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Consumer Attitudes towards Sustainability Attributes on Food Labels

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Concerns about climate change and the general status of the environment have increased expectation that food products have sustainability credentials, and that these can be verified. There are significant and increasing pressures in key export markets for information on Greenhouse gas (GHG) intensity of products throughout its life-cycle. How this information is conveyed to consumers is a key issue. Labelling is a common method of communicating certain product attributes to consumers that may influence their choices. In a choice experiment concerning fruit purchase decisions, this study estimates willingness to pay for sustainability attributes by consumers in Japan and the UK. The role of label presentation format is investigated: text only, text and graphical, and graphical only. Results indicate that sustainability attributes influence consumers' fruit purchase decisions. Reduction of carbon in fruit production is shown to be the least valued out of sustainability attributes considered. Differences are evident between presentation formats and between countries, with increased nutrient content being the most sensitive to format and country while carbon reduction is the most insensitive and almost always valued the least.

Key Words: Willingness to pay, Choice experiment, Food labelling, Sustainability, Cross-country comparison.

JEL Codes: Q18, Q51, Q56

Topics: Agriculture & Food Policy, Environmental Economics & Policy
Consumer/Household Economics, Food Consumption/Nutrition/Food Safety

1. Introduction

Changes in consumer and retailer demands in some markets are driving substantial changes in the value chains that New Zealand's primary industries participate in. There is an increasing expectation that products have sustainability credentials, and that these can be verified. In particular, there is significant and increasing pressure in some key export markets for information on the Greenhouse gas intensity for products throughout the product life-cycle.

In 2008 Cabinet agreed on a New Zealand strategy on GHG Footprinting for land-based primary sectors. The goal for this strategy is for New Zealand primary industries to be able to operate in markets with credibility and where necessary use internationally recognised, transparent and validated GHG Footprinting methodologies. Potential benefits to exporters include maintaining and/or enhancing market place access and improving relationships with suppliers and customers.

In order to extract full benefits from footprinting activity it becomes essential to understand how Footprinting information can be converted to consumers and other members of the value chain, particularly when this information may be associated existing and new information on environmental , health, safety and social concerns that are reflected in food marketing. This papers contribution is to provide information that will assist industries and firms to benefit from potential market opportunities, by assessing the importance of, and methods by which, GHG Footprinting information and measures can be incorporated alongside information on other sustainability criteria in marketing of products. These are important considerations in proactively positioning New Zealand's land-based primary sector for the emerging sustainability agenda of export markets.

This work develops a discrete choice model that is applied to consumers in Japan and the UK to assess how they value various sustainability attributes of fruit, and the role of label format. Three main objectives are addressed in this paper. Which fruit sustainability characteristics have a significant influence on consumers' fruit choice, what is the relative importance of these and how much are consumers' willing-to-pay for these characteristics? Does the way that information is presented influence consumers fruit choice and willingness-to-pay? What differences are there between the United Kingdom and Japan across the first two objectives? Three discrete choice surveys were conducted for each country, Japan and the UK. Each of the three surveys was identical in all respects except attribute presentation format. The formats were intended to represent alternative possible food labelling schemes, they are; text, graphical, and a sustainability compass. This resulted in six datasets for modelling, three for Japan and three for the UK.

Non-market valuation studies have been extensively applied in valuing various attributes of food including; production technology attributes (e.g. Morkbak and Nordstrom, 2009; Lusk etal. 2006), health attributes (Anders and Moser, 2010; Ginon etal. 2009; Barreiro-Hurle, 2008; Xue etal. 2010; Saba etal. 2010; Gracia etal. 2009), genetically modified foods (Hu etal. 2005), food safety (Angulo and Gil, 2007), region of origin (Stefani etal. 2006; Jaeger and Ros, 2008). There is, however, a relative lack of studies examining consumer wtp for sustainability attributes, particularly in a context of multiple sustainability attributes presented simultaneously.

1.1 Carbon Labelling

The practice of carbon-labelling consumer goods, while relatively new, is likely to grow in importance. In 2009, there were roughly 15 carbon labels documented of which 8 were developed in European countries. The UK's pursuit of carbon footprinting and carbon labelling is of particular interest for New Zealand as it is an important export market. The UK received 3.9 per cent of all New Zealand exports in 2010 (YE June). It was New Zealand's principal export market for sheep meat products with 30 per cent in 2010, worth NZ $ 642 million, the second largest export market of wine products (29 per cent of all wine product exports) and the fourth largest export market of wool products (7 per cent of all wool product exports) (Statistics New Zealand, 2010). The UK Carbon Trust in 2006 introduced a label called the Carbon Reduction Label with the proviso that products bearing the label have to reduce emissions associated with producing the product by 20 per cent over two years following certification otherwise they risk to lose the right of use the label. In January 2007 Tesco started as part of a trial of the Carbon Label Company to include four types of products. These categories comprised of potatoes, orange juice, washing detergents, light bulbs and milk products. In the last three years, this has been expanded to more than 100 products from different product categories with plans for more categories in the future. Tesco aims to reduce the carbon impact of its products in its supply chain by 30 per cent by 2020 (Tesco, 2009). The process of developing carbon labels has varied with some being initiated by governments, others by government quangos, and some by non-profit organisations, but all have generally involved cross-sector consolation.

Japan has introduced a Carbon Offset labelling scheme, with retailers voluntarily attaching these labels to their products. The Japanese carbon label includes an image of a lead weight with the letters "CO_2" in the centre, with the attached carbon "weight" of the product in bold letters above (METI, 2009). Also, Japan's undertaking of carbon footprinting and carbon labelling is of particular interest for New Zealand as it is an important export market. As trade statistics show Japan was New Zealand's fourth-largest export market in 2010, receiving 3.1b in export value. Japan is New Zealand's principal export market in vegetable products (30 per cent of all vegetable product exports) and kiwifruit (27 per cent of all

kiwifruit exports). Japan is second largest export market in cheese products, worth NZ$642 million (Statistics New Zealand, 2010).

1.2 Food Sustainability Attributes and Label Presentation

There are many ways of presenting specific information on labels and different manufacturers use different methods of presenting and emphasizing information on their product labels. The design of labelled information may also depend on the type of information that needs to be introduced to the label. Environmental and other sustainability features of a product possibly require a different design than the display of nutritional values or information on GM ingredients of the food product.

Several international empirical studies on consumer's WTP for different types of food product labels were examined by McCluskey & Loureiro (2003). They argue that consumers from different countries may respond differently to the same environmental product attribute that is labelled. For example, results of a study on consumer response for environmentally-friendly seafood in the U.S. and Norway showed differences of consumer preferences for price premium, species, consumer group, and certifying agency (see Johnson et al. 2001). Similarly, Roosen, and Fox (2003) estimated consumer's willingness-to-pay for genetically modified corn fed beef in France, Germany, the United Kingdom, and the United States by using a choice experiment, for several beef attributes and compared valuations of these attributes. Results indicate that consumers in France, Germany, and the United Kingdom are willing to pay more for beef from animals not GM fed corn than are consumer in the U.S. In order to learn more about consumer preferences towards GM ingredients in food products in different countries, comparable surveys were conducted by McCluskey and colleagues in Japan, China and Norway. The surveys included questions if respondents were willing to pay the same price for the GM food as a corresponding, non-GM food product.

The survey results for Japan (McCluskey et al. 2003a) indicated that environmental attitudes and food safety, self-reported knowledge about biotechnology and risk perceptions of products containing GM ingredients, income, and education significantly increase the discount required for consumers to choose GM food products. The results show that Japanese consumers in the sample request on average 60 per cent discount on GM products compared to non GM products, whereas Norwegian consumers need a 49.5-per cent discount on GM bread compared to conventional bread. Interestingly, the estimation results for China showed the opposite as Chinese consumers, on average, were willing to pay a premium of 38 per cent premium for GM rice over non-GM rice and a premium of 16.3 per cent for GM soybean oil over non-GM soybean oil (see Li et al. 2003). The results show that positive opinions and low risk perception regarding biotechnology and GM foodstuffs

significantly increase the premium that Chinese consumers are willing to pay for GM foods. With these results McCluskey and colleagues (2003) emphasize the statement that the WTP for GM food depends on the culture and tradition and perception of the science, and they conclude that especially for socially responsible and origin-based food products consumers must perceive high food quality to pay a price premium for the labelled food product.

Concerns about climate change have also been seen through changes in markets and development of labelling schemes. The importance and role of sustainability and carbon footprint labelling for consumers has been investigated in several studies. Fischer (2009) discusses several studies on consumer perceptions of different environmental labels. Based on results of large survey across several countries (USA, UK, Netherlands and France) conducted by Capgemini (2007) an international consulting firm Fischer (2009) discusses that consumers are willing to pay at least a small difference for sustainability attributes. The majority of consumers are willing to pay more when the product label covers fair trade issues and sustainable manufacturing. Fischer (2009) assumes that many consumers are willing to pay a premium for products that support sustainability requirements in order to give 'peace of mind'.

A survey undertaken by the European Commission in 2009 (Eurobarometer, 2009) investigated which of the many environmental product attributes are the most important on environmental labels. Regarding label information on package recycling and reusability, a majority of Finnish (57 per cent), British, Portuguese and Irish respondents (all 52 per cent) stated that whether a product can be recycled or reused is the most important information that an environmental label should display. Compared to Latvia and Lithuania where less than a quarter of participants selected this response (18 per cent and 24 per cent, respectively). With regards to the products' GHG emissions display on an environmental label in almost all European countries that were surveyed, the proportion of respondents selecting the carbon footprint as the most important information on environmental labels was lower than that selecting each of the alternative possibilities (e.g. recycling, eco-friendly packaging, eco-friendly sources) listed in the survey. The proportion stressing the importance of information about a product's carbon footprint was the highest in Portugal (19 per cent) and the lowest in Latvia and Poland (3 per cent and 4 per cent, respectively).

In the United Kingdom there are approaches to develop a holistic sustainability label (Sustain, 2007). Sustain Ltd an alliance representing 100 national public interest organisations in food and agriculture policies and practices related topics presented a holistic label consisting of several sustainability criteria to the FSA in consultation with the European Union. This holistic 'flower' uses a version of the 'traffic light' system (red=poor, amber=improving, green=good) where each petal can have a value associated with it. Each petal of the "flower" represents a different sustainability factor and colours allow for rapid and clear assessment by consumers and clear signals to the food industry. Sustain (2008)

argues that a single system of sustainability labelling which can be understood at a glance is needed, and they suggest that the FSA and the European Commission should collaborate on developing effective models of sustainability labelling as currently, each label is unique in the way it is calculated, assessed and awarded. Sustain is developing, with its membership and others, methods for handling multiple sustainability criteria, allowing grading for each.

Empirical research also showed that consumer attitudes towards different label designs differ from country to country. In their study on consumer preferences for several nutrition front-of pack formats, Feunekes et al (2008) surveyed 1,630 men and women (18–55 yrs) in the United Kingdom, Germany, Italy and the Netherlands. In their study the impact of eight front-of-pack nutrition labelling formats was investigated across these countries. The study investigated consumer friendliness (comprehension, liking and credibility) of these labelling formats. In the study participants were shown three (out of six) different nutrition labelling formats ranging from a simple tick (healthier choice) to a complex wheel of health using the traffic light system.

These formats were presented to the respondents in nine pairs of products with a healthy and an unhealthy choice. Results showed that the interaction between country and format was significant. Results of the cross-country comparison indicated that Dutch consumers had a better understanding of the formats compared to participants from the UK, Germany and Italy. Regarding the liking of a format, it could be seen that participants from the UK liked the Multiple Traffic Light more than the Wheel of Health, but this difference was not found in other countries. With regards of the impact of the label on perceived healthiness the interaction between format and country was also significant. Smileys and Stars were significantly the best differentiators between healthier and less healthy product choices. The authors summarize that although there were several significant differences between countries, the overall effects were quite similar. Furthermore, some differences between countries were found, but these were not large enough to warrant different labels between countries. The authors argue that differences between countries may have been influenced by the different demographics in each country.

In another study Feunekes (2008) evaluated the impact of the different labelling formats on purchase decisions (usage intention and process time) of consumers in Italy and UK with a number of 371 participants and 405 participants, respectively. With conducting the second study Feunekes et al. (2008) emphasized that the tick is a method of displaying nutritional value that helps consumers to make healthier food choices. In the computer-based experiment the respondents were more attracted to the simpler logos for nutrition information such as tick or stars than to the more complex formats that display % Guideline Daily Amount (GDA) scores across countries. For the display of nutritional values and considering the aspects of a shopping environment, Feunekes et al. (2008) suggest the use

of simple formats for the front of the food product in combination with a more complex nutritional fact panel on the back of the package.

2. Choice Modelling Method

This analysis employs the stated preference (SP) method to collect information on respondent's fruit preferences. The SP method involves simulating the context in which consumers would normally make choices among a set of competing product alternatives. This is achieved by designing experiments in which product characteristics and prices are systematically and independently varied to produce multiple choice scenarios. Consumers are then asked to indicate their preferred alternative in each scenario. The observed choice, levels of attributes in the chosen alternative and levels of attributes in non-chosen alternatives, are modelled in a probabilistic econometric framework.

The stated preference method is one of various choice modelling approaches that are underpinned by the rigorous and well tested theory of consumer choice behaviour known as random utility theory (e.g. McFadden, 1974; Ben-Akiva and Lerman, 1985). Random utility theory postulates that consumers associate some utility (a latent measure of preference) with each product that they consider. Consumers try to maximise their utility by choosing the things that they think suit them best, all else equal. That is, consumers try to choose products that are "best" for them, subject to what they know about competing options and whatever constraints, such as income, are operating on their choices.

The model can be made operational by formulising the relationship as follows:

$$U_{ij} = \beta_{0ij} + \sum \beta_k x_{ij} + e_{ij} \quad (1)$$

Where U_{ij} is the measure of utility derived by individual *i* from alternative *j*, which is a function of the sum of the utilities for each *k* attribute $\sum \beta_k x_{ij}$, where β is the utility weight given to attribute *k* in the valuation, and e_{ij} is an error term which is randomly distributed.
The random component allows analysts to express consumer choice in probabilistic terms that enables the underlying preferences for attributes to be extracted.

$$P_{(ij|A)} = Prob\left(U_{ij} > U_{i1}\right) \; where \; 1 \in A \; and \; 1 \neq j \quad (2)$$

Where the probability that individual *i* chooses alternative *j* in the choice set *A* (i.e. $P_{(ij|A)}$) is commensurate with the probability that the utility U_{ij} is greater than the utility of the other alternatives U_{i1} in *A*.

The most commonly used form of discrete choice model is the Multinomial Logit model which takes the form:

$$P_{iq} = \exp\left(V_{iq}\right)/\sum_{j=1}^{J} exp\left(V_{jq}\right) \quad (3)$$

In which the error terms of alternatives are assumed to be independently and identically distributed as extreme type I variates.

The random parameter logit (RPL) model represents a full relaxation of the IID assumption and addresses the other behaviour limits of MNL models by accommodating correlations among panel observations and accounting for uncontrolled heterogeneity in tastes across respondents (Train, 2003). The parameter vector can be expressed as the population mean β and the individual specific deviation from the mean η_i. Hence the above utility function can be rewritten as:

$$U_i = \beta X_i + \eta_i X_i + \varepsilon_i \quad (4)$$

The stochastic part of utility now may be correlated among alternatives and across the sequence of choices via the common influence of η_i (Hensher and Greene, 2003). The choice probability resulting from this specification does not have a closed form solution and requires estimation by simulated maximum likelihood (ML). The ML algorithm searches for a solution by simulating m draws from distributions with given means and standard deviations. Probabilities can then be calculated by integrating the joint simulated distribution (the mixture distribution of the IID distribution of ε_i and the specified distribution for η_i).

3. Survey Development and Description

Questionnaire development took place over an extended period. The sustainability attributes identified by focus groups participants were supplemented by literature review and discussions with experts in the field. Focus group meetings are an important aspect when trying to understand the importance and role of sustainability and particularly of carbon footprint labelling. It is necessary to understand the larger process of food consumption decisions including information collection, store behaviour, and label priorities. In order to determine the study attributes for the survey, focus group meetings and interviews with key stakeholders in the food industry were conducted. In these interviews participants were predominantly concerned about the future of water scarcity and quality. Hence, an attribute describing water efficiency is included in the study.

Two focus groups were held in February 2010 in New Zealand to derive an understanding of people's views and attitudes towards different food product labels and to identify attributes for inclusion in the choice experiment. The participants in the first group were aged 20 to 30 years old whereas the second group included people aged 30 to 60 years old. Both focus groups followed a similar format including discussion of individual products and awareness and perceptions of sustainable, especially carbon footprint labelling. The level of awareness was roughly the same across both groups although group one has a slightly higher level of involvement and awareness than those in group two. The lower level reflects that group one believed it would be difficult to make a decision based on sustainability due to limited knowledge and information provided.

This difficulty was found when three specific carbon labels were presented to the participants for preference and user interpretation. Participants were concerned about how the standard of the carbon measure was set. In addition, respondents were missing reference point and background information. However, it was agreed that if all products had such labels it would be useful for comparing food items.

The focus groups responses reveal the complexity of decision-making facing individuals. The variety of responses and the influence of sustainability criteria reflect the nature of the decision process and constraints that individual consumers face. The awareness of sustainability issues is encouraging even though it may not be the primary driver of decision-making. The final attributes selected for the choice experiment are described in Table 1.

Table 1 Attribute descriptions

Price	This attribute compares the price for the fruit in the survey to the price you currently pay for the fruit you normally buy. The fruit in the survey may cost more or may cost less than you currently pay.
Carbon/ greenhouse gas emissions reduction	This attribute concerns the amount of carbon dioxide (CO_2) and other greenhouse gases emitted during production and distribution. For many of the options in the survey, emissions have been reduced. Most scientists believe that greenhouse gas emissions, often expressed as CO_2-equivalents, are causing global climate change or global warming.
Water efficiency	This attribute focuses on the use of water in production and distribution. Greater efficiency means that less water is used to grow the fruit and get it to the consumer.

Vitamins	Fruit is a good source of vitamins. There are natural ways to grow and distribute fruit that is high in vitamins, such as selecting varieties that have higher levels of vitamins or reducing vitamin loss during storage. These changes are reflected in the higher vitamin content of some of the options in the survey.
Waste/ packaging reduction	This attribute indicates that the product is produced and distributed in ways that reduce waste packaging. Reducing waste and packaging means less use of natural resources.

Each of these attributes is assigned multiple levels, as presented in Table 2. These levels are systematically varied and combined to form the questions that survey respondents face.

Table 2 Attribute levels

Attributes	Level 1	Level 2	Level 3	Level 4
Price	- 10%	No change	+ 10%	+ 20%
Carbon	- 30%	- 20%	- 10%	No change
Water	+ 60%	+ 40%	+ 20%	No change
Waste	- 60%	- 40%	- 20%	No change
Vitamins	+ 100%	+ 66%	+ 33%	No change

The final questionnaire included twelve questions each made up of a paired comparison of two alternatives. Figure 1 gives an example of one of the questions for the 'text' attribute presentation format. This presentation format represents what can be considered as the conventional approach in mainstream choice modelling applications. Figure 2 gives an example of a question for the 'graphical' attribute presentation format. This format combines visual stimulus through the graphical representation of attribute level changes and a brief text description with each of the attributes presented individually. Figure 3 gives an example of a question for the 'sustainability compass' presentation format. This presentation format allows product information to be presented in a holistic way by presenting all the sustainability attributes together; price is given separately reflecting normal markets. Each of four sustainability attributes corresponds to a point on the compass. The points can be filled in with colour to represent how well the product is doing. For the 'graphical' and 'compass' labels; if the scale or area of the bar or point is more filled in, then; there are greater reductions in CO_2 emissions, water is being used more efficiently, there are greater amounts of vitamins in the fruit, and there are greater reductions in waste or product packaging.

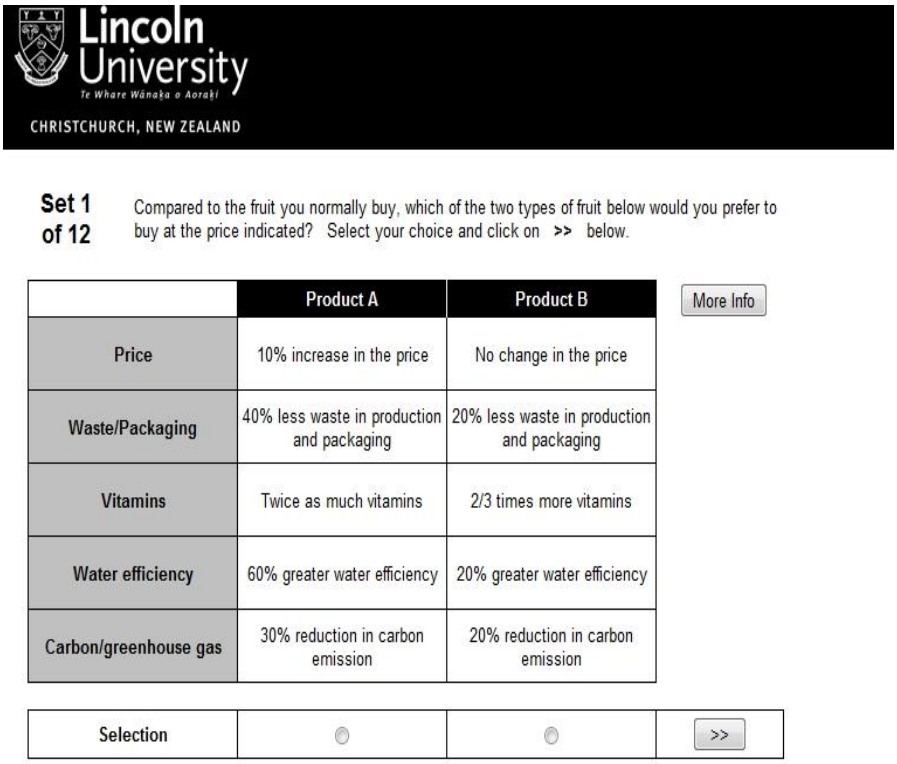

Figure 1 Plain text attribute presentation

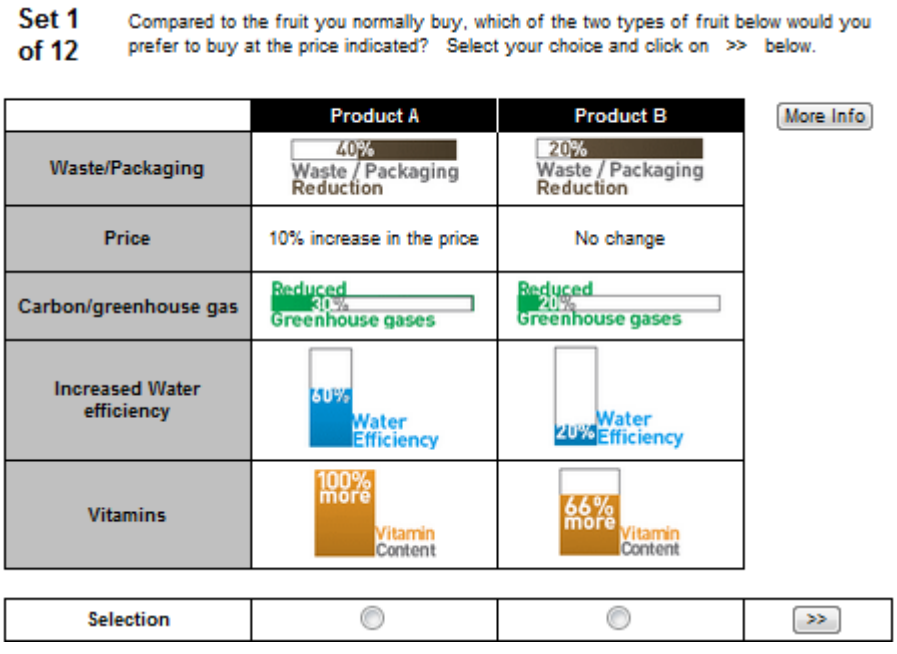

Figure 2 Graphical attribute presentation

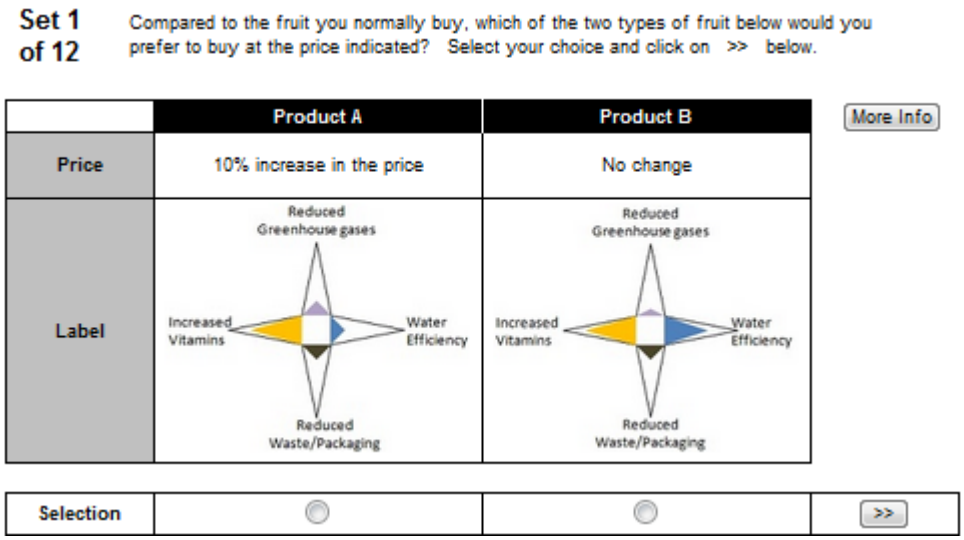

Figure 3 Sustainability compass attribute presentation

The sampling strategy involved recruiting from an online panel database of consumers. Each survey was stratified by the countries age and household income distributions. The survey instrument included generic questions on shopping behaviour, demographics and the choice experiment. Surveys were implemented using a combination of Qualtrics™ and purpose built software developed for (Kaye-Blake, Abell and Zellman, 2009). The six surveys were conducted during September and October 2010, each survey was pilot tested before full launch. Sample sizes are given in Table 3.

4. Choice Model Estimation

The levels of each attribute and the choices observed from each question are modelled specifying a Random Parameter Panel Logit model estimated using Maximum Likelihood employing econometric software Limdep v.9™ and Nlogit v.4.3™. This method models the probability of a particular fruit alternative being chosen as a function of the levels of observed attributes. Table 3 presents parameter estimates for each attribute from the six surveys with varying attribute presentation formats. To allow for preference heterogeneity, we assume all parameters, except the ones for price of fruit and the ASC, to be normally distributed random parameters. The price parameter is fixed, even though it implies that the marginal utility of money is fixed over the population, but it avoids a number of potentially severe problems associated with specifying a random price parameter (see e.g. Hensher et al., 2005; Train, 2003; Train and Sonnier, 2005). In all our models we applied the panel data setting of the RPL model based on the sequential repetition of choice tasks per respondent. Error component and correlated parameter specifications were examined without any improvement.

The strength of statistical significance of a parameter is determined at conventional levels. For example, if a parameter is significant at a 1% level there is a less than 1% probability that the observed relationship is by chance. A negative sign on a parameter indicates that fruit options with relatively higher levels of this attribute are less likely to be chosen by a respondent. Conversely, a positive sign indicates that a fruit option containing relatively higher levels of this attribute is more likely to be chosen.

Table 3 Choice modelling estimates. Random parameter panel logit models. All Simulations are based on 1000 Halton draws. Each panel contains 12 choice sets with two alternatives in each.

Parameter estimates by country and presentation format						
	United Kingdom			**Japan**		
	Text	*Graphic*	*Compass*	*Text*	*Graphic*	*Compass*
Variable						
ASC	0.09	0.15*	-0.08	0.21***	0.17**	-0.05
Price	-14.04***	-9.08***	-12.83***	-6.68***	-10.06***	-10.59***
Carbon	5.5***	3.18***	3.68***	2.35***	2.3***	2.30***
Water	2.42***	1.88***	1.86***	1.37***	0.73***	0.72***
Waste	3.12***	1.58***	1.61***	0.47**	0.91***	1.54***
Vitamins	0.85***	1.52***	1.71***	0.51***	2.67***	2.93***
Standard deviations						
Carbon	5.55***	3.61***	3.25***	2.72***	3.11***	2.87***
Water	1.56***		1.41***			
Waste	3.33***	1.09***	2.26***		1.19***	1.14***
Vitamins	1.69***	1.09***	2.13***		2.33***	2.01***
AIC	0.89	1.01	0.93	1.11	1.03	0.94
BIC	0.93	1.05	0.97	1.15	1.05	0.98
Psuedo-R^2	0.37	0.28	0.34	0.20	0.31	0.33
Observations	1143	1199	1196	1229	1210	1193

Note: ***, **, * significance at 1%, 5%, and 10%.

The signs and statistical significance of each fruit attribute parameter are consistent across all presentation formats, and between countries. All attribute parameters are highly statistically significant and of the expected signs. Consumers are more likely to select a fruit option with a lower price, greater carbon/ greenhouse gas emissions reduction, greater water efficiency in production, increased vitamin content, and greater waste/ packaging reduction. Significant heterogeneity is present around the means of most random parameters.

4.1. Parameter Equality Tests

This section endeavours to investigate the influence of differing fruit labelling formats on the choices made by consumers, choice model estimates, and attribute willingness-to-pay (WTP) estimates. Presented first are tests of equality for estimated model parameters across each of the label presentation formats. Followed by calculation of WTP for attributes of each model, and tests of equality between these estimates.

Looking across the different models there appears to be some differences in parameters. The differences in parameter estimates between models cannot be gauged directly as each is confounded with a scale parameter inherent in the parametric formulation of the error distribution. To overcome this, a testing procedure proposed by Swait and Louviere (1993) is undertaken that accounts for the scaling effect. This test is performed by estimating two models separately and then a combined model with the two datasets stacked and scaled relative to each other. Table 4 presents the results of this testing procedure. The null hypothesis (H_0) is that the parameters of each model are equal. For this procedure Multinomial Logit models are specified.

For example in the first test given, UK text vs. graphical, a test for equality between the parameters of the UK 'text' attribute presentation model and the UK 'graphical' attribute presentation model, the relative scale ratio was found to be one after stacking both UK 'text' and UK 'graphical' datasets, then rescaling the 'text' data relative to the 'graphical' data. This implies that the 'text' sample has on average, the same response variability as the 'graphical' sample. The likelihood ratio test statistic for a comparison of the choice model parameters between the 'text' and 'graphical' models is 10. The critical Chi-square value of 16.8 at the 5% significance level (six degrees of freedom), is above the calculated value. Therefore, it can be concluded that there is no significant difference between the two models parameters, and we can retain the null hypothesis. Looking at Table 4 we can see that the null hypothesis of parameter equality is rejected for all but two model comparisons.

Table 4 Model parameter equality tests

Models	Relative scale ratio	Log likelihood ratio $\chi2=-2(LL_{Model1+Model2}-(LL_{Model1}+LL_{Model2}))$	Critical value $\chi2_{\alpha,k+1}$	Reject H_0
UK text vs. graphical	μ = 1	χ2 = -2(-1188-(-606-577)) = 10	$\chi2_{0.01,6}$ = 16.8	No
UK graphical vs. compass	μ = 1.2	χ2 = -2(-1150-(-535-606)) = 18	$\chi2_{0.01,6}$ = 16.8	Yes
UK compass vs. text	μ = 1.1	χ2 = -2(-1122-(-577-535)) = 20	$\chi2_{0.01,6}$ = 16.8	Yes
Japan text vs. graphical	μ = 0.8	χ2 = -2(-1347-(-688-635)) = 46	$\chi2_{0.01,6}$ = 16.8	Yes
Japan graphical vs. compass	μ = 0.9	χ2 = -2(-1223-(-635-584)) = 6	$\chi2_{0.01,6}$ = 16.8	No
Japan compass vs. text	μ = 0.7	χ2 =-2(-1309-(-688-584)) = 72	$\chi2_{0.01,6}$ = 16.8	Yes
Text Japan vs. UK	μ = 1.6	χ2 = -2(-1235-(-535-688)) = 24	$\chi2_{0.01,6}$ = 16.8	Yes
Graphical Japan vs. UK	μ = 1	χ2 = -2(-1259-(-606-635)) = 36	$\chi2_{0.01,6}$ = 16.8	Yes
Compass Japan vs. UK	μ = 1.1	χ2 = -2(-1185-(-577-584))= 48	$\chi2_{0.01,6}$ = 16.8	Yes

The results of this testing procedure indicate that there are differences at the overall model level between fruit labels employing different presentation formats. The next section focuses down from this aggregate level to investigate which individual attributes are contributing to this overall difference.

4.2. Willingness-to-pay Estimates and Equality Tests

How consumers' trade-off an attribute for another is calculated as a ratio of the estimated model parameters. These measures are known as marginal rates of substitution as they tell us how one unit of an attribute is substituted for a unit of another attribute. For example, how respondents trade off a reduction in carbon for an increase in the price of fruit is calculated as

$$WTP = \frac{-\beta_{Carbon}}{\beta_{Price}} \quad (4)$$

This trade-off with price is called willingness-to-pay as it measures how much money a consumer is willing-to-pay for a change in the level of another attribute, in this example a decrease in carbon. The WTP amounts are reported in Table 5. For example, using estimates from the 'UK Text' model tells us that the average consumer is WTP a 1% increase in the price of a piece of fruit for a:

- 39% reduction in carbon
- 17% increase in water efficiency
- 22% reduction in waste/packaging
- 6% increase in vitamins

This means that consumers require the greatest improvement in carbon reduction (39%) for the same price increase (1%), while they require the lowest improvement in vitamins (6%) for the one percent price increase. The rank of importance, based on WTP, is therefore; increased vitamins first, greater water efficiency second, greater waste/packaging reduction third and greater carbon reduction last. Importantly, this ranking is not consistent across presentation formats or countries, although carbon reduction is ranked last in five out of the six models, and waste reduction first or second, in five out of the six models.

Table 5. Willingness-to-pay across country and presentation format.

	United Kingdom			**Japan**		
	Text	*Graphical*	*Compass*	*Text*	*Graphical*	*Compass*
Carbon	39% (33%-50%)	35% (25%-45%)	29% (23%-40%)	35% (24%-46%)	23% (14%-34%)	21% (12%-32%
Water	17% (12%-21%)	21% (16%-27%)	15% (10%-20%)	21% (13%-27%)	7% (2%-12%)	7% (1%-12%)
Waste	22% (19%-27%)	17% (13%-22%)	12% (10%-18%)	7% (1%-13%)	9% (5%-15%)	14% (10%-20%)
Vitamins	6% (4%-10%)	17% (14%-22%)	13% (10%-16%)	8% (5%-12%)	23% (18%-25%)	28% (23%-30%)

Notes: 95% confidence intervals in brackets

Looking at Table 5 suggests that there may be differences in WTP across presentation formats and countries. To test the hypotheses of WTP equality, a parametric bootstrapping technique (Krinsky and Robb, 1986) was used to draw a vector of 1000 parameter estimates from the multivariate normal distribution with mean and variance equal to the parameter mean vectors and the covariance matrix for each of the estimated MNL models. WTP measures were calculated from each parameter estimate. The simple convolutions method of Poe et al. (2001) was then used to estimate the average proportion (over 100 random draws) of WTP differences that were negative. This proportion is used to approximate a p-

value for the null hypothesis of no difference between the distributions of wtp between the different models.

Table 6. Testing for differences in willingness-to-pay across presentation formats and countries. P-values estimated using Poe (2001). ***, **, * denotes statistically significant difference at 1%, 5% and 10% respectively.

Comparisons	Carbon	Water	Waste	Vitamins
Within country-across presentation format				
UK text vs. UK graphical	0.29	0.84	0.11	0.99***
UK graphical vs. UK compass	0.22	0.06	0.11	0.13
UK compass vs. UK text	0.08	0.21	0.01**	0.99**
Japan text vs. Japan graphical	0.08	0.00***	0.68	0.99***
Japan graphical vs. Japan compass	0.44	0.46	0.93	0.91
Japan compass vs. Japan text	0.05	0.00***	0.98**	1.00***
Within presentation format-across country				
Japan text vs. UK text	0.69	0.21	0.99**	0.28
Japan graphic vs. UK graphic	0.93	0.99**	0.98**	0.07
Japan compass vs. UK compass	0.86	0.98**	0.30	0.00***

Looking at Table 6 shows that significant differences exist for some attributes in seven out of the nine comparisons. Two out of the nine comparisons have only one difference, five comparisons have two differences and two comparisons have three differences. Within countries the least differences are between the 'graphical' and 'compass' formats with no statistical differences for any attributes in both Japan and the UK. Across countries the least differences are between the 'text' presentation format models with just one significant difference. The greatest differences are between the 'text' and 'compass' formats, both within and across countries.

When we look across the pair-wise model comparisons, we can see that there are no differences for the 'carbon' attribute. While the majority of pair-wise comparisons yield differences for the 'vitamins' attribute. These results suggest that preferences over the 'carbon' attribute are consistent across label formats and countries, while WTP for 'vitamins' is very sensitive to the way that information is presented to consumers.

5. Conclusions

Modelling results indicate that all attributes of fruit considered here are important contributors to consumers' fruit purchasing decisions. The influence of presentation format and country is apparent when looking at Table 5. Taking the WTP estimates for the 'text' presentation format, the preference ordering for the UK is: 'vitamins' first, 'water' second, 'waste' third and 'carbon' last. This ordering is relatively consistent across presentation formats within the UK as 'carbon' is always ranked last and 'vitamins' always ranked first or second. While for Japan the ordering is: 'waste' first, 'water' second, 'vitamins' third and 'carbon' last. The ranking of 'carbon' is relatively constant across presentation formats within Japan at either last or second to last. Likewise the ranking of 'waste' is fairly consistent at either first or second. However the ranking of the other non-price attributes is more uncertain.

An important finding is that overall, 'carbon' is valued lowest of all attributes, and has an average preference ranking of 3.8 (out of 4, with 1 being most preferred) over the six models WTP estimates shown in Table 5. The other non-price attributes average preference rankings over all models are: 2.2 for 'water', 1.8 for 'waste' and 2 for 'vitamins'. Taken as a whole these results indicate that reductions in 'carbon' are valued the least for both countries and across all presentation formats. The UK values increases in 'vitamins' the most while Japan values improvements in 'waste' the most. Using the results presented in Table 6 reveals that consumers WTP for 'carbon' is insensitive to information presentation format or country. Conversely, consumers WTP for 'vitamins' is very sensitive to information presentation format and country.

This study suggests that care should be taken in how labels are developed as they may lead to consumers' perceptions of information being dependent on presentation format and influencing WTP for sustainability attributes.

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