants thought that carbon labels would make it easier to compare the environmental impact of products. Further, the majority of participants said it was either "likely" or "extremely likely" that they would purchase carbon-labeled bread, apples and milk over non-labeled counterparts.


Findings from a ranking question suggest that the most important label to a majority of participants was nutrition facts; and, the carbon label was ranked more important than other eco-labels by at least 45% of participants. To determine whether the source of the carbon label influenced their willingness to trust the information conveyed, participants were asked whether they had seen or purchased labels from a variety of entities, as well as which entities they trusted

most. Findings demonstrate that consumers tended to trust environmental groups most to ensure the food they eat is sustainable, yet the majority of participants were unsure of the source of the eco-labels they had seen and purchased. Further, participants did not feel that the source of a carbon label would influence their purchase of carbon-labeled bread, apples, or milk. These findings suggest that a carbon label would help consumers make knowledgeable decisions in reducing their carbon footprint as well as make purchases that align with their values.

Future research should be done to determine how consumers would behave when actually faced with a larger variety of carbon-labeled products, as opposed to just bread, apples, and milk. This would also provide insight as to whether income truly has a negligible influence on environmental purchasing behavior. Future research should also examine how both label source and product brand interact with the purchase of carbon-labeled products. Additionally, while this research used reported environmental awareness as a key metric in determining conscious purchasing behavior, future research should test consumers' actual environmental knowledge to measure the influence on carbon label purchasing behavior. Further, surveys of more representative samples should be administered to determine whether or not these findings are valid for the United States population as a whole. Finally, future research might seek to identify how producers would react to a carbon label, including their willingness to adopt a new certification scheme and the associated cost.

Appendix 1

Carbon labels and characteristics.

Name of Scheme	Certifier	Public or Private	Launch	Nation of Origin	Companies	Products & Services
Approved by Climatop 	Climatop	Private	2008	Switzerland	11	65
CarbonCounted 	CarbonCounted Standards	Private	2007	Canada	unknown	22
Product Footprint Certification 	Carbon Trust	Private	2008	United Kingdom	20	3,829
CarboNZero Programme 	CarboNZero	Private	2008	New Zealand	87	~246
Certified CarbonFree* 	Carbon Fund	Private	2007	United States	16	77
Climate Marketing 	KRAV, Svenskt Sigill	Public/Private	2010	Sweden	7	61
Cool CO2 label 	KEITI	Public	2009	South Korea	unknown	>360
Eosta Climate Neutral 	TUV Nord	Private	2008	Holland	unknown	unknown
Indice Carbone Casino 	Casino France	Public/Private	2008	France	1	629
Pilot Californian carbon label**	Carbon Labeling Act 2008	Public	2009	United States	unknown	unknown
Taiwan BSI Product Carbon Footprint 	British Standard Institute	Public	2010	Taiwan	unknown	unknown
Thailand Carbon Reduction Label 	Thailand Greenhouse Gas Management Organization	Public	2009	Thailand	100	458
Zurueck zum Ursprung 	Hofer	Private	2009	Austria	unknown	79

Adapted from Guenther, Saunders, & Tait (2012).

*Certified Carbonfree uses carbon offsetting measures to help retailers make their products carbon neutral.

**Assembly Bill 19 was introduced on December 1, 2008 to establish a state-wide carbon labeling policy. The bill was not passed.

Appendix 2

Consumer Perceptions Toward a Carbon Label on Food Products

Welcome and thank you for agreeing to participate in this survey! This study pertains to consumer perceptions of a carbon label on food products. The proposed carbon label falls under the category of 'eco-label,' which are known to provide consumers with information about a product's environmental impact. Please answer all questions as truthfully as possible.

What is your age?

- 18-29 years old
- 30-49 years old
- 50-64 years old
- 65 years or older

What is your gender identity?

- Male
- Female
- Transgender
- Prefer not to say
- Other _____

What is the highest level of education you have completed?

- Some high school
- High school graduate
- Some college
- Associate's degree
- Bachelor's degree
- Higher degree

Which categories best describe you? Select all that apply.

- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic, Latino, or Spanish Origin
- Middle Eastern or North African
- Native Hawaiian or other Pacific Islander
- White
- Other

What category best describes your household's annual income? "Household" can be defined as any group that shares income and expenses, whether or not they currently live in the same residential unit.

- Less than \$25,000
- \$25,000 to \$49,999
- \$50,000 to \$74,999
- \$75,000 to \$99,999
- \$100,000 to \$149,999
- \$150,000 or more

For how many people does the above selected income provide, including yourself?

- 1
- 2
- 3
- 4
- 5+

On a scale from 1-10, how environmentally aware are you?

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

How important to you are the following attributes when purchasing food?

	Not at all Important	Low Importance	Neutral	Very Important	Extremely Important
Taste	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Freshness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Price	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental Impact	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Location/Origin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Health Benefits	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Brand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adapted from Gutierrez and Thornton (2014)

Do you feel that your food purchasing habits have an impact on the environment?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Adapted from Gadema & Oglethorpe (2011)

How important to you are the following attributes when purchasing food?

	Not at all Important	Low Importance	Neutral	Very Important	Extremely Important
Sourcing food from sustainable sources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shopping at retailers that care about how their products are produced	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My food purchases are ___ in influencing retailers' buying policies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adapted from Gadema & Oglethorpe (2011)

Have you seen and/or purchased one or more food products with an eco-label or environmental claim? This may include food products labeled "organic," "fair-trade," "non-GMO," etc.

- Yes, I have seen and purchased one or more of these products.
- Yes, I have seen one or more of these products, but not purchased them.
- No, I have not seen or purchased any of these products.

Adapted from Gutierrez and Thornton (2014)

Display This Question:

If 'Have you seen and/or purchased one or more food products with an eco-label or environmental claim? This may include food products labeled "organic," "fair-trade," "non-GMO," etc.' 'No, I have not seen or purchased any of these products.' Is Not Selected:

How clear was the information given to you via the eco-label or environmental claim?

- Extremely clear
- Slightly clear
- Neither clear nor unclear
- Slightly unclear
- Extremely unclear

Display This Question:

If 'Have you seen and/or purchased one or more food products with an eco-label or environmental claim...' 'No, I have not seen or purchased any of these products.' Is Not Selected:

From what sources were the labels on food products you have seen and/or purchased? Select all that apply.

- Government
- Industry
- Environmental Group
- Retailer
- Consumer Group
- Unsure
- Other _____

The next questions pertain to the following description: Suppose you saw a label on a type of food product that displayed the amount of carbon emitted (in grams) throughout its production process (including the product's growth, transport, processing, and distribution), also referred to as its 'carbon footprint.' Then suppose the label were present on comparable food products of different brands and you as the customer had the option to compare the carbon emissions of one product to another.

Do you feel that carbon labels would make it easier to compare environmental standards and products?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Adapted from Gadema & Oglethorpe (2011)

Do you feel it is important for food companies to measure and disclose the carbon footprint of their products?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Adapted from Gadema & Oglethorpe (2011)

How do you rank the importance of the following labels on food products (1 being the most important, 7 being the least important)?

- _____ Carbon label
- _____ Nutrition facts
- _____ Points of origin/sourcing
- _____ Organic Certified
- _____ Certified Non-GMO
- _____ Fair Trade Certified

_____ Humane Treatment label (such as 'cage-free')
Adapted from Gadema & Oglethorpe (2011)

Do you think that a carbon label on a food product would increase your perception of the taste of the food product?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

How likely is it that you would purchase one brand of bread/apples/milk over another if the former had a lower carbon footprint?

	Extremely Unlikely	Unlikely	Neither Likely nor Unlikely	Likely	Extremely Likely
Bread	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Apples	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Milk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adapted from Larceneux, Benoit-Moreau, & Renaudin. (2012)

What is the minimum and maximum price you would pay for each of these products?

	Minimum (\$)	Maximum (\$)
1 lb. of bread (1 loaf)		
3 lb. bag of apples		
1/2 gallon of milk		

How likely is it that the source of the label (e.g. private third party, government institution, NGO, etc.) would influence whether or not you would purchase the following carbon-labeled product?

	Extremely Unlikely	Unlikely	Neither Likely nor Unlikely	Likely	Extremely Likely
Bread	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Apples	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Milk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Of the following organizations, please select which organization you trust the most to ensure that the food you eat is sustainable.

- Government
- Industry
- Environmental Groups
- Retailers
- Consumer Groups
- None/My own judgment

Adapted from Gutierrez and Thornton (2014)

Would you like to be entered into the drawing of a \$25 Visa gift card?

- Yes
- No

Display This Question:

If 'Would you like to be entered into the drawing of a \$25 Visa gift card?' 'Yes' Is Selected
Please enter your full name.

Display This Question:

If 'Would you like to be entered into the drawing of a \$25 Visa gift card?' 'Yes' Is Selected
Please enter your email address.

Appendix 3

Frequency table. Do you feel that carbon labels would make it easier to compare environmental standards and products?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely not	1	0.2	0.3	0.3
	Probably not	7	1.6	1.9	2.2
	Might or might not	40	9.4	11	13.3
	Probably yes	125	29.3	34.5	47.8
	Definitely yes	189	44.3	52.2	100
	Total	362	84.8	100	
Missing	System	65	15.2		
Total		427	100		

Appendix 4

Frequency table. Of the following organizations, please select which organization you trust the most to ensure that the food you eat is sustainable.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government	91	21.3	25.3	25.3
	Industry	14	3.3	3.9	29.2
	Environmental Groups	174	40.7	48.3	77.5
	Retailers	2	0.5	0.6	78.1
	Consumer Groups	38	8.9	10.6	88.6
	None/My own judgment	41	9.6	11.4	100.0
	Total	360	84.3	100.0	
Missing	System	67	15.7		
Total		427	100		

References

- ADEME. (n.d.). Bilans GES. Retrieved March 4, 2017, from http://www.bilans-ges.ademe.fr/en/accueil/contenu/index/page/environmental_display/siGras/0
- Akaichi, F., de Grauw, S., Darmon, P., & Revoredo-Giha, C. (2016). Does Fair Trade Compete with Carbon Footprint and Organic Attributes in the Eyes of Consumers? Results from a Pilot Study in Scotland, The Netherlands and France. *Journal of Agricultural and Environmental Ethics*, 29(6), 969–984. <http://doi.org/10.1007/s10806-016-9642-7>
- Banerjee, A., & Solomon, B. D. (2002). Eco-labeling for energy efficiency and sustainability: A meta-evaluation of US programs. *Energy Policy*, 31, 109–123. [http://doi.org/10.1016/S0301-4215\(02\)00012-5](http://doi.org/10.1016/S0301-4215(02)00012-5)
- Boardman, B. (2008). Carbon labelling: too complex or will it transform our buying? *Significance*, 5(4), 168–171. <http://doi.org/10.1111/j.1740-9713.2008.00322.x>
- British Standards Institution. Specification for the assessment of the life cycle greenhouse gas emissions of goods and services, Publicly Available Specification 2050 (2011). Retrieved from <http://shop.bsigroup.com/upload/shop/download/pas/pas2050.pdf>
- Carbon Trust Product Footprint Certification. (n.d.). Retrieved from <https://www.carbontrust.com/media/558406/carbon-trust-product-footprint-certification.pdf>
- Chekima, B., Chekima, S., Syed Khalid Wafa, S. A. W., Igau, O. A., & Sondoh, S. L. (2015). Sustainable consumption: the effects of knowledge, cultural values, environmental advertising, and demographics. *International Journal of Sustainable Development & World Ecology*, 23(2), 210–220. <http://doi.org/10.1080/13504509.2015.1114043>
- Crawford, M., Church, J., & Akin, B. (2017). CPI Detailed Report: Data for February 2017. Retrieved from <https://www.bls.gov/cpi/cpid1702.pdf>

Ecolabel Index. (2014). Ecolabel Index. Retrieved from

<http://www.ecolabelindex.com/ecolabels/>

Gadema, Z., & Oglethorpe, D. (2011). The use and usefulness of carbon labelling food: A policy perspective from a survey of UK supermarket shoppers. *Food Policy*, *36*, 815–822.

<http://doi.org/10.1016/j.foodpol.2011.08.001>

Grankvist, G., & Biel, A. (2001). The Importance of Beliefs and Purchase Criteria in the Choice of Eco-labeled Food Products. *Journal of Environmental Psychology*, *21*(4), 405–410.

Retrieved from [http://ac.els-cdn.com/S0272494401902348/1-s2.0-S0272494401902348-main.pdf?_tid=6e24ea70-155a-11e7-a146-](http://ac.els-cdn.com/S0272494401902348/1-s2.0-S0272494401902348-main.pdf?_tid=6e24ea70-155a-11e7-a146-00000aacb35d&acdnat=1490886559_f9508c0c3aac08ee9979913d9025e1d6)

[00000aacb35d&acdnat=1490886559_f9508c0c3aac08ee9979913d9025e1d6](http://ac.els-cdn.com/S0272494401902348/1-s2.0-S0272494401902348-main.pdf?_tid=6e24ea70-155a-11e7-a146-00000aacb35d&acdnat=1490886559_f9508c0c3aac08ee9979913d9025e1d6)

Guenther, M., Saunders, C. M., & Tait, P. R. (2012). Carbon labeling and consumer attitudes.

Carbon Management Journal, *3*(35), 445–455. Retrieved from

https://researcharchive.lincoln.ac.nz/bitstream/handle/10182/5332/carbon_labeling.pdf;sequence=1

Gutierrez, A., & Thornton, T. F. (2014). Can Consumers Understand Sustainability through Seafood Eco-Labels? A U.S. and UK Case Study. *Sustainability*, *6*, 8195–8217.

<http://doi.org/10.3390/su6118195>

Harbaugh, R., Maxwell, J. W., & Roussillon, B. (2011). Label Confusion: The Groucho Effect of Uncertain Standards. *Management Science*, *57*(9), 1512–1527.

<http://doi.org/10.1287/mnsc.1110.1412>

Howden, L. M., & Meyer, J. A. (2011). Age and Sex Composition: 2010 2010 Census Briefs.

Retrieved from <https://www.census.gov/prod/cen2010/briefs/c2010br-03.pdf>

- International Trade Centre. (2011). Carbon Trust – Carbon Reduction Label. Retrieved from <http://www.intracen.org/WorkArea/DownloadAsset.aspx?id=58602>
- Klimatmarkning For Mat. (2010). Criteria for Mitigation of Climate Impact from Food Production and Distribution. Retrieved from <http://www.klimatmarkningen.se/wp-content/uploads/2009/02/Climate-Certification-of-Food-2010-3.pdf>
- Klimatmarkning For Mat. (2012). Status Report: Climate Certification for Food, 1–3. Retrieved from <http://www.klimatmarkningen.se/wp-content/uploads/2012/02/Status-report-climate-certification-Sweden-feb-2012.pdf>
- Kruger, J., & Dunning, D. (1999). Unskilled and Unaware of It: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments. *Journal of Personality and Social Psychology*, 77(6), 1121–1134. Retrieved from http://psych.colorado.edu/~vanboven/teaching/p7536_heurbias/p7536_readings/kruger_dunning.pdf
- Larceneux, F., Benoit-Moreau, F., & Renaudin, V. (2012). Why Might Organic Labels Fail to Influence Consumer Choices? Marginal Labelling and Brand Equity Effects. *Journal of Consumer Policy*, 35(1), 85–104. <http://doi.org/10.1007/s10603-011-9186-1>
- Leach, A. M., Emery, K. A., Gephart, J., Davis, K. F., Erisman, J. W., Leip, A., ... Galloway, J. N. (2016). Environmental impact food labels combining carbon, nitrogen, and water footprints. *Food Policy*, 61, 213–223. <http://doi.org/10.1016/j.foodpol.2016.03.006>
- McCluskey, J., Durham, C., & Horn, B. (2009). Consumer preferences for socially responsible production attributes across food products. *Agricultural & Resource ...*, 3(December), 345–356. Retrieved from <http://www.researchgate.net/>

- Pedersen, E. R., & Neergaard, P. (2005). Caveat Emptor – Let the Buyer Beware! Environmental Labelling and the Limitations of “Green” Consumerism. Retrieved from <http://onlinelibrary.wiley.com.proxy.lib.umich.edu/doi/10.1111/1540-6237.8402008/epdf>
- Petrescu, D., & Petrescu-Mag, R. (2015). Organic Food Perception: Fad, or Healthy and Environmentally Friendly? A Case on Romanian Consumers. *Sustainability*, 7(9), 12017–12031. <http://doi.org/10.3390/su70912017>
- Pew Research Center. (2015). Trust in the Government: 1958-2015. Retrieved from <http://www.people-press.org/2015/11/23/1-trust-in-government-1958-2015/>
- Pollan, M. (2006). Why Eating Well Is “Elitist.” Retrieved March 16, 2017, from <http://michaelpollan.com/articles-archive/why-eating-well-is-elitist/>
- Pollan, M. (2010). The Food Movement, Rising. Retrieved March 28, 2017, from <http://michaelpollan.com/articles-archive/the-food-movement-rising/>
- Schröck, R. (2010). Determinants of the demand for organic and conventional fresh milk in Germany -- an econometric analysis. Retrieved from http://ageconsearch.umn.edu/bitstream/116387/2/1A-1_Schröck.pdf
- Shewmake, S., Okrent, A., Thabrew, L., & Vandenberg, M. (2015). Predicting consumer demand responses to carbon labels. *Ecological Economics*, 119, 168–180. <http://doi.org/10.1016/j.ecolecon.2015.08.007>
- Sønderskov, K. M., & Daugbjerg, C. (2010). Eco-Labeling, the State and Consumer Confidence. *Political Studies Association Annual Conference*.
- Teisl, M. F., Roe, B., & Hicks, R. L. (2002). Can Eco-Labels Tune a Market? Evidence from Dolphin-Safe Labeling. *Journal of Environmental Economics and Management*, 43(3), 339–359. <http://doi.org/10.1006/jeem.2000.1186>

- The Environmental Literacy Council. (n.d.). Life Cycle Analysis. Retrieved March 5, 2017, from <https://enviroliteracy.org/environment-society/life-cycle-analysis/>
- Tidaker, P., & Richert, A. (n.d.). *Climate labelling of food*. Retrieved from https://www.lrf.se/globalassets/dokument/om-lrf/in-english/climate-change/lrf_folder_a4_climate_090907.pdf
- Treuhaft, S., & Karpyn, A. (2010). The Grocery Gap: Who Has Access to Healthy Food and Why It Matters. *PolicyLink, The Food Trust*. Retrieved from http://thefoodtrust.org/uploads/media_items/grocerygap.original.pdf
- USDA ERS. (2014). Organic Market Overview. Retrieved March 4, 2017, from <https://www.ers.usda.gov/topics/natural-resources-environment/organic-agriculture/organic-market-overview.aspx>
- van Amstel-van Saane, M., Driessen, P., & Glasbergen, P. (2008). Eco-labeling and information asymmetry: a comparison of five eco-labels in the Netherlands. *Journal of Cleaner Production, 16*(3), 263–276. <http://doi.org/10.1016/j.jclepro.2006.07.039>
- Vanclay, J. K., Shortiss, J., Aulsebrook, S., Gillespie, A. M., Howell, B. C., Johanni, R., ... Yates, J. (2011). Customer response to carbon labelling of groceries. <http://doi.org/10.1007/s10603-010-9140-7>
- Vieux, F., Soler, L.-G., Touazi, D., & Darmon, N. (2013). High nutritional quality is not associated with low greenhouse gas emissions in self-selected diets of French adults. *American Journal of Clinical Nutrition, 97*(3), 569–583. <http://doi.org/10.3945/ajcn.112.035105>