

Title: Carbon labeling and consumer attitudes

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Author(s) names & affiliations:

Meike Guenther
Agribusiness and Economics Research Unit
Lincoln University
PO Box 84
Lincoln 7647
Christchurch
New Zealand
meike.guenther@lincoln.ac.nz

Prof Caroline M Saunders
Agribusiness and Economics Research Unit
Lincoln University
PO Box 84
Lincoln 7647
Christchurch
New Zealand
caroline.saunders@lincoln.ac.nz

Dr Peter R Tait
Agribusiness and Economics Research Unit
Lincoln University
PO Box 84
Lincoln 7647
Christchurch
New Zealand
peter.tait@lincolnuni.ac.nz

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Abstract:

Background: There is growing pressure in some of New Zealand's export markets for product information on sustainability credentials and on carbon emissions with several schemes under development worldwide. The aim of this study is to assess in two key markets consumer attitudes, knowledge and preferences towards sustainability; including carbon emissions information on food products. Method: The method included focus groups and surveys in the United Kingdom and Japan. Results: This study finds evidence that consumers in both countries desire labels that display sustainability credentials. Differences were observed between countries in terms of perceived knowledge about specific issues. Similar preferences for environmental product-features were observed. Conclusion: The information gained from this study may support producers and manufacturers labeling policy and practices.

Key Terms:

1. **CARBON FOOTPRINT:** This is a technique for measuring the exclusive total amount of Greenhouse gas emissions from a product or activity within a supply chain [1,2].

2. **CARBON LABEL:** Carbon labels and Carbon Reduction labels are a new initiative to help consumers' understanding of the carbon footprints of products or services they purchase. Carbon labels show the amount of carbon dioxide (CO₂) and other Greenhouse gases emitted during the production, distribution, use and disposal of a product. Carbon Reduction labels display the reduction of carbon emissions that has been achieved during the production, distribution, use and disposal of a product [101,102].

LIFE CYCLE ASSESSMENT (LCA): The LCA is a compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle. Within this, a "product system" is a chain of activities linking the raw material extraction and/or manufacture with the processing, use and disposal of a product. In the ISO standards the term "product" includes services [3].

3. **PAS 2050:** The Publicly Available Specification (PAS) 2050 is an independent Greenhouse gas emissions (GHG) quantification standard for products and services developed by the UK Department for the Environment, Food and Rural Affairs (Defra), the British Standard Institute (BSI), and the Carbon Trust [4].

4. **ISO:** The International Organization for Standardization (ISO) has a series of international standards dealing with carbon accounting and labeling of products and services produced by different organizations internationally. These ISO standards include ISO 14025, ISO 14064-1, and ISO 14067-1 [5,6,7]. The standards provide a reference framework for quantifying and communicating Greenhouse gas emissions between organizations, and to

consumers and other interested parties. They also ensure that products and services have characteristics such as quality, environmental friendliness, safety, reliability, efficiency and are interchangeable [103].

1. Introduction

Many consumers are concerned about the environmental and social impacts of the products they purchase, and seek out products that have sustainability credentials that can be verified [e.g. 8, 9]. One credential that has recently been introduced is the amount of carbon emissions from the production of food shown on a carbon label. There are several schemes of carbon labels under development worldwide.

Values, attitudes and perceptions on environmental and sustainability issues have been investigated in a large number of studies worldwide [8,10]; however, only a few studies have been published on how consumers evaluate sustainability credentials of food products, including carbon emission information and carbon labelling, and even fewer studies have examined cross country comparisons [11,12,13]. This paper aims to assess consumer attitudes towards the display of carbon emissions and how this relates to other sustainability credentials of food products in the United Kingdom (UK) and Japan as these are key export markets for New Zealand. New Zealand depends heavily on its agricultural exports and increasing pressure in key export markets such as the UK and Japan for information on sustainability credentials of products including the carbon emissions associated with products throughout the product life-cycle has the potential to affect domestic production and trade in New Zealand. The research is part of a wider research study that also includes a choice modelling analysis [14] estimating consumers' willingness to pay for sustainability credentials on food labels. In this paper the working definition of sustainability is derived from most cited definition provided by the UN World Commission on Environment and Development in 1987: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" and therefore encompasses environmental, economic and social dimensions [15]. Greenhouse gas (GHG) emissions are assumed to include all sources of emissions and are measured in carbon dioxide (CO₂) equivalents throughout this paper.

The paper is structured as follows. Section 2 presents an overview of the development and use of carbon labeling. The development of these labels are then assessed and compared with other sustainability credentials and consumer attitudes towards these. The methodology of the study is outlined in section 3, followed by a presentation and discussion of the results in section 4. The paper finishes with a brief conclusion in section 5.

2. Development of carbon labels and consumer attitudes towards these

This section reviews the development of carbon labeling with a brief account of their source and methodology to provide context to their introduction and likely development. This is followed by a review of the literature on the response of consumers to carbon labeling alongside other sustainability credentials.

The introduction and development of labeling of sustainability credentials has arisen from changes in consumer attitudes and purchase behaviors alongside retailers marketing strategies and is continuing to grow [8]. More recently carbon labeling has been introduced to reflect a particular sustainability credential and relates to concern about climate change. As these new carbon labels evolve it is important to understand how these affect consumers purchasing decisions as well as how the display of carbon emissions is evaluated alongside other sustainability credentials on labels to enable producers to react accordingly.

2.1 Carbon labels and their development

Most carbon labels inform the consumer of the amount of carbon dioxide embedded in a product. These are typically presented in numerical form and may include information about emissions reductions being achieved in the product's distribution [16]. A carbon label aids consumers to make an informed choice and to understand the carbon footprints of products or services they purchase [101]. However, the methodology used to calculate these emissions vary between labels. Brief discussions of these methodologies are provided below to illustrate the differences between schemes, their relative length of time in operation and likely development. Whilst the review concentrates upon the UK and Japan, other countries' labels have been included to illustrate how the existence of labels is developing and where further research maybe focussed.

Through a review of literature and other sources, the authors of this study identified 22 schemes worldwide, most of which were in early stages of development. A summary of these are provided in Table 1, which also (where available) shows the methodology used, the country in which they apply, the year in which the scheme was launched and the number of products covered.

Table 1: Carbon labels and characteristics, 2011

| Name of scheme/ Certifier | Operator, Public/ Private | Launch | Nation of Origin | Accounting Method | Companies | Products & services |
|--|------------------------------|--------|---------------------|---|-----------|------------------------|
| Approved by Climatop/ Climatop | Private | 2008 | Switzerland | ISO 14040 | 11 | 65 |
| Bilan CO ₂ / E. Leclerc | Private | 2008 | France | ISO 14040 ISO 14044 | 1 | 20,000 price tags |
| Carbon Connect/ CarbonCounted™ Standards | Private | 2007 | Canada | unspecified LCA | unknown | 22 |
| Carbonlabels.org/ Conscious Brands | Private | 2008 | Canada | unspecified LCA | unknown | unknown |
| Carbon Reduction label/ Carbon Trust | Public | 2008 | U.K. | PAS 2050 | 20 | 3,829 |
| carboNZero ^{Cert™} programme, CEMARS™ / CarboNZero | Private | 2008 | New Zealand | PAS 2050 ISO 14064 | 87 | approx. 246 |
| Certified CarbonFree/ Carbon Fund | Private | 2007 | U.S. | PAS 2050 ISO 14044 ⁽¹⁾ | 16 | 77 |
| Climate Conscious Carbon Label/ The Climate Conservancy | Private | 2007 | U.S. | unspecified LCA | unknown | unknown |
| Climate Certification for the Food Chain/ KRAV, Svenskt Sigill, Kvalitetssystem AB | Private | 2010 | Sweden | ISO 14040 | 7 | 61 |
| Cool CO ₂ label/ KEITI | Public | 2009 | South Korea | PAS 2050 | unknown | >360 |
| Eosta climate Neutral/ TUV Nord | Private | 2008 | Holland | ISO 14040, ISO 14044 ⁽¹⁾ | unknown | unknown |
| German Product Carbon Footprint Project/ Product Carbon Footprint Project | Public | 2008 | Germany | unspecified LCA | 8 | 10 |
| Green Index Rating/ Timberland | Private | 2007 | U.S. | unspecified LCA | unknown | 8 |
| Indice carbone casino/ Casino France | Private | 2008 | France | Methode Carbone® | Bilan 1 | 629 |
| METI Carbon Footprint System/ METI | Public | 2009 | Japan | ISO 14040,14044 ⁽¹⁾ ISO 14067 | unknown | 460 |
| Pilot Californian carbon label/ California State Senate Carbon Labeling Act 2008 | Public | 2009 | U.S. | unspecified LCA | unknown | unknown |
| SGS Carbon neutrality/ SGS | Private | 2007 | Switzerland | GHG protocol ISO 14064 | unknown | unknown |
| Stop Climate Change/ AGRA-TEG | Private | 2007 | Germany | PAS 2050 GHG Protocol | 11 | unknown |
| Taiwan BSI Product Carbon Footprint/ British Standard Institute | Public | 2010 | Taiwan | PAS 2050 ISO 14001 ⁽²⁾ | unknown | unknown |
| Thailand Carbon Reduction Label/ Thailand Greenhouse Gas Management Organization | Public | 2009 | Thailand | PAS 2050 | 100 | 458 |
| TUV Nord Cert/ TUV Nord | Private | 2008 | Germany | ISO 14001 ⁽²⁾ EMAS ⁽³⁾ | Unknown | unknown |
| Zurueck zum Ursprung/ Hofer | Private | 2009 | Austria | unspecified LCA | unknown | 79 |

Notes: (1)The ISO 14044 standard provides the requirements and guidelines for an LCA [41].

(2) The ISO 14001 standard provides the general requirements for an environmental system [17].

(3) EMAS stands for the European eco-management and audit scheme [18]

All other accounting methods have been described in more detail in section 2.1.

A UK quasi non-governmental organization (quango), the Carbon Trust took the lead in the development of carbon-labeling goods and introduced the Carbon Reduction Label in 2006. Products bearing this label are required to reduce emissions by 20 per cent within two years following certification or they lose the right to use the label [104]. In January 2007, Tesco announced it would carbon footprint 70,000 of its products investing £500 million using the Carbon Reduction Label. Currently, Tesco labels 500 products from six different product categories [19,105]. However, Tesco announced recently that it would review the use of its Carbon Reduction Label partly as a consequence of customer feedback showing they had difficulties in understanding the label [106].

A carbon labeling scheme was introduced in Japan in 2009, with retailers voluntarily attaching the Carbon Footprint Label to their products. Since February 2010, two products carrying the label (wiener sausage and ham made of pork loin) have been available in stores throughout Japan. The label includes an image of a lead weight with the letters CO₂ in the centre, with the attached carbon weight of the product in bold letters above. The attached carbon weight value is an approximation of the amount of carbon released across the entire lifecycle of the product [109,110].

Other countries have followed suit. In 2009, South Korea initiated a programme to certify carbon content in consumer goods. That voluntary labeling scheme involves two types of labels: the Greenhouse Gas Emission Certificate, which states the product's carbon footprint (by GHG in grams), illustrated by a CO₂ image; and the CO₂ low label, which verifies that low levels of carbon have been emitted in the production of the product, with the product's carbon footprint displayed [111]. Two basic sets of criteria underlie the CO₂ low label, the Minimum Carbon Emission Amount Criteria and Minimum Carbon Reduction Criteria. The former varies between different product categories, while the latter is fixed at a basic reduction rate of 4.24 per cent across the entire life cycle of a product within three years [20].

Other initiatives include a climate certification scheme in Sweden which aims to reduce the negative impact on the climate from food production but also to increase the competitiveness of food producers [21]. In Switzerland, products are being labeled Climatop if their production emits less CO₂ than similar products [112]. In France, one retailer applies a carbon label to 3,000 of its food products and another is already labeling all its home-brand products [113, 114]. In Thailand, a labeling scheme was launched in 2009, with more than 450 labeled products from 100 companies [115].

The labels and schemes above have used a variety of standards and an initial criticism was the absence of a uniform standard to measure carbon emissions [25]. The Carbon Trust, the UK Department for the Environment, Food and Rural Affairs (Defra), and the British Standard Institute (BSI) took the initiative and developed the Publicly Available Specification (PAS) 2050 [22]. PAS 2050 is an independent GHG emissions quantification standard for products and services and its methodology draws on both the World Business Council for Sustainable Development's GHG protocol [23] and the ISO standard 14064 on GHG quantification and reporting [22].

However, there is still debate about the methodologies used and their complexity as well as the argument that the science behind their measurement is uncertain [24,25]. For example, whether this should be a full LCA approach that takes into account associated carbon release through processes involved in raw material procurement, production, distribution and sale, utilization and maintenance, and disposal and recycling [109,110]. The issue with LCA relates to the volume of data required and its availability and accessibility [26].

Despite those acknowledged issues, the use of carbon labels is continuing, therefore it is important to understand how consumers evaluate the display of those carbon emissions by themselves and alongside other sustainability labels for food products. Therefore, the following section will review relevant literature on consumer attitudes to sustainability credentials including carbon labels.

2.2 Consumer concerns and attitudes for sustainability credentials

There have been a range of studies assessing the importance of sustainability credentials of products and services for consumers in different countries. This section reviews these studies concentrating on those relevant to carbon labels and climate change and the relationship between these and other sustainability credentials. Ideally, this review would concentrate upon the countries of key interest to the study, that is Japan and the UK, however due to the lack of studies in these countries, studies of other countries have been included.

Results from a recent survey in Europe on sustainable consumption and production showed that the information on the environmental impact of a product is likely to influence consumption habits of European citizens [12]. The majority of participants stated that a product's impact on the environment is an important variable when deciding which product to buy (49 per cent stated rather important and 34 per cent very important); only 4 per cent responded this is not important at all. Results showed that recycling and reusability was the most desired environmental attribute a product label could offer. The proportion saying this is important ranged from 57 per cent in Finland to 18 per cent in Latvia. The display of the product's GHG emissions was selected as the least important by all participants compared to the other environmental product attributes (recycling/reusability, environmentally friendly packaging, eco-friendly sources). However, interestingly, many survey participants favored mandatory carbon footprint labeling. Ninety per cent of respondents in Croatia and Greece were in favor of such labeling, compared to 47 per cent of participants from the Czech Republic. This was the only country where less than half of respondents favored such labeling.

A 2007 survey, with 14,220 participants across 21 countries, showed that around 68 per cent of consumers were concerned about climate change. Within this, over 95 per cent of participants claimed to be involved in activities aimed at reducing the negative impacts of climate change. Recycling was one of the most commonly selected activities, with German respondents showing the highest engagement (93 per cent) and Indians the lowest (12 per cent). However, fewer participants (20 per cent) were involved in activities which off-set their personal carbon emissions, of these Brazilians showed the highest engagement (43 per cent) and UK respondents the lowest (8 per cent) [13].

Research New Zealand conducted a survey in 2007 to investigate the perceptions of New Zealanders towards sustainability issues such as global warming, climate change and carbon footprint [27]. The study developed seven consumer segments derived from a model developed by the Department of Environment, Food and Rural Affairs in the UK [28]. Consumers were categorized by their ability and willingness to care for the environment and their perceived knowledge about certain sustainability issues. The consumer segment with the highest perceived knowledge about climate change (69 per cent), global warming (70 per cent), and carbon footprint (53 per cent) were categorised as the Positive Greens. This represented 14 per cent of New Zealand's population. Consumers in this segment reported being particularly environmentally friendly. This is in contrast with the segment of Honestly Disengaged which represented 1 per cent of New Zealand's population. Consumers in this group were the least likely group to care for the environment. The largest segment was the Waste Watchers (39 per cent of the population) who indicated they did a few environmentally friendly things [27].

2.3 Consumer concerns and attitudes for carbon labels

Although there is some literature regarding public perceptions of the relationship between climate change, carbon labels and other sustainability credentials across countries as reviewed above [12, 13,27], there is still little research on consumer attitudes towards carbon labels [16]. Four such studies are reviewed in this section. The study by Berry et al (2008) used expert interviews, focus groups and a survey (which included a subset of questions on carbon footprinting) to assess the role carbon labeling could play in stimulating low carbon purchase behavior. Results showed that nearly 40 per cent of respondents find the information on existing carbon labels very helpful but almost 60 per cent of the respondents desired more information about the climate change impacts of the products they purchase. The researchers argued, however, that it is too early to evaluate if on-pack carbon labeling affects consumers purchase decisions [29]. Similarly, Gadema & Oglethorpe (2011) showed that food consumers in the UK do not feel well informed enough to make purchasing decisions based on carbon footprint labels. However, there is evidence that consumers are increasingly interested in the environmental impact of food, although traditional factors such as quality, taste and price are still dominating purchase decisions [11]. Likewise, Upham et al (2011) demonstrated that consumers' willingness to use carbon labels for product selection is very low, particularly because the public found it very difficult to make sense of labeled GHG emissions without additional information [16]. Roos & Tjarnemo (2011) used results from studies on labeling of organic products to explore how these might apply to the area of carbon labeling food. They speculated that there are a number of reasons why organic labeling does not increase premiums or purchases which might apply to carbon labeling of food. The reasons are "... perceived high price, strong habits for governing food purchases, perceived low availability, lack of marketing and information, lack of trust in the labeling system, and low perceived customer effectiveness" [30]. The researchers argued that some of these reasons are even greater obstacles for the sale of carbon labeled food products than for organic products as these do not bring any direct personal benefits to the consumer [30].

To summarize, the reviewed literature on consumers' attitudes and preferences for certain product attributes showed that preferences differ both for different sustainability credentials and between different countries. Furthermore, it was shown that most research has investigated consumer attitudes towards product labels claiming sustainability credentials, while only a few studies have examined preferences towards carbon emissions information on food. Therefore, this research contributes to the existing literature by examining the attitudes of consumers in two key New Zealand export markets (the UK and Japan) to carbon emissions information alongside other sustainability credentials. It further explores consumers' attitudes and preferences for certain label claims including carbon emissions display and the knowledge they have on various sustainability issues. This provides information on how consumers could react to carbon labeling schemes and can inform further analysis and development of carbon labeling.

3. Methodology

A number of methods to elicit consumer attributes and preferences are available. These generally include market surveys which can be open-ended, semi-structured or structured [31]. These can be administered through a number of formats including face-to-face interviews, postal and phone surveys [31]. The research was carried out by the Agribusiness and Economics Research Unit at Lincoln University in New Zealand and due to the distance to the samples to be surveyed and the number of survey responses required for statistical analysis, this study used a structured, self-administered survey in both the UK and Japan. This was administered through Qualtrics™, a web-based survey system. Respondents were given a link to the on-line survey and by clicking on the link the Qualtrics interface opened and questions were shown consecutively to the respondent.

The sampling strategy involved the recruiting of participants from an online panel database of consumers. Each survey was stratified by the countries' age and household income distributions. The sample was randomly distributed within the regions in Japan and in the UK. The original survey was in English. For the Japanese survey the questionnaire was translated into Japanese (Kanji) by a professional translation service.

The survey was designed in reference to previous research and literature [e.g. 12,13,27,33] and from stakeholder consultation and results of focus groups in New Zealand. Ideally, the focus groups would have been held in the UK and Japan however resources did not permit this but the focus group meetings gave an indication for consumer preferences for specific environmental label claims and awareness and perceptions of sustainable, particularly carbon labeling and thus helped to inform the design of the survey.

The key sustainability credentials used in the survey were:

Recyclability/ reusability; Made from environmentally friendly sources; Eco-friendly packaging; and GHG emissions.

These four credentials were selected from the literature review as having been shown as important label claims in previous surveys [e.g. 12,13,33].

The questionnaire was designed and structured utilising predominantly Likert scales [34]. Although there seems to be controversy whether Likert scales are a good instrument for measuring attitudes [35,36], and alternative scales exist (e.g. attitudinal/ behavioral statements), for this study Likert scales were selected as they are an established and widely used instrument [37,38], also due to their simplicity in construction, development and use and their likeliness to provide reliable results [39].

The survey was comprised of a range of questions constructed to assess the public perception of certain product features, consumer attitudes to specific environmental label claims, and knowledge held regarding social and environmental information in the UK and Japan. Human Ethics approval was obtained from the Human Ethics Committee of Lincoln University before the online survey was carried out in each country in July 2010.

Descriptive statistics were used to determine the knowledge, attitudes and preferences of the respondents towards sustainability issues and carbon labeling. In addition, p-values for a chi-square test of the null hypothesis of no difference between sample distributions were calculated as a statistical test of difference between the results from the Japanese and UK respondents.

4. Results and discussion

The results of the survey provided information on the knowledge, attitudes and preferences of consumers in Japan and the UK towards credentials of food. As stated above the sample size was 880 participants, 440 in each country. Respondent demographics for both countries are presented in Table 2 and 3. The sample was biased towards the older generation in the UK; otherwise it reflected the demographic distribution of the general population in the UK and Japan.

Table 2: Summary demographics of survey participants (per cent)

| | UK | Japan |
|--|----|-------|
| <i>Gender</i> | | |
| Male | 45 | 50 |
| Female | 55 | 50 |
| <i>Age</i> | | |
| 15-19 | 0 | 4 |
| 20-29 | 5 | 15 |
| 30-39 | 8 | 18 |
| 40-49 | 13 | 12 |
| 50-59 | 17 | 18 |
| 60+ | 56 | 33 |
| <i>Living environment of participants</i> | | |
| Urban | 23 | 48 |
| Suburban | 46 | 44 |
| Rural | 31 | 7 |
| <i>Relationship status</i> | | |
| single | 15 | 31 |
| married | 57 | 61 |
| other | 27 | 7 |
| <i>Education</i> | | |
| Junior High School | 14 | 2 |
| High School | 30 | 30 |
| Junior College | 1 | 19 |
| University degree/ Tertiary level qual. | 44 | 43 |
| Post-graduate Degree | 7 | 4 |
| Other | 4 | 1 |
| <i>Based on 440 responses in each country</i> | | |

Table 3: Income distribution of survey participants (per cent)

| Income | UK | Income | Japan |
|----------------------|----|----------------------|-------|
| < £15,000 | 19 | < £15,196 | 12 |
| £15,001-£40,000 | 42 | £15,197- £26,594 | 16 |
| £40,001-£60,000 | 17 | £26,595- £41,791 | 27 |
| £60,001-£100,000 | 8 | £41,792- £64,585 | 22 |
| £100,001 or more | 3 | £64,586 or more | 18 |
| Prefer not to answer | 11 | Prefer not to answer | 5 |

Note: The income ranges differ between the UK and Japan as incomes were elicited in respondents' domestic currency.

4.1 Consumers preferences for environmental labels in the UK and Japan

Based on a five-point Likert scale varying from strongly agree to strongly disagree, participants were asked if they would like to see the display of the following included on a label:

- Recyclability/ reusability;
- Made from environmentally friendly sources;
- Eco-friendly packaging; and
- GHG emissions.

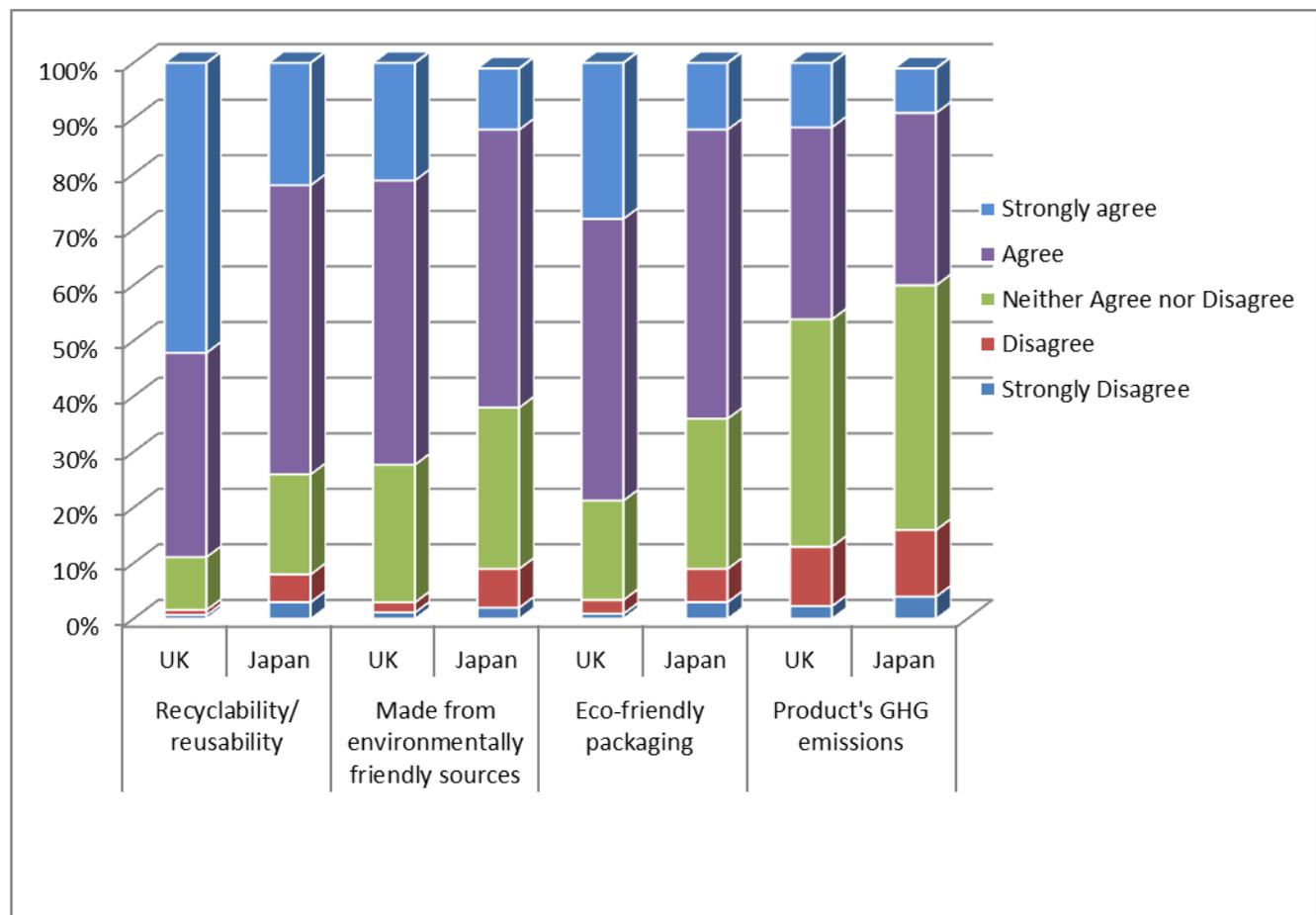
As shown in Figure 1, information on a package's recycling and reusability was the most desired label claim in both countries with high proportions of people selecting strongly agree or agree (UK 89 per cent, Japan 74 per cent). Interestingly, over half of the participants in the UK strongly agreed that this information should be included on a label compared to only one in five people in Japan.

The second most desired label claim was whether a package is eco-friendly with 79 per cent of UK respondents and 65 per cent of Japanese respondents selecting strongly agree or agree to the display of this attribute on a product label. This was followed relatively closely by the claim made from environmentally friendly sources with 72 per cent of UK respondents and 61 per cent of Japanese respondents selecting strongly agree or agree to the display of this attribute on a product label.

In both countries, the display of GHG emissions on a label was the least desired information compared to the other environmental label attributes, although 46 per cent of UK respondents and 39 per cent of Japanese participants did at least agree to include the GHG

emissions in a label. These results for the display of GHG emissions on a label are in line with the Eurobarometer study presented above [12], in which survey participants in Europe rated the display of GHG emissions on an environmental label lower than the other listed alternatives (recycling/ reusability, environmentally friendly packaging, eco-friendly sources). Similarly, Gadema & Oglethorpe (2011) showed that the display of carbon emissions is ranked lower than other product attributes. In their study, survey participants rated the display of carbon emissions as the second lowest attribute out of fourteen. Consumers were primarily concerned with the traditional factors of quality, taste and price [11].

Figure 1: Consumer preferences for environmental label claims (per cent)



Note: Chi-Square Test for H0: no differences between country distributions, rejected for all cases.

4.2 Consumers knowledge about sustainability issues in the UK and Japan

To assess perceptions and attitudes about specific environmental and social issues, participants were asked about their knowledge of general sustainability issues on a five-point Likert scale varying between a lot and never heard of it. These issues were:

- Carbon off-setting
- CO₂ –emissions
- Carbon footprint
- Global warming
- Climate change
- Sustainability
- Animal welfare
- Water footprint

Figure 2 shows that the overall knowledge of respondents' was reasonable, with the majority indicating that they had a fair amount or a little knowledge of the majority of issues presented.

In the UK survey, the most well-known issues were Animal welfare and Global warming. The vast majority (95 per cent) claimed to know at least a little about Global warming, and 92 per cent at least a little about Animal welfare. This is followed by Climate change, Sustainability, Carbon footprint and CO₂–emissions that the majority (85 per cent or more) knew at least a little about, and over a third of respondents knew a fair amount or more about these issues. This was consistent with the findings by Thornton (2009) who showed in DEFRA's survey for public attitudes and behaviors towards the environment that almost half of the UK respondents claimed to know at least a fair amount about Carbon footprint and the majority of respondents claimed to know either a lot or a fair amount about Climate change (61 per cent), Global warming (65 per cent) and Carbon dioxide emissions (52 per cent) [40].

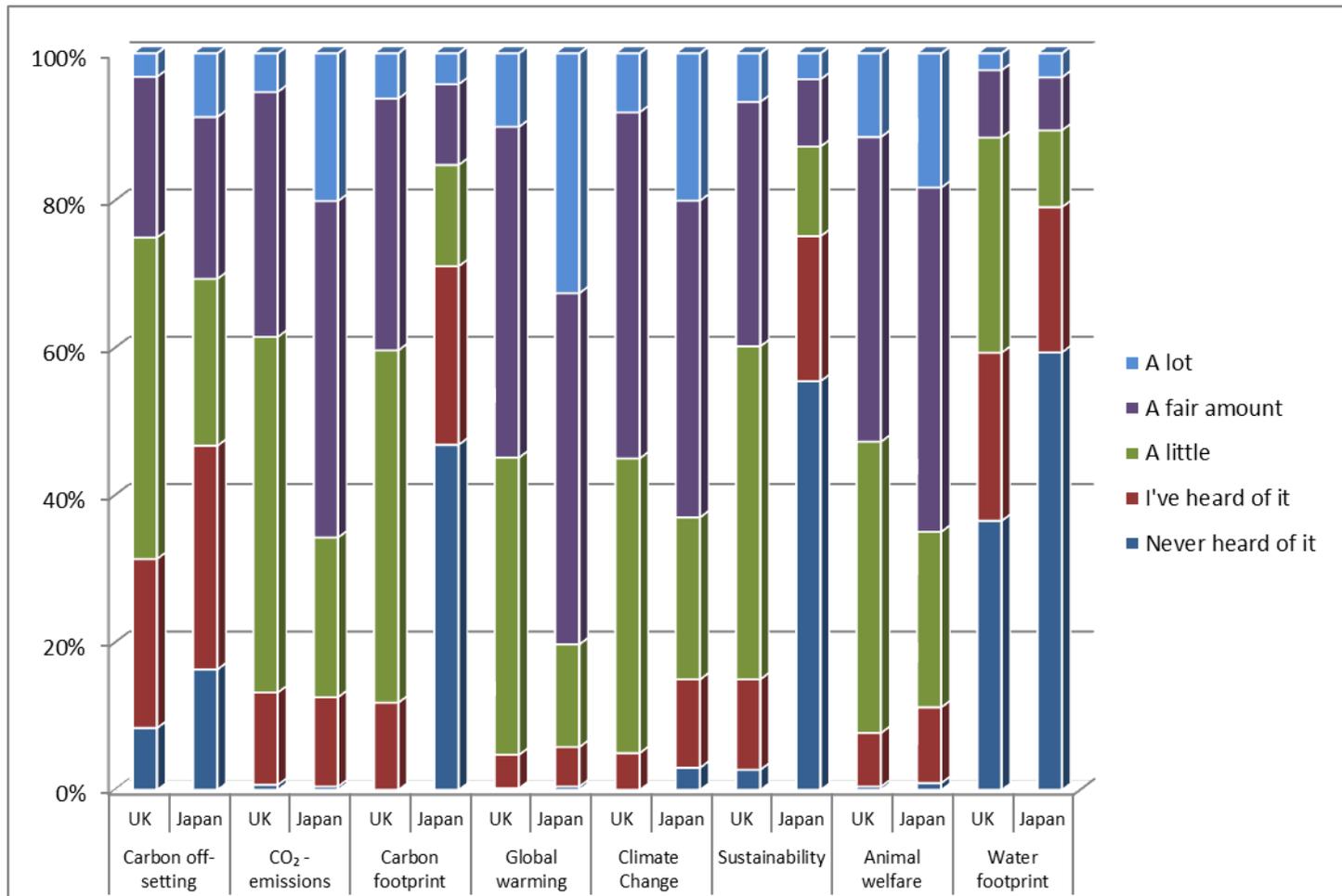
The results showed that the least known issues in the UK survey were Carbon off-setting and Water footprint. The vast majority (67 per cent) knew only a little or had only heard of Carbon off-setting; and for Water footprint in particular, over a third (37 per cent) of participants had never heard of this.

In Japan, CO₂ -emissions, Global warming and Climate change were the most well-known, with about 20 per cent or more of participants claiming to know a lot about each. The issue of Global warming received the highest proportion of respondents (30 per cent) claiming to know a lot about it. Similar to the UK, respondents were not overly knowledgeable on Carbon off-setting with the majority (54 per cent) selecting to know a little about this. In Japan, the least known issues were Carbon footprint, Sustainability and Water footprint. Almost half (47 per cent) had not heard about Carbon footprint, and the majority had not heard of Sustainability (56 per cent) and Water footprint (59 per cent). The reasons why these terms were less familiar could be due to a number of reasons. In both, Japan and the UK water footprint is a recently but not extensively used term. However, the fact that a

higher proportion of UK respondent's understood the terms Carbon footprint and Sustainability than their Japanese counterpart could be through the use of these terms in the respective countries. This is an interesting conclusion in itself for New Zealand exporters and is an area for further research, in particular, further research of particular terms used in the different countries to explain sustainability and its credentials.

Comparatively, respondents in Japan were more likely to claim they knew a lot about an issue (i.e. exceeding 20 per cent of respondents) than those in the UK (only a few issues had 10 per cent or more claiming to know a lot). Interestingly, Japan also had more respondents who did not know about certain issues; in three cases, almost half respondents had never heard of the issue. In contrast, in the UK, with the exception of Water footprint, less than 10 per cent of people had never heard of each topic. However, in the majority of cases all respondents had at least heard of the issues.

Figure 2: Knowledge of participants of various environmental and social issues (per cent)



Note: Chi-Square Test for H0: no differences between country distributions, rejected for all cases.

5. Conclusion

There have been various schemes put in place to meet retailers and consumer demands for information on sustainability credentials including carbon labeling schemes. This is where producers and retailers label goods with the amount of carbon emissions produced by this product. Such schemes are being adopted in many countries including the UK, USA, France, Japan and Switzerland. Most of these schemes are under development.

This study surveyed consumers in the UK and Japan to assess consumer attitudes on the display of carbon emissions on food products, alongside their knowledge and preferences towards sustainability credentials. Overall, the results of this study find evidence that consumers in the UK and Japan desire labels that display sustainability credentials. Results showed that consumers in the UK and Japan have similar preferences for the desired label information on the product with recycling/ reusability information ranked highest and GHG emissions display ranked lowest. Perceived knowledge about specific environmental and social issues showed similarities and differences between the countries with Sustainability and Carbon footprint not well known by Japanese participants and well known by their UK fellows. Water footprint was not known well by respondents from both countries. Further research would be useful to clarify why 56 per cent of Japanese have not heard about the term Sustainability. Another interesting finding is that almost 50 per cent of Japanese respondents stated to have not heard about the term Carbon Footprint, considering their perceived knowledge about other carbon-related terms such CO₂-emissions and Carbon off-setting. The researchers suggest that the good knowledge of Carbon footprint in the UK may be because the Carbon footprint labeling of one of the major supermarket chains in the UK [8]. Similarly, the good knowledge of CO₂ –emissions, Global warming and Climate change in Japan may be generated by the government initiatives towards climate change and carbon labeling. Thus, as stated earlier, further research of the terms used and how they are interpreted in the different countries would be useful.

To conclude, carbon labeling is in its infancy and further research is required to investigate consumer's ability to understand carbon labeling. This would indicate their ability to interpret the range of different carbon labeling approaches and subsequently inform about which approach is better. Further research is required to compare existing carbon labels schemes. To the best knowledge of the researchers, there are currently no such studies available. The next steps include discrete choice modeling for certain product attributes. In addition, consumers' attitudes and comprehensibility of different label designs will be examined, varying from pure text, to pictorial and to a combination of these two in UK and Japan. This will provide further information in developing an effective carbon label, particularly on how carbon labels should be designed and which format should be used.

Future perspective: The current move towards food product labels with sustainability credentials, including carbon emissions information, seems set to continue into the future although difficulties in relation to consumer understanding of the labels persist and may need to be addressed for carbon footprint labels to gain traction. This is more difficult when the method of developing carbon labels is not consistent. Thus, an important obstacle to

develop a carbon label lies in harmonizing the different global methodologies that exist to calculate, verify, certify and report on GHG emissions.

Executive Summary:

Carbon labeling schemes

- There is pressure in some markets for displaying information on a product's GHG emissions that were emitted during the production, distribution, use and disposal of the product.
- Schemes to achieve this are under development but in their infancy. In 2012, there were roughly 22 carbon labels documented.

Consumer concerns & attitudes

- There is evidence that consumers are increasingly interested in the environmental impact of food products they purchase although traditional factors such as quality, taste and price are still ranked higher.
- There exists little literature on consumer attitudes towards displayed carbon labels. Four studies on public perceptions of carbon labels were reviewed.
- These showed that consumers desire more information about the climate change impacts of the products. However, it was shown that food consumers do not feel well informed enough to make purchasing decisions based on carbon footprint labels because they found it very difficult to make sense of labeled emissions values without additional information.
- It is argued by many researchers that the influence of labels on consumers purchase behavior is still unknown.

Consumer attitudes, knowledge & preferences in the UK and Japan

- The method of this study included a survey of 880 people in the UK and Japan. The survey included a range of questions constructed to assess consumer attitudes, knowledge and preferences towards the display of carbon emissions and how this relates to other sustainability credentials of food products.
- Overall, the results of this study find evidence that consumers in the UK and Japan desire labels that display sustainability credentials.
- Similar preferences for environmental labels were observed with *recycling/reusability* ranked highest and *GHG emissions* lowest in both countries.
- Differences were observed between Japan and the UK in terms of perceived knowledge about specific issues such as Sustainability and Carbon footprint which

were not well known by Japanese participants and well known by their UK fellows.
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