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Purchaser Preferences On Carbon Labels: Conventional Vs. Organic Milk

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PURCHASER PREFERENCES ON CARBON LABELS: CONVENTIONAL VS. ORGANIC MILK

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ABSTRACT

Over the past several years, there has been growing attention concerning global warming/climate change and how humans are contributors. It is known that agricultural production is a main contributor of greenhouse gas emissions and the livestock sector is particularly significant because it is quoted as having between 3 and 18% of greenhouse gas emissions measured in CO_2 equivalent pending different assumptions. Due to this, carbon footprint labeling has been described as a potential tool to inform consumers about greenhouse gases associated with food products and assist them with the necessary information to purchase products that help reduce greenhouse gas emissions. Currently TESCO, a British grocery chain, prints carbon footprint labels on many of their products and they are striving for all of their products to display the label in the foreseeable future. Research has also been done in supermarkets throughout the UK showing there is an interest/demand for carbon labels in that country. Our main goal with this research was to analyze if a carbon label would modify milk consumer behavior for University of Arkansas faculty, staff and students. In particular would consumers be willing to pay for this information, would it affect how much milk they drink, what they pay for milk and if they would switch from organic to conventional milk because of a carbon footprint label. While the sample of respondents was more highly educated and younger than representative of the US or Arkansas, respondents did positively value the label information, would pay extra for lower carbon footprint milk and nearly half of the "organic" milk purchasers would switch to conventional milk for a more favorable carbon footprint.

Key Words: Milk, Greenhouse Gas Emissions, Carbon Footprint Label, Fayetteville.

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ACRONYMS

C	Carbon
CF	Carbon Footprint
CH_4	Methane
CM	Centimeter
CO_2	Carbon Dioxide
DEFRA	UK Department for Environment, Food and Rural Affairs
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FPCM	Fat and Protein Corrected Milk
G	Gram
GAL	Gallon
GED	General Educational Development
GHG	Greenhouse Gas
HCL	Hydrochloric acid or Hydrogen Chloride
IRB	Institutional Review Board
IT	Information Technology
L	Liter
LB/LBS	Pound/Pounds
LCA	Life Cycle Analysis
LU	Livestock Units
ML	Milliliter
NH_3	Ammonia
N_2O	Nitrous Oxide
NO_x	Nitric Oxide and Nitrogen Dioxide
O	Oxygen
PAS	Publicly Available Specification
PCE	Perceived Consumer Effectiveness
SO_2	Sulfur Dioxide
UK, U.K.	United Kingdom
UN	United Nations
URL	Uniform Resource Locator
US, U.S. / USA	United States / United States of America
USDA	United States Department of Agriculture
WTI	Willingness to Pay for Label Information
WTP	Willingness To Pay for Lower CF
WTC	Willingness To Consume Less with Higher CF
WTS	Willingness To Substitute Organic for Conventional because of CF

PURCHASER PREFERENCES ON CARBON LABELS: CONVENTIONAL VS. ORGANIC MILK

Chapter One: Introduction

1.1 Contextual Framework

In recent years there has been much debate and concern regarding climate change/global warming and how/if human behavior plays a role. It has been proven that food production is one of the largest contributors to greenhouse gas (GHG) emissions and therefore this industry has received a lot of attention and scrutiny. The livestock sector bears tremendous significance since it represents as much as eighteen percent of GHG emissions measured in CO_2 equivalent (Steinfeld et al., 2006). As of late, carbon footprint[1] (CF) and carbon labeling are considered as possible tools to document and inform consumers about the GHG emissions associated with products. Carbon labels on food products in particular, would provide consumers with the necessary information and ability to select lower GHG intensive products and thereby, theoretically, total GHG emissions (Flysjo, Cederberg and Johannesen, 2011). What is largely unknown is the consumer response to carbon labeling.

Further, since agricultural systems are of biological origins which include complex processes, initial calculations that analyze food products' contribution to climate change/global warming will contain large uncertainties. Some argue that this is more difficult than analyzing the electricity, energy and transport sectors which dominate the overall emission of GHG's.

[1] Carbon footprint (CF) accounts for all GHG emissions with nitrous oxide (N_2O) and methane (CH_4) especially important for agricultural products because of their heightened impact on global warming compared to carbon dioxide. Hence, CF does not only consist of gases containing carbon as the name implies.

> "Hence, while it is important to obtain data with as high quality as possible, it is, however, also important to remember that some data, e.g. emissions from biological processes, can have a high 'inherent uncertainty', because the complexity of the process, lack of measurement methods and natural variations make it extremely complicated to come up with one true figure." (Flysjo, Cederberg and Johannesen, nd, p.2)

Furthermore, differences exist between farms, depending on managerial practices, which make it difficult to complete CF analysis of products. For the case of milk, for example, it is currently not possible to get the CF for each specific farm producing and delivering milk (Flysjo, Cederberg and Johannesen, nd).

Nevertheless, were it was possible to develop definitive measures the question arises whether and how consumers would respond in their purchases if labeled with a CF. Hence, the Carbon Reduction Label, developed by the Carbon Trust was one of the first CF labels developed. This label measures all GHG emissions from every stage in the product's lifecycle: raw materials and packaging needed to produce it, manufacture, transportation, sale, use and disposal. Once the CF has been measured and certified, the applying company must commit to a reduction goal. If this reduction goal is not met after a two year timeframe, that company will not be able to use the Carbon Trust label (Carbon Trust, 2010). This approach allows for comparison of products both within and between product groups (e.g. comparing meat products with different production methods and meat to vegetable substitutes (e.g. beef vs. tofu as a protein source)).

1.2 Problem Statement

The purpose of this research is to compare and contrast consumer preferences towards carbon labeled milk between conventional and organic production systems. Conventional and organic milk for direct consumption are tested because production

differences provide a variety of perceived and/or real product attributes (e.g. degree of presence of artificial hormones, perishability, price, CF, feed ration/land use/manure management/treatment of animals) which are hypothesized to affect purchasing behavior. As such, it will be interesting to see what specific consumer demographic and consumption attributes of organic milk purchasers will drive the decision to switch to conventional milk if carbon labels reveal that organic milk production incurs a higher CF per unit of milk. This is deemed important, as conventional milk producers may be able to recapture part of their milk market that they have lost to organic producers. In addition, organic milk producers and marketing organizations may learn about ways to minimize CF label effects by examining how much they need to lower their CF in milk production to maintain or increase market share. Regardless of how the information is used by different decision makers, consumer responsiveness to CF labeling will allow decision makers to respond to this issue.

For this study a survey was utilized i) to assess consumers' preferences about milk attributes, their beliefs and knowledge regarding environmental concerns; and ii) to determine the potential impact of carbon labeling on purchasing decisions of milk products. An integral part of the survey is measuring respondents' awareness of their personal contribution to the environment utilizing the Perceived Consumer Effectiveness (PCE) construct that is discussed further in chapter 2 section 5.

A direct relationship between PCE and willingness to pay for carbon labels and/or selection of lesser CF products is hypothesized. The other construct tested in the survey is Subjective/Objective Knowledge which is used to determine and measure the purchasers' perceived and actual knowledge regarding climate change and CF issues

(House et al., 2004; Pieniak, Aertsens and Verbeke, 2010). Again, whether knowledge is subjective or objective, a more knowledgeable consumer is expected to be able to fulfill their CF goal with carbon labels on products because he/she will possess the ability to compare products and make a more GHG conscientious decision. In addition, the aforementioned measurements are expected to help classify potential purchasers of carbon labeled milk products into different categories that may be correlated with other consumer demographics commonly tracked (e.g. age, gender and income).

Since carbon labeling is attaining more global attention, private corporations are attempting to capitalize on "green" market opportunities and are placing company calculated carbon labels on their products (i.e. TESCO, Patagonia and Timberland[2]).

Presently, there is little published research regarding consumer preferences towards carbon labeled products, however, and thus, this research is deemed beneficial to provide decision makers with information about likely effects of labeling on milk products.

1.3 Hypothesis

A survey of a sample of consumers is expected to provide a representation of food consumers' understanding and beliefs of current environmental issues and a test of the impact of carbon labeling on willingness to pay for different milk attributes related to CF. As a function of differential social awareness, demographic characteristics and media

[2] The corporate websites showing their carbon labeled products are:
http://www.tesco.com/greenerliving/greener_tesco/what_tesco_is_doing/carbon_labelling.page?
http://www.patagonia.com/us/footprint/index.jsp
http://earthkeepers.timberland.com/

efforts, consumers are expected to reveal different responses regarding environmental issues and hence differences in their reactions to carbon labeling. This analysis will thus help provide private companies and governments with making investment and policy decisions that would alter CF and marketing strategies and/or informational campaigns about climate change.

Four null hypotheses regarding consumer behavior are tested in this study and stated below. The respondents' behavior is not affected by carbon labeling for …

1. purchasers with lower/higher PCE scores, indicating a perception of lesser/greater effect of personal purchasing decisions on environmental outcomes of that purchasing decision;
2. purchasers with lower/higher objective knowledge scores, indicating lesser/greater extent of correct understanding about climate change and CFs;
3. purchasers with lower/higher subjective knowledge scores, indicating lesser/greater extent of perceived understanding regarding climate change and CFs, as reflective of their objective knowledge score;
4. purchasers of organic milk with current prices of conventional and organic milk unchanged.

1.4 Study Organization

A literature review of a detailed life cycle analysis of greenhouse gas emissions from the global dairy sector, a study of conventional and organic milk production systems, purchaser preference studies of grocery shoppers and appropriate research applications using the PCE and Subjective/Objective Knowledge constructs are presented

in Chapter II. From these findings, a survey instrument was prepared and the rationale for questions is provided in Chapter III. Chapter IV summarizes results of this survey and provides estimates of willingness to pay for carbon label information and likelihood of modifying consumption of milk as a function of PCE, consumer knowledge regarding GHG emissions and climate change, and finally demographic characteristics of the respondents. These results, along with potential direction for future research can be used by policy makers and various producers and marketers within the dairy industry to determine consumer's wants and needs, as well as current feelings and perspectives toward carbon labeling.

Chapter Two: Review of the Literature

2.1 Introduction

Globally, carbon labeling is a new idea and practiced by only a handful of private companies in the U.S. and the EU. The Carbon Trust (Carbon Trust Footprinting Company, 2010) has standardized a "carbon reduction labeling" scheme which has warranted attention from several private food companies such as: Dyson, Kingsmill, Morphy Richards, Tesco and Walkers at the time of this writing. The Carbon Reduction Label is an easily recognizable label that consumers can check to see if the manufacturer of a product is committed to reducing their carbon emissions. Brand manufacturers that want to use the label must calculate the exact footprint of the product to the PAS 2050 standard which was developed in 2007 by the Carbon Trust in partnership with the UK Department for Environment, Food and Rural Affairs (Defra) and BSI British Standards. Globally, companies are now using this standard to calculate the CFs of their products. When calculating a CF, every stage in the product's lifecycle must be accounted for: raw materials, packaging, manufacture, transportation, sale to end user, use and disposal. Once the product's CF has been measured and certified, the brand must commit to reducing the product's emissions. Every two years the product must be reassessed and an emissions reduction has to be achieved and independently certified or the label is removed.

As shown in this chapter, some barriers of consumer and producer adoption for this label include a lack of purchaser knowledge and awareness about GHG emissions and also the complications of standardizing GHG measurement within the food industry

given complexities of biological processes and a myriad of different and region-specific production methods.

The first part of this chapter provides an overview of a Life Cycle Assessment (LCA) of the global dairy sector and presents a plausible standardized measurement. The second part of this chapter compares the production systems of conventional and organic milk to show how their production differences impact their respective CF. The third part of this chapter presents two current studies on consumer preferences regarding carbon labels. One of the studies is presently ongoing in the EU and has already publicly shared some consumer attitude results. This will serve as a means to make interesting comparison for results from this research. The fourth part of this chapter compares and contrasts different measures/constructs that can be used to measure consumers' attitude towards climate change. The fifth part provides literature on the use of inferred valuation for gaining estimates of willingness to pay. Finally, the literature review concludes with summarizing comments.

2.2 Global GHG Emissions from the Dairy Sector

In addition to the growing awareness about agriculture's impact on climate change, population growth coupled with rising incomes is increasing the demand for meat and milk consumption. Demand is projected to double by 2050 compared to 2000 (Alexandratos, 2006). Therefore, it has become obvious that a pressing need exists to better understand the magnitude of the livestock sector's overall contribution to GHG emissions, to identify effective approaches to reduce emissions and where in the food chain to target these efforts. Addressing these needs has motivated many to re-examine global livestock food chain emissions using an (LCA) approach. Improving the CF of the

dairy sector[3] in particular is a crucial element for sustainable milk production (Gerber et al., 2010) and may have consumer impacts.

> "The overall goal of this report (Greenhouse Gas Emissions from the Dairy Sector. A Life Cycle Assessment) was to provide estimates of GHG emissions associated with milk production and processing for main regions and farming systems of the world. The specific objective of the study was two-fold: (1) to develop a methodology based on the LCA approach applicable to the global dairy sector and (2) to apply this methodology to assess, and provide insights about, GHG emissions from the dairy cattle sector." (Gerber et al., 2010, p.9)

The Gerber et al. study elaborates on *Livestock's Long Shadow's* (Steinfeld et al., 2006) work on livestock's contribution to GHG emissions, by refining and detailing the emission estimates for the dairy cattle sector. It concentrates on the entire dairy food chain, encircling the entire life cycle of dairy products from the production and transport of inputs (fertilizer, pesticide and feed), transportation of milk off-farm, dairy processing, the production of packages and the distribution of products to retailers. Excluded are emissions related to capital goods such as farm equipment and buildings; on-farm milking and cooling; and retail storage activities (e.g. refrigeration and disposal of packaging). The following excerpts from this study highlight the complexities involved:

> "Emissions, including those taking place after the farm-gate are all reported in per kg of fat and protein corrected milk (FPCM) units at the farm gate." (Gerber et al., 2010, p.9)

> "Emissions related to manure outside the livestock systems and to draught animals, are separated from other dairy sector emissions. The remaining emissions are allocated to milk and meat on the basis of their proportional contribution to total protein production." (Gerber et al., 2010, p. 9)

[3] By dairy sector, we include all activities related to the feeding and rearing of dairy animals (milking cows, replacement stock and surplus calves from milked cows that are fattened for meat production), milk processing and the transportation of milk to dairy processing plants, and transportation of dairy products from dairy to retailers.

> "In 2007 there was about 553 million tons of global milk production. 1,969 million tonnes CO_2 eq. of GHG emissions were estimated from the dairy herd, including emissions from deforestation and milk processing. From that figure, 1,328 million tonnes is attributed to milk, 151 million tonnes to meat production from culled animals and 490 million tones to meat production from fattened calves." (Gerber et al., 2010, p. 10)
>
> "Milk and meat production from the dairy herd (comprised of milking cows, replacement calves, surplus calves and culled animals) plus the processing of dairy products, production of packaging and transport activities are thus estimated to contribute 4.0 percent to total GHG anthropogenic emissions, estimated at 49 gigatonnes (IPCC 2007). Milk production, processing and transport alone are estimated to contribute 2.7 percent to total anthropogenic GHG emissions. The average global emissions from milk production, processing and transport are estimated to be 2.4 kg of CO_2 eq. per kg of FPCM at farm gate." (Gerber et al., 2010, p. 32)

The data used from this study is the estimate of 2.4 KG of CO_2 eq. per kg of FPCM[4]. In other words, given a lack of more specific CF for local milk consumed at the University of Arkansas, an estimate of 6 lbs of C per gallon of milk could be taken from this study. How this CF would change across production systems is discussed next.

One of several key trends noted from the study's results is that intensive systems produce a lower level of emissions per unit of product than extensive systems. Primarily this is due to the higher digestibility of the animals' feed and the higher milk productivity level with intensive systems. The emissions related to intensive systems such as those from feed production, on-farm energy consumption, processing and transport are of lower magnitude than methane and nitrous oxide emissions of the animal, and therefore, do not change the overall picture. This observation holds true when broadly considering the

[4] By way of molecular weight (C = 12 and O = 16), 2.4 kg of CO_2 per kg of milk converts to 1.5 lbs per kg of milk or approximately 5.9 lb of C per US gal of milk. Fat content having a minor impact on weight of milk.

range of production systems (Gerber et al., 2010). It should be noted that definitions of extensive or intensive systems were not provided in this study or in *Liverstock's Long Shadow*. However the following was mentioned in the Livestock's Long Shadow preface and introduction:

> "Extensive grazing still occupies and degrades vast areas of land; though there is an increasing trend towards intensification and industrialization. Livestock production is shifting geographically, first from rural areas to urban and peri-urban, to get closer to consumers, then towards the sources of feedstuff, whether these are feedcrop areas, or transport and trade hubs where feed is imported." (Steinfeld et al., 2006, p.XX)

> "While intensive livestock production is booming in large emerging countries, there are still vast areas where extensive livestock production and its associated livelihoods persist." (Steinfeld et al., 2006, pp.3-4)

In dairy system production, the main mitigation paths are to limit methane and nitrous oxide emissions from the cow. With intensive systems, enteric methane emissions per kg of milk are comparatively low compared with extensive systems, thus leaving little opportunity for improvement. However, it is to be noted that the fraction of methane originating from manure storage is relatively high with intensive systems (15% - 20%, compared to < 5% in extensive systems in the arid and humid zones). Anaerobic digestion is a proven technique to answer this dilemma. With extensive systems in the arid and humid zones, marginal improvements of feed digestibility would attain significant reductions in methane emissions per kg of milk through direct emission reductions and improvements of milk yields (Gerber et al., 2010).

Even given the lack of description of extensive vs. intensive production, this study is a benchmark for global LCA calculations that will be instrumental for universal dairy carbon labeling standards.

> "The method and database developed for this assessment effectively supported the calculation of GHG emissions related to dairy production on a global scale, and may be considered an important step towards a harmonized methodology for the quantification of emissions. Similarly, the global datasets collected for this assessment serve as useful initial data sources, which can be refined and updated by users over time." (Gerber et al., 2010, p.55)

Hence increased objectivity in carbon labeling standards are potentially attainable which would provide an objective means of information for the consumer to analyze at least across product choices.

2.3 Conventional and Organic Milk Overview

Since this research involves the comparison of conventional milk to organic milk in regards to carbon label preference, it is first necessary to understand the different production methods and the environmental ramifications of such. The Dutch case study "Life Cycle Assessment of Conventional and Organic Milk Production in the Netherlands" was completed in June 2007 and compares Dutch conventional and organic milk production systems regarding their environmental impacts and critical areas (or "hot spots") of GHG emissions in the two production chains (Thomassen et al., 2008). The LCA case study was based on 10 conventional and 11 organic farms from which the data gathered refers to year 2003. A detailed cradle to farm gate life cycle assessment including on and off farm pollution was performed.

Some key findings include:

> "…better environmental performance concerning energy use and eutrophication[5] potential per kilogram of milk for organic farms.

[5] Eutrophication includes emission of substrates and gasses to the water and air that affect the growth pattern of ecosystems (de Boer 2002).

> Furthermore, higher on farm acidification[6] potential and global warming potential per kilogram organic milk showed that higher ammonia, methane, and nitrous oxide emissions occur on farm per kilogram organic milk than for conventional milk. In addition, results showed lower land use per kilogram conventional milk compared with organic milk. In the selected conventional farms, purchased concentrates were found to be the hotspot in off farm and total impact for all impact categories, whereas in the selected organic farms, both purchased concentrates and roughage were found to be the hotspots in off farm impact." (Thomassen et al., 2008, p.95)

Additionally, the authors recommend improving the environmental performance of milk production via reducing the use of concentrate ingredients which possess high environmental impact, decreasing concentrate use per kilogram of milk and reducing nutrient surpluses through improving farm nutrient flows (Thomassen et al., 2008).

With relevance to the Gerber et al. (2010) study, it should be noted that grassland based[7] and mixed[8] systems are estimated to each supply approximately 50% of global milk production. Though on average, grassland based systems account for 60 percent of the global sector's emissions, mixed systems are characterized by lower emission intensity and account for only 40 percent of emissions.

> "The average emissions from grassland based systems are 2.72 kg CO_2 eq. per kg of FPCM, compared to an average of 1.78 kg CO_2 eq. per kg of FPCM, in the mixed systems." (Gerber et al., 2010, p.35)

The Thomassen et al. case study found that organic production produces a global warming potential of 1.5 kg CO_2 equivalents/kg FPCM compared to 1.4 kg CO_2

[6] Acidification is the emission of gasses (SO_2, NO_x, HCl, NH_3) into the air that combine with other molecules in the atmosphere.
[7] Livestock production systems in which more than 10% of the dry matter fed to animals is farm-produced and in which annual average stocking rates are less than ten livestock units (LU) per hectare of agricultural land.
[8] Those systems in which more than 10% of the dry matter fed to livestock comes from crop by-products and/or stubble or more than 10% of the value of production comes from non-livestock farming activities.

equivalents/kg FPCM for conventional production, both much below the 2.48 kg CO_2 equivalents/kg FPCM for global milk production. It should be noted that these two calculations are relatively close with the Gerber et al. (2010) mixed system calculation aforementioned but are not close to the grassland based system calculation. In the absence of more detailed information available for U.S. dairy production processes as to the CF information to attach to these two types of milk, I am therefore hesitant to associate the grassland system figure above with organic production and the mixed system figure with conventional production. Nonetheless, this information provides a benchmark/platform for comparison and future research.

In conclusion, these studies show a tendency that organic milk production creates a slightly larger CF opposed to the production of conventional milk. Also, the studies suggest that significant variation in CF exists pending production method.

2.4 Purchaser Preferences Overview

In recent years the topic of carbon labeling on products, especially food products has become increasingly popular mainly due to climate change. Since few consumer response studies on carbon labeling have been published, currently a large opportunity exists to expand this research. The following sections highlight some studies that directly relate to the research goals posed in chapter 1.

Groceries are directly responsible for a significant share of the greenhouse burden of a standard household since most consumers in the US do not produce their own milk. Therefore notifying consumers of product choices with different carbon labels within a product category, such as milk, can potentially reduce GHG emissions. Mohan (2009)

presented results from recent focus group studies conducted for the UK supermarket chain, TESCO, found that customers are alarmed about climate change and are interested in carbon labeling of supermarket products. A case study from Vanclay et al. also exists in Australia. These studies are highlighted below.

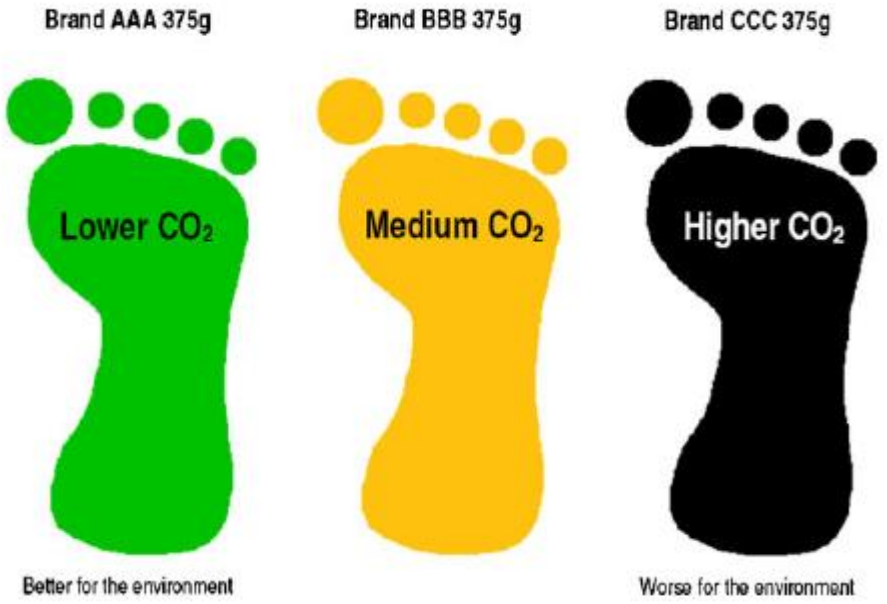
2.4.1 Australian Case Study

The study "Customer Response to Carbon Labeling of Groceries" was conducted at a grocery store in East Ballina, Australia which mirrors the Australian demographic median across a number of demographic metrics including age, gender, income, number of children per household, etc. (Vanclay et al., 2011). East Ballina FoodWorks is a convenience store located in a shopping mall which sells fast food, snacks and grocery items seven days a week with half a million grocery items sold annually. Thirty seven products were labeled within five lines (milk, spreadable butter, canned tomatoes, bottled water and non perishable pet foods) and were classified on the basis of CO_2 emissions. These five product lines were selected because they possessed both high turnover and sufficient customer choice in the store. Colored labels with footprint pictures similar in size to most promotional signs (6x12 cm) were placed on shelves next to each product with a yellow footprint indicating medium, green indicating lower and black indicating higher than average carbon emissions[9] within the product group (Figure 2.1). All fresh whole milk labeled as flavored and soy milk was excluded. The researchers felt that the classification into three footprint categories was reliable, consistent and appropriate to

[9] CO_2 product emissions were calculated and compared from point of production, including manufacturing, packaging and transport, while considering the transportation system rather than using food miles which are defined as how many miles the product travels from the producer to the shelf.

monitor customer response. Purchasing preferences were examined in a non intrusive manner by monitoring sales recorded at point of sale which excludes it from biases and limitations known in focus group studies (Vanclay et al., 2011).

Figure 2.1 Labels used in the Vanclay study to indicate carbon footprints of grocery items.



Sales data was collected for the 12 week period encompassing four weeks before and eight weeks after the labeling started on Monday August 25, 2008. In total, 2,890 items were sold during the twelve week period. The study was advertised the first week of labeling through local press, radio and television. Initial interest was strong as gross turnover increased by 12% the first two weeks and 4% overall during the eight weeks following labeling. By the fourth week of the study, inventory of green labeled bottled water were temporarily sold out due to the added interest. To supplement consumer knowledge and understanding, informational leaflets describing the study were placed near the checkout and shoppers voluntarily took hundreds of them. It is understood that

the media coverage and advertising may have changed customer behavior and demography; however it was thought to be the most effective approach to notify consumers about the new labels and the study. Any bias related to the media coverage and customer demography is believed to have been short term, mainly during the first week but not through the final weeks as point of sales data revealed increased total sales of labeled items as opposed to non-labeled items but overall purchasing pattern changes were minimal. Green labeled sales increased 4% from 53% to 57% of daily labeled items and black labeled sales decreased 6% from 32% to 26% of total labeled item sales during the labeling period (Table 2.1).

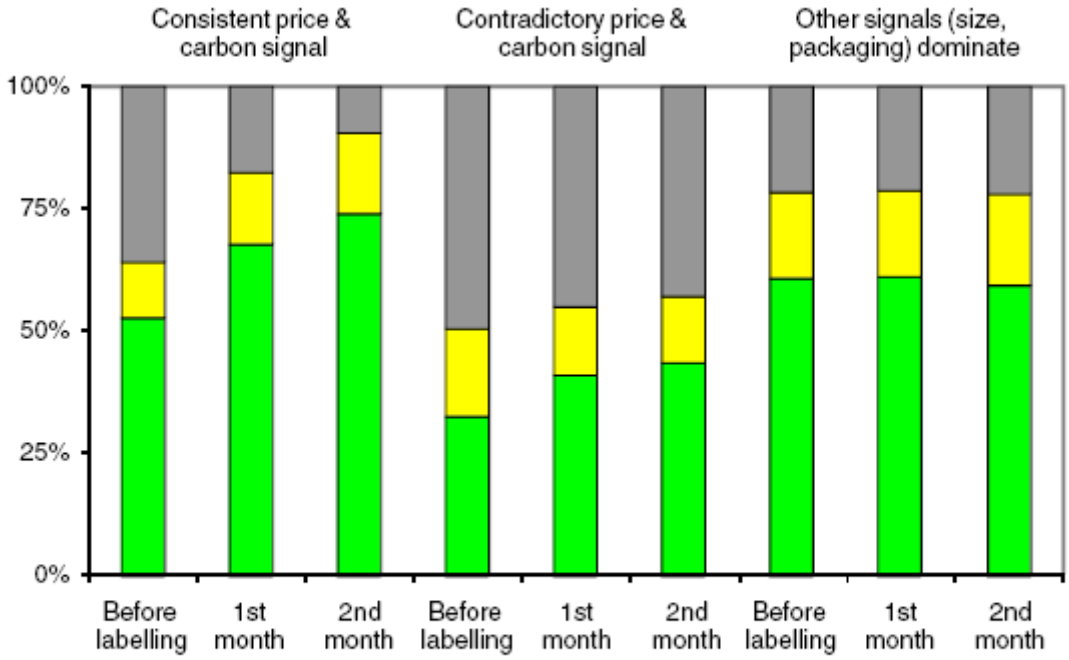
Table 2.1 Relative sales volume of all labeled products (by number of items).

Label	Before labelling (%)	1st month (%)	2nd month (%)
Black	32	28	26
Yellow	15	17	17
Green	53	55	57
Total	100	100	100

Source: Vanclay et al. (2011).

Further, three trends relating relative carbon and price became evident. When relative CF and price were low as in the case of canned tomatoes and butter, a 20% switch from black to green labeled sales was observed (left panel of Figure 2.2.). When relative CF is low but the product is priced relatively higher as in the case of bottled water and pet food, sales of green labeled items increased to a lesser extent (middle panel of Figure 2.2). Finally, when other factors dominate over CF and price, like perishability in milk for example, relative CF information did not affect sales regardless of price (right panel of Figure 2.2).

Figure 2.2 Purchasing trends for the three categories of labeled products over a 3 month period including 1 month before and 2 months. (Top bar represents sales of black labeled product with high footprint, middle bar represents yellow, medium footprint and bottom bar represents green or low carbon footprint items).



Source: Vanclay et al. 2011

With fresh milk no consumer response was seen. With these milk products the CF was directly correlated with package size (more packaging per gallon of milk is required for smaller package size and hence increases handling and packaging CF per gallon of milk sold since all milk came from the same processing facility). In this example, consumers could choose among 2 and 3 liter *plastic* containers that were labeled green; 600 ml and 1 liter *cartons* labeled yellow; and 1 liter *plastic* containers labeled black. It was observed that purchasers had a strong preference for a specific size. From casual observation it was discovered that customers paused while reading the labels before selecting a yellow (carton) or black (plastic) labeled 1 liter product whereas they did not pause when picking the 2 or 3 liter and 600 ml package size. This suggests that

the consumers select the same sized container to balance household consumption and freshness. Choosing a bigger package would not fit use pattern of a convenience store customer (milk consumption on the go) or package size dimensions do not fit with refrigerator door space. In other words, after allowing for spoilage and waste, the shoppers were optimizing their CF at point of consumption rather than at point of sale (Vanclay et al., 2011). Therefore, it was hypothesized with this thesis research that average respondent milk consumption will not change when presented with lower CF labeled milk.

The study concentrated only on CO_2 emissions and overlooked other main agriculture related emissions because the research focused on customer response rather than the accuracy of GHG calculations and labels. In addition, since the study dealt with carbon emissions within a product range, focus was on packaging, storage and transportation even though this contributes a relatively small part of the overall lifecycle impact. The primary focus of the study was consumer response about labeling and the dependability of labels was to uphold faith with customers and manufacturers (Vanclay et al., 2011).

All things considered, the aforementioned research exemplifies the potential for voluntary reductions in CF of groceries, particularly when price and carbon signals coincide. It is suggested by Vanclay et al. (2011) that when consumers receive suitable guidance about carbon emissions, purchasing preferences may be changed to favor green labeled goods, representing a 5% sales increase of green labeled products across all labeled sales. When the CF reduction coincides with a lower purchase price, changes in preference will be even larger, approximately 20% in this study. In conclusion, this study

demonstrates the possibility for carbon labeling to promote both conviction and price related reductions in household CO_2 emissions (Vanclay et al., 2011).

2.4.2 Food Shoppers in the U.K.

At the time of this writing there was another relevant study in the works by Zaina Gadema, a logistics and supply chain management researcher at Newcastle Business School. The work involves measuring consumer perceptions on green issues when food shopping. The research included questioning a total of 432 shoppers across all of U.K.'s major supermarkets on their demand for carbon labeling, their knowledge of their own personal CF, whether they believe climate change is an important issue when purchasing food, and whether current carbon labels are easily understood (Mohan, 2010).

The results showed that 2% of U.K. supermarket shoppers want carbon labels on food products. Eighty three percent of shoppers did not know their own personal CF, but approximately 75% of respondents stated that clearer carbon labeling on food products would help them think green. Sixty three percent of those who were surveyed through a questionnaire believed that carbon labels are a useful tool for comparing environmental standards, although quality and taste were largely deemed more important when buying food than such environmental issues as carbon and food miles. Additionally, 68% declared their buying behavior changed notably during the past ten years. Shoppers claimed their spending habits have shifted toward purchasing more free range (46%); more fair trade (42%), more locally sourced (32%) and more organic/less processed food products (32%).

> "In light of the high proportion of consumers expressing a definite shift in shopping habits, these initial findings suggest that concern is indeed high with respect to climate change and food purchasing simultaneously," says Gadema. (Mohan, 2010, p.2)
>
> "Overall," Gadema adds, "the dominant theme arising from this research is that consumers would generally like carbon labels on their food products. However, because there is little understanding or knowledge surrounding such information, as well as little in terms of availability of products with carbon footprints, it is difficult for consumers to compare environmental standards via carbon labels even though the majority of respondents think labels would help to do so. Greater and clearer use of carbon labels would help even more shoppers associate the importance of climate change with food purchasing." (Mohan, 2010, p.2)

Lastly, as of 2009 it was announced that Tesco will display its CF label on its full fat, semi skimmed and skimmed milk products as a continued effort to help raise awareness of climate change and the carbon impact of products. Tesco planned to have foot printed 500 products by the end of the 2009. Tesco's initiative is partly driven by…

> "new independent consumer research" which found that "…50% of consumers surveyed now understand the correct meaning of the term 'carbon footprint,' compared with only 32% of people surveyed in 2008." (Mohan, 2009, p.1)

The survey also showed consumer desire to shop green with over half stating that they would look for lower CF products in their weekly purchases, as compared to 35% in 2008. The respondents believed it was imperative to have correct information describing the carbon impact of products to assist making informed choices. The source of the research was not provided in the article (Mohan, 2009).

Since milk is one of the best sellers in Tesco stores, the company believes that carbon labeling its milk products will not only help raise awareness, but will also help consumers with the new carbon 'currency'. Tesco realizes that the agricultural stage of milk production accounts for the largest portion of its CF and is mainly derived from

methane emissions from the cows. Tesco is currently working on research projects to help reduce these emissions in conjunction with farmers and the dairy industry through the Tesco Sustainable Dairy Group and Dairy Center of Excellence. Some projects include utilizing different feeds to help reduce methane emissions from cows and the use of renewable energy on farms (Mohan, 2009).

Both studies suggest that consumers will respond to carbon labeling. What is unknown is the degree of purchasing behavior change and how carbon labeling ranks relative to other milk attributes important to consumers. This research attempts to develop a better understanding in this regard.

2.5 Perceived Consumer Effectiveness and Knowledge Constructs

PCE is a vital concept explaining a link between environmental attitudes and consumer behavior. The construct refers to what extent a person thinks their actions make a difference in solving a problem. It is…

> "the evaluation of the self in the context of the issue." (Berger and Corbin, 1992, p.80-81)

Consumer concerns regarding environmental issues may not convert into environmentally friendly behaviors. However, individuals that possess a strong belief that their personal behavior will produce a positive result are likely to behave in support of their environmental concerns. This follows from the theory of reasoned action that posits that a person's belief, that a specific action can solve an environmental problem, will greatly influence the individual's willingness to partake in that action (Laskova, 2007).

The Laskova study used the PCE construct to predict the likelihood that Australian consumers engage in pro-environmental behaviors. A convenience sample of 165 students, mainly between 18 and 24 years old, recruited from lecture classes were used to obtain the primary data. Through regression analysis, the study found that PCE is a strong predictor of the environmental attitude/behavior relationship. This supported the study's prior expectation that people with higher levels of PCE would demonstrate a greater relationship between green attitudes and pro environmental behavior than those with PCE at lower levels. These results were also consistent with the findings from Berger and Corbin who found that persons with high PCE scores showed a considerably stronger relationship between environmental attitudes and pro environmental behavior than subjects with lower PCE scores (Laskova, 2007).

All in all, the results reiterate the significance of PCE in explaining the relationship between green attitudes and behavior. A related study stated that an…

> "individual's self perception of his or her efficacy in struggling with environmental problems influences whether or not he/she will act on these environmental concerns in the marketplace." (Kim, 2002, p.103)

Basically, consumers that feel powerless in helping the environment are probably not going to undertake pro environmental behavior. As a result, PCE should be considered as a significant variable because it helps uncover the vital link between green attitudes and behavior. Important in this equation is that to influence consumer intention to purchase green products, marketers will need to educate consumers on the environmental benefits of green purchases to improve their green attitudes (Laskova, 2007). Hence it is also important to identify whether the consumer is knowledgeable about environmental impacts of carbon emissions in this study.

Another relevant study by Roberts (1996) found that PCE was positively correlated and provided the greatest insight into ecologically conscious behavior. Roberts (1996) found that PCE was the single strongest predictor of ecologically conscious consumer behavior, exceeding all other demographic and psychographic correlates tested (Straughan and Roberts, 1999; Ellen, Wiener and Cobb-Walgren, 1991). Each of these studies supports the findings from Laskova (2007) and Berger and Corbin (1992).

Also suggested is that environmental-based marketing efforts should be clearly connected with beneficial outcomes. Just claiming "green" is insufficient; marketers must present how consumers that choose green products are helping the environment (Straughan and Roberts, 1999). Thus a carbon label that also indicates that a 10 kg reduction in CO_2 emissions per person per year could, for example, slow down climate change by 10% would potentially be more effective than a label indicating only a relative level of carbon emissions. Label content is therefore also important.

Lastly, a third study referenced is by Ellen et al. (1991).

> "The results suggest that motivating consumers to express their concern through actual behavior is to some extent a function of increasing their perception that individual actions do make a difference." (Ellen, Wiener and Cobb-Walgren, 1991, p.102)

Public and private policy makers that wish to facilitate voluntary environmentally friendly behavior should develop consumer perceptions that their personal actions will improve the environment. Knowledge regarding outcomes is thus important.

Commonly, two conceptually different constructs of knowledge, subjective and objective, can be measured.

> "Objective knowledge is the accurate information about the product stored in consumer's long term memory; and subjective knowledge is people's subjective perceptions of what or how much they know about (how familiar they are with) a product based on the subjective interpretation of what one knows." (Pieniak, Aertsens and Verbeke, 2010, p.582)

It is rational to think that what an individual believes to know should be some function of what they actually do know. Radecki and Jaccard (1995) go further and deduct from this that there is an expectation of a positive and significant relationship between subjective and objective knowledge. Conversely, Park et al. (1994) found that the amount of connection between the two is usually not high. In the research of Brucks (1985) and Radecki and Jaccard (1995), they also found a weak to moderate correlation between the two knowledge constructs. Additionally, a recent meta-analysis conducted by Carlson et al. (2009) found rather diverse results regarding the relationship between the two. Alba and Hutchinson, (2000) concluded that correspondence between the two types of knowledge is not high and that consumers are usually overconfident of their knowledge, thus their subjective knowledge is commonly higher than their objective knowledge (Pieniak, Aertsens and Verbeke, 2010).

In addition, findings about whether or not subjective or objective knowledge is a better predictor of behavior are often contradictory. It should be noted that studies from Feick, Park and Mothersbaugh (1992) and Pienak et al. (2006) concluded that subjective knowledge was a stronger motivator of behavior than objective knowledge. Furthermore, Ellen (1994) conducted a study about pro-ecological attitude and behavior and found that subjective knowledge was positively associated with committed recycling, source reduction and political action, while objective knowledge was only significantly related to committed recycling (Pieniak, Aertsens and Verbeke, 2010).

The definitions in this section's first paragraph were referenced from the study by Pieniak et al. 2010 which focuses on distinguishing consumers' subjective and objective knowledge and analyzing their influence on organic vegetable consumption. This study hypothesized that a modest relationship between objective and subjective knowledge would be observed in regards to organic vegetables. It also hypothesized that subjective knowledge would be a stronger predictor of organic vegetable consumption compared with objective knowledge.

As it turned out, consumers' subjective knowledge was on a moderate to rather low level compared to objective knowledge in the Pieniak et al. study which was the opposite found in previous studies referenced where subjective knowledge was much higher than objective knowledge. In Pieniak et al. people did not perceive themselves as extremely knowledgeable, at the same time respondents were well educated about organic vegetables and organic production, thus resulting in the high objective knowledge. The results also showed that subjective knowledge was significantly and directly related with organic vegetable consumption and that objective knowledge was indirectly related (Pieniak, Aertsens and Verbeke, 2010). The result that subjective knowledge is a more important predictor of organic vegetable consumption than objective knowledge supports the findings from Feick, Park and Mothersbaugh (1992), Pienak et al. (2006), Ellen (1994).

A pertinent study of this construct which will be useful for future cross country research is House et al. (2004). This study distinguishes and examines the impact of both subjective and objective knowledge associated with the acceptance of genetically

modified foods. The primary data from this study was collected through a survey in three cities in the U.S., one in England and one in France.

From the results, there was no considerable disparity between the U.S. cities (Jacksonville, FL; Long Beach, CA; and Lubbock, TX) and Reading, England; however there was a significant difference between the Grenoble, France respondents and the rest of the sample. French respondents were much more likely to indicate they were more knowledgeable (subjective knowledge) about genetic modification in food production. It was also noted that there were no statistical differences among the respondents from the three countries for objective knowledge. This differs from the previous results of both Gaskell et al. (1999) and Hoban (1998) who each found that objective knowledge depended on respondent location. Gaskell et al. found that EU respondents had more objective knowledge than U.S. respondents and Hoban found the exact opposite (House et al., 2004). Overall, objective knowledge was not related to acceptance; conversely, subjective knowledge was an important determinant of the willingness of consumers to eat genetically modified food products.

As seen from the results in Pienak, Aertsens and Verbeke (2010) and House et al. (2004), the respondents in both studies all had relatively the same amount of higher objective knowledge and only disparities were seen with respondents' subjective knowledge. For this reason, subjective knowledge held the significance and was the better predictor because it was the only way to differentiate and classify behavior.

Since climate change is a debatable and fairly new topic, no hypothesis related to which knowledge construct would be a better predictor for carbon labeled milk

consumption was developed. This thesis provides insights in determining whether either one or both are good predictors of ecologically conscious behavior.

2.6 Inferred Valuation

Researchers have found that:

> "people's predictions of other's choices were a significantly more precise predictor of actual future behavior than the people's statements about themselves." (Lusk and Norwood, 2009a, p. 241)

This is explained by the hypothesis of social desirability bias which is the satisfaction people get from the act of saying they are willing to pay for a good; basically to please the researcher or themselves (Lusk and Norwood, 2009a).

In 2008, Lusk and Norwood studied the relationship existing between self and inferred values for new private goods with normative attributes. The products they used in their research were environmentally friendly dish washing liquid, organic flour and organic beef and obtained the actual sales of these products in a grocery store. The results revealed that people indicated they more strongly preferred the goods with normative attributes than what they predicted for other local shoppers. More significantly, it was found that the people's predictions of others' shopping behavior more accurately predicted the actual sales of the new normative goods in the store than what the people stated as their personal behavior in the experiment (Lusk and Norwood, 2009a).

A more recent study by the same authors involved a model which presented that when people obtain utility from stating they are willing to pay for a good, most of the time there is a wedge between real and hypothetical statements of value. The model used

in this research attempts to remove these probable wedges by asking people what they think others will pay rather than asking what they are willing to pay. The results showed that inferred predictions about others' voting behavior were extremely similar to actual voting behavior. Therefore, these results showed that inferred valuation was at least as good as non-hypothetical experiments at giving an estimate of peoples' consumption for the good (Lusk and Norwood, 2009b).

Due to the above mentioned researched disparities from responses to actual behavior; it was decided to use inferred valuation in our respondent behavior section of the survey. This was done to remove as much social desirability bias as possible and capture responses in theory most identical to actual behavior.

2.7 Conclusion

As seen from this literature review, the opportunity to measure purchaser preferences towards carbon labeling of conventional and organic milk exists. Five key points from Chapter 2 that should be noted by the reader are: i) Standards for GHG labeling are emerging; ii) currently, CF for milk can be of a broad range and hence exact estimates of CF will be location specific but are nonetheless expected to reveal that conventional milk may have a lower CF than organic milk; iii) carbon labels have been shown to affect behavior; iv) PCE and knowledge in addition to other milk attributes need to be measured to put carbon label response into perspective; v) use of inferred valuation in hypothetical survey instruments is appropriate for ascertaining willingness to pay for differential milk attributes. The aforementioned coupled with the supported evidence of consumer eagerness to shop for more environmentally friendly and carbon

labeled products leads this research interest in identifying and comparing potential carbon label responses toward milk purchase decisions in the United States.

Chapter Three: Methodology

3.1 Introduction

This chapter introduces the survey tool that was presented to potential respondents through a mass email from the University of Arkansas email server. A subsample of university email accounts was split evenly among faculty and staff (3,000) as well as students (3,000). Respondents were invited to follow a URL link in the first e-mail contact. This e-mail served to pre-screen respondents for those individuals that actually drink and/or purchase milk. Also, the e-mail announced a $50 prize for three respondents chosen at random as an incentive to respond.

The first part of this chapter describes why this survey methodology was chosen. The second part describes the survey tool by presenting groups of questions, their intended rationale for inclusion and how the survey was coded. The third part describes survey collection procedures. The final section describes the statistical tools used to analyze the survey data. The e-mail text used for the initial mailing and reminder can be found in Appendix A. The survey is found in Appendix B. The numbers in bold and larger font represent how the responses were coded.

3.2 Rationale for Survey Tool Selection

To collect a comprehensive set of data from milk purchasers with a broad range of demographics, a survey tool assessing consumer preferences, perceived consumer effectiveness in dealing with environmental issues (*PCE*), knowledge of specific climate change related issues and knowledge of conventional and organic milk production methods was needed. It became clear that this would entail a sufficiently large set of

questions such that an in-person survey procedure in retail stores would likely lead to excessive response bias as shoppers would either rush to complete the survey, not fill it out completely or simply not take the survey. Hence a focus group session, mail, internet or telephone survey would be remaining data collection choices. The focus group session was ruled out on the basis of insufficient funds and the likelihood of getting too few responses to generalize to a broader population. Mail and telephone surveys were ruled out on the basis of cost. This left the internet as the logical survey tool. Internet addresses were available at no charge at the University of Arkansas with some control over who would receive the survey (faculty and staff vs. students but without a specific randomization structure to preselect respondents[10]). Not only would it be relatively low in cost as software support to design the survey was available in the department, it also offered the opportunity to conduct the survey internationally if e-mail addresses at a foreign institution would be available. Unfortunately, privacy regulations at Humboldt University in Berlin prevented international dissemination of the survey. For any of the above methods, selection bias still exists as respondents feeling strong about the environment are more likely to have completed the survey. To reduce this bias, the $50 incentive was offered to enhance the response rate without unduly influencing responses to be part of the drawing (i.e. a 3/6000 chance at $50 would be insufficient monetary incentive to induce taking the survey for monetary reasons).

Since the intent of the survey was to determine the willingness to pay (*WTI*) for carbon label information, willingness to pay for CF reduction (*WTP*) , willingness to

[10] The University of Arkansas IT department selected batches of 200 e-mails at random until 3,000 each of faculty and staff vs. student e-mails from their current e-mail list were collected.

consume (*WTC*) differently labeled product in a hypothetical setting and finally, willingness to substitute (*WTS*) conventional milk for organic milk on the basis of respondent specified threshold levels of CF improvements. The survey sample of 6,000 potential respondents was further divided by phrasing questions 8 and 9, pertaining to *WTP* and *WTC*, with different CF differences. One third of the respondents were provided with a hypothetical carbon label difference of 10%. The other two thirds were equally split between a 20% and 40% deviation.

A response rate of approx. 10% was anticipated leading to a target of 600 responses, of which, 10% to 15% were anticipated to be organic consumers. This number was deemed sufficient to test the last hypothesis about whether or not organic milk purchasers would switch to the conventional milk if CF could be lowered through purchasing behavior. Again, given this many responses required, a telephone and/or mail survey was deemed infeasible given financial constraints and an internet based survey tool was utilized.

3.3 Survey Tool Description and Rationale

The main objectives of the survey were to ascertain i) a *PCE* score for each respondent; ii) consumer objective and subjective knowledge regarding climate change, greenhouse gases, CFs and milk production; and iii) their current milk purchasing behavior (organic vs. conventional, type of preferred packaging, quantity and importance of various milk attributes). A set of questions targeted at carbon labels was subsequently used to measure *WTI*, *WTC*, *WTP* and *WTS*. Finally the impact of demographics and other opinion questions might affect responses to carbon label information and are discussed below.

While the complete survey can be found in Appendix B, a discussion of each question is provided below. Each question is summarized by: i) reiterating the question in the text; ii) presenting variable names for the question in italicized, capital letters enclosed in parentheses; iii) providing a discussion on how it was coded for statistical analysis (bold font numbers) ; and iv) discussing the rationale for inclusion as well as anticipated effect on *WTI*, *WTP*, *WTC* and *WTS*.

3.3.1 Purchase/Consumption Characteristics

Questions 1-4 were asked to understand the attributes of each respondent's typical milk purchasing/consumption behavior. These characteristics would be used later in the analysis to draw conclusions about willingness to pay, consume and substitute.

Question 1:

Do you buy 50% or more of the groceries for your household/yourself? (*DSHOP*)

1□ Yes **0**□ No

The response to this question was coded as a dummy variable with 1 indicating a positive response. The variable was named *DSHOP*. This was asked to determine whether the milk purchaser shops for the majority of food products for their household. As primary shopper, these respondents on average are expected to make decisions for more than one person and hence purchasing decisions would likely involve larger quantities of milk and for more than one person. Non-primary shoppers on the other hand, are likely to purchase less milk, perhaps only for themselves and hence they are hypothesized to attach less importance to the impact of their decision.

Question 2:

Please describe your typical milk purchase/the typical milk you drink[11]:

Characteristic	(In each row, please mark the item purchased the most)
Container Size (*SIZE*)	**1**□ Gallon **0.5**□ ½ Gallon **0.25**□ Quart **0.125**□ Pint or smaller
Container Type (*PLASTIC, CARTON, GLASS*)	**0/1**□ Plastic **0/1**□ Carton **0/1**□ Glass
Production Method (*ORGANIC*)	**1**□ Organic **0** □ Conventional
Price of Last Purchase (*P*)	____ to nearest $0.25 *(use recent market prices below for reference if needed)*

Container size, *SIZE* was coded to conform to the container size in units of gallons. The type of packaging material and production method were coded as a series of 0/1 dummy variables. The price variable, *P*, was to reflect the latest purchase price for the type of milk purchased. Market price information, shown in Figure 3.1, was presented to refresh the memory of the respondent regarding their last purchase. The

Figure 3.1. Recent Market Prices for Organic and Conventional Milk for Different Package Sizes. Ranges are across brands and packaging. Fayetteville, AR, October, 2010.

Package Size	1 Gallon (3.78 L)	½ Gallon (1.89 L)	Quart (0.95 L)	Pint (0.48 L)
Organic Milk	$6.89 to $7.69	$3.50 to $4.49	$2.19 to $2.49	$1.35 to $1.79
Conventional Milk	$2.66 to $3.48	$1.72 to $2.17	$1.14 to $1.44	$.79 to $1.32

intention was to have the respondent provide the most accurate answer possible. The prices documented also exposed the respondent to the large price difference between conventional and organic milk products. A range of milk prices were gathered across brands and packages at WalMart and Ozark Natural Foods in Fayetteville, Arkansas, in

[11] Pending the answer to Question 1, the respondent would either be asked about their typical milk purchase or the typical milk product they drink.

October, 2010. For statistical analyses *P* was divided by *SIZE* to arrive at a comparable price per gallon of milk across purchase options.

This question was used to determine what kind of milk container and type of milk the respondent typically purchased/drank either for themselves or for their household. This description not only served to differentiate among respondents with respect to these parameters but also was used as the benchmark for comparison with alternatively labeled milk in the *WTI*, *WTP*, *WTC* and *WTS* questions described below.

It was hypothesized that the respondents who purchase/consume the larger containers of milk were more likely to pay for the carbon label information *(WTI)* and lower carbon milk *(WTP)* due to that fact they incur a larger CF with this container size. Typically, conventional milk is packaged using plastic containers in the gallon size, whereas organic milk is often sold in half-gallon cartons. It was conjectured that respondents (conventional and organic) who already pay a higher price for their milk for a particular brand or special milk attributes would pay more for label information and reduced carbon milk compared to those shoppers primarily shopping for least cost milk. In regards to *(WTC)*, it was thought that consumption patterns would not change regardless of typical milk purchase characteristics due to the Australian research study showing relatively little changes in consumption pattern. Lastly, since organic milk drinkers already pay more for their milk and the containers usually are smaller sized cartons, the *ORGANIC* variable could measure these attributes as well as others associated with organic milk. This variable, *ORGANIC*, was also used to differentiate the sample of respondents among conventional and organic to measure *WTS*.

Question 3:

How much milk do you typically buy/drink per week[12]? (*TQ*)

_____ average gallons per week or please mark appropriate amount below…

0.25□ Less than ½ gal. **1**□ 1 gal **1.5**□ 1 to 2 gal. **2.5**□ 2 gal. + /

0.0625□ *Less than one pint* ***0.1875***□*1 pint to 1 quart* ***0.625***□*1 quart to 1 gal* ***1.25***□*1 gal. +*

Respondents could provide their actual average weekly consumption in gallons or pick from two sets of response categories pending their answer about whether they purchased only for themselves or for the household. The question was coded at mid points of the categories with the exception of the highest quantity response categories. These were coded at 2.5 and 1.25 gallon, respectively, for shoppers vs. drinkers.

Question 3 thus determined how much milk the respondent purchases/drinks on a weekly basis. Note that the answer to this question could be divided by the number of persons in the household drinking milk to arrive at per capita consumption for those respondent that were primary shoppers and had several persons living in their household (Question 16).

The expected correlation between *TQ* and *WTI*, *WTP*, *WTC* and *WTS* was positive as knowledge of CF at higher consumption levels will lead to greater environmental impact. Nonetheless, higher purchase quantity or frequency could also lead to lower

[12] If the respondent answered "yes" to question 1 then they received the first set of choices as a milk purchaser. If the respondent answered "no" to question 1 then they received the second set of choices as a milk drinker.

WTP as higher quantities consumed would also lead to greater financial impact. This was one of the reasons for including a variable about the relative importance of milk expenditures relative to income. This variable will be discussed separately below.

Question 4:

Of the following milk attributes what are the five most important characteristics to you?

Characteristic	**Rank** Please rank the top five of the seven characteristics using 1 = most important to 5 = least important)
Package Size (*RSIZE*)	□
Brand (*RBRAND*)	□
Price (*RPRICE*)	□
Fat Content (*RFAT*)	□
Organic (*RORGANIC*)	□
Freshness/Expiration Date (*RFRESH*)	□
Other (please specify) (*ROTHER*)	□

Answers to this ranking question were coded as seven individual dummy variables (*DSIZE*, *DBRAND*, *DPRICE*, *DFAT*, *DORGANIC*, *DFRESH* and *DOTHER*) to reflect whether package size, brand, price, fat content, nature of production, freshness or other factors were either deemed important (1 = ranked in the top 3 of 5) or not important (0 = ranked 4 or 5 or not ranked). This was done mainly for statistical reasons as ordinal rankings are difficult to use in conventional regression techniques.

This question determines the milk attributes which are most significant in the respondent's decision making process. The individual attributes can potentially have significant correlation with any of the remaining questions in the survey. For example, a

consumer that is not price conscientious (*DPRICE* = 0), may be willing to pay more for environmental benefits of CF reduction, or *WTP*, than a non-price driven consumer. Further, a price conscientious organic consumer may be more easily convinced to switch to conventional, lower CF milk, given the lower price point of conventional milk. Ranking package size and freshness high, as mentioned as significant in the Australian experiment discussed in chapter 2, may deter from paying attention to CF. By the same token, brand loyalty may lead respondents to stick with a particular milk regardless of CF label. However, brand conscious consumers could also be less price sensitive and hence willing to pay for CF reductions. Fat content and organic milk may also be purchased primarily for targeting health issues or animal welfare aspects often associated with organic purchases. Hence, these issues may override CF impacts, and further, in a non-predictable fashion. Nonetheless, respondents who rank "Organic" as important, may possess higher milk/environmental awareness and may be accustomed to reading labels and therefore willing to pay for information (*WTI*) and/or act on label information (*WTP*, *WTC*, *WTS*). It was also predicted that respondents who ranked "Other" factors as important may be less willing to switch to milk with lower CF as they may have specific preferences for certain milk purchases (lactose intolerance or other benefits that may be modified in milk with a different CF).

3.3.2 Attitude Construct

As mentioned in chapter 2, the perceived consumer effectiveness (*PCE*) construct is commonly used in the literature to translate/correlate environmental attitude with consumer choice. A set of questions is used to arrive at a total scale score (*T*) directly

correlated with *PCE*, i.e. higher scores imply greater consumer perception that their choices will have an impact on the environment.

Question 5:

Please indicate your level of agreement with the statements in the following table.

	Strongly Disagree	Dis-agree	Neutral	Agree	Strongly Agree
It is worthless for the individual consumer to do anything about pollution. (*PCE1*)	**5**□	**4**□	**3**□	**2**□	**1**□
When I buy products, I try to consider how my use of them will affect the environment and other consumers. (*PCE2*)	**1**□	**2**□	**3**□	**4**□	**5**□
Since one person cannot have any effect upon pollution and natural resource problems, it doesn't make any difference what I do. (*PCE3*)	**5**□	**4**□	**3**□	**2**□	**1**□
Each consumer's behavior can have a positive effect on society by purchasing products sold by socially responsible companies. (*PCE4*)	**1**□	**2**□	**3**□	**4**□	**5**□

Responses to question 5 were coded as shown in the table above. Note that each row represents either a positively or negatively worded statement (often referred to as an item) and agreement with the statement was coded in such a fashion[13] that a positive correlation between item responses for individual respondents would reveal consistent answering throughout the construct. That is, a respondent's answers are checked for

[13] To be consistent, the values assigned to the levels of agreement were reverse scored in order for a total scale score to reflect the respondent's perception. Reverse scoring is performed using the following equation: R = (H + L) – I, where R is the reverse score, H is the highest value within the scale (5), L is the lowest value within the scale (1), and I is the scaled response of the respondent (Spector 1992).

consistent positive or negative responses to items with respect to environmental attitude. As such, if item correlation, the partial correlation between the scored responses for individual items in a construct compared to the sum of the scored responses from the remaining items, is greater than 0.30, this typically indicates that the respondents prudently completed the statements in that question (Spector 1992).

A second test for internal validity of a construct is the coefficient alpha or Cronbach alpha:

$$a = \frac{k}{k-1} * \frac{s_T^{\,2} - \sum s_I^{\,2}}{s_T^{\,2}}$$

where k is the number of items in the question, S_T^2 is the variance of the total scale scores across all respondents and S_I^2 is the variance of an individual item's scores across all responses. The coefficient alpha should generally lie between 0 and 1 with a coefficient alpha closer to 1 indicating a higher level of internal consistency (Spector 1992). A widely accepted rule developed by Nunnally states that for a construct to demonstrate internal consistency, alpha should be at least 0.70. The use of constructs with coefficient alphas below 0.70 is considered questionable (Nunnally 1978).

Once tested for item correlation and internal validity using Cronbach alpha, the item scores could be totaled across all items to reflect the *PCE* construct score or *T*. The *PCE* value, summarizing all four items could thus range from a low of 4 to a high of 20 with a higher score indicating a respondent feeling empowered to affect the environment in a positive fashion by their own actions. Respondents with higher levels of *PCE* are thus expected to exhibit positive responses with respect to *WTI*, *WTP*, *WTC* and *WTS*.

3.3.3 Consumer Knowledge and Perception Regarding Climate Change Issues

As previously cited by Laskova (2007), marketers will need to educate consumers on the environmental benefits of green purchases to improve their green attitudes and influence consumer intention to purchase green products. Question 6 attempted to ascertain both subjective (top half of table) and objective knowledge levels (bottom half of questions).

Question 6:

Please indicate your level of agreement with each of the following statements.

Opinion Statements	Strongly Disagree	Dis-agree	Neutral	Agree	Strongly Agree
I do not believe in climate change. (*SUB1*)	**5**□	**4**□	**3**□	**2**□	**1**□
Climate change is accelerated by human influence. (*SUB2*)	**1**□	**2**□	**3**□	**4**□	**5**□
Climate change is not affected by changes in green house gas levels in the atmosphere. (*SUB3*)	**5**□	**4**□	**3**□	**2**□	**1**□
Awareness Statements	True		Don't know		False
Carbon dioxide emissions are the *only* greenhouse gas emissions tracked for a product's carbon footprint.	□		□		■
The primary greenhouse gases are nitrous oxide, methane and carbon dioxide and are usually converted to a carbon equivalent for carbon footprint labeling.	■		□		□
The way we grow, process, package, transport and use food products contributes more than 10% of the earth's overall greenhouse gas levels in the atmosphere.	■		□		□
Every consumer has a carbon footprint.	■		□		□

Similar to the *PCE* construct, *SUB1* to *SUB3* were used to obtain a subjective knowledge score *SUB*. Subjective knowledge can range from 3-15 with higher scores reflecting greater subjective knowledge/opinion regarding climate change and some of its characteristics. The remaining four questions were awareness statements to measure respondents' actual (objective) knowledge regarding greenhouse gases (GHG) and CF. To capture the objective knowledge of a respondent, the number of correct responses (*CORRECT*) was used as a proxy (correct answers are highlighted). Also the number of non-responses (*ABSTAIN*), leaving the answer field unmarked was tracked to see whether the number of correct answers was merely a function of non-response. If respondents answered all questions, percent of correct answers across all questions would measure knowledge as in a typical exam situation. Responses are voluntary, however, in a survey setting and hence non-responses were expected and *CORRECT* would be more appropriate than percentage of questions answered correctly of total questions asked calculated as number of correct answers divided by number of questions answered including those answered "Don't know". This only holds as long as non-response is a function of lack of knowledge. More details on this issue will be provided in chapter 4.

Both higher *SUB* and *CORRECT* scores are hypothesized to potentially lead to greater *WTI*. Being more informed would not necessarily lead to greater *WTP*, however, as respondents would know the positive correlation between cost of production and CF. That is, more environmentally friendly milk (on the basis of GHG emissions/gal of milk) would likely use more GHG efficient inputs that could translate to lower cost and hence these savings would pass through to retail milk prices to gain a marketing advantage. Nonetheless, better informed consumers would be expected to exhibit a positive response

with *WTC* in the sense that they would either increase or not change the level of milk consumption with lower CF milk if available with the same attributes as their current milk purchases at the same price.

3.3.4 Willingness to Pay for label information

Prior to ascertaining *WTI, WTC, WTP* and *WTS* information from the respondents, the following paragraph of information was provided:

"Since consumer awareness toward the environment has been increasing retailers are beginning to think about providing more information to their customers.

TESCO is a large food retailer in the United Kingdom and is currently carbon footprinting their products through the Carbon Trust who certifies the label. To the right is one example of such a label. The carbon footprint is from farm origin to store and captures greenhouse gas emissions in their carbon dioxide (CO_2) equivalent form.

Note that approximately 2 lbs of CO_2 emissions are generated when driving an average car for 3 miles.

454 g of CO2 is the same as 1 lb of CO2 emissions

The following questions are designed to capture your thoughts about how someone might react to this kind of carbon footprint labeling on milk."

The purpose of noting the aforementioned information to the respondents was to provide them a mental reference to a real life carbon label currently used in the UK and to provide a benchmark comparison of CF effects from consuming 1 gallon of labeled milk product with driving an average car 3 miles. Since the Carbon Trust label seen above corresponded to a pint of UK milk, it is approximately equal to 2 lbs of C

equivalent emissions per US gallon[14], this level of emissions was used across all different typical milk categories a respondent could select as more specific information related to packaging, production method and source of milk was not available. The 2 lbs of C per gallon of milk was thus used as the base level of CF for typical milk consumed by the respondent in questions 8 and 9 to assist the respondent with understanding the potential carbon reductions associated with hypothetically introduced changes to the label.

Following the above paragraph intended to inform respondents about CF label and impact of CF, questions 7 – 9 and 11 were asked in the third person using inferred valuation as discussed in chapter 2.

Question 7:

Previously you indicated the following milk characteristics to apply to you:

Characteristic	Your Answers
Container Size	*½ Gallon*
Container Type	*Carton*
Production Method	*Conventional*
Price	*$2.09*

If a label similar to the TESCO label presented above were added to your typical milk, how much extra would someone pay for this label information? (*PLABEL*)

They would pay no more than $_____ per *Gallon* extra for this information.

This question allowed for a response to measure how much respondents would pay for extra information. It provides critical information needed to determine what

[14] 1 UK pint = 0.15 US gal. 800 g of CO_2 eq. = (12/44 * 800 g / 454 g) lbs of C eq. or 0.48 lb of C eq. per UK pint and hence 3.2 lbs of C eq. per US gallon of milk. Nonetheless a CF of 2 lbs of C eq. per US gallon was chosen in part by calculation error and in part because detailed GHG footprint data from farm to retail across different package size was not available at the time of study.

respondent factors drive consumer willingness to pay for added information about CF (*WTI*). Responses to this question were left-censored at zero as negative responses were deemed illogical responses (4 of 506 responses). As such regressing *PLABEL* against a list of respondent characteristics was deemed most appropriate using TOBIT regression techniques (Gujarati, 1995).

3.3.5 Changes in Consumption due to CF

Question 8:

Previously you indicated the following milk characteristics to apply to you:

Characteristic	**Your Answers**
Container Size	*½ Gallon*
Container Type	*Carton*
Production Method	*Conventional*
Price	*$2.09*

Assuming the same milk as described above has a carbon label of 2 lbs per gallon from farm to store and price does not change with a different carbon footprint label…

a. If the milk label indicated a *20%*[15] **higher** 2.4 lb carbon footprint would that person drink or buy *(please circle answer)*
-1□ *less* **1□ *more*** **0□ *the same*** (*QWHIGHER*)

b. What if the label decreased by *20%* to a 1.6 lb carbon footprint *(please circle answer)*
-1□ *less* **1□ *more*** **0□ *the same*** (*QWLOWER*)

[15] The question was also asked at 10% and 40% carbon footprint level changes.

Answers to the question 8a and 8b were coded in such a fashion that

	1 =	if respondent chose to increase consumption
QWLOWER/QWHIGHER	0 =	behavior consistent with CF information having no impact on consumption
	-1 =	if respondent chose to decrease consumption

Without a price effect (holding price constant across different labels), this question was intended to measure whether consumers would opt to drink more in light of lesser CF impact (*QWLOWER* =1) or whether they would curtail consumption if CF would increase (*QWHIGHER* = -1). If a consumer responds by not changing his/her consumption level then the consumer either faces other constraints or is not concerned about the environment. The question is asked in both directions (consuming more and less to see whether the direction of the CF label would impact consumption behavior to the same degree). Put differently, will a consumer only curtail consumption to save CF or are they also willing to enjoy drinking more of lower CF milk if they now need not worry about overall footprint expansion. Consistency in responses can be checked with this question. If a respondent is willing to consume more of lesser CF milk, they should also consume less of higher CF milk to be consistent. If a negative correlation (< -0.3 similar to item correlation threshold) between these responses exists, respondents answered this question consistently. *QWLOWER*, will be chosen as the dependent variable to measure *WTC* since it is likely that milk producers will respond to carbon labeling by becoming more efficient in their production process as they could gain a retailing advantage (not only selling more milk if consumers respond to lower CF labels in that fashion but also likely lowering cost by using inputs more GHG efficiently and

thereby lowering the CF). Since *QWLOWER* is a binomial variable (-1 responses were removed as they were illogical responses (9 of 524), PROBIT regression techniques were used for measuring the effects of consumer attributes on this binomial decision variable (Gujarati, 1995). An alternative approach would allow using all entries to determine what factors lead to a consumption change (positive or negative) as a consumer could curtail consumption and purchase lower CF milk to really be environmentally conscientious, for example.

3.3.6 Willingness to Pay for CF Reduction

This question expanded on the *WTC* measure in question 8 by applying carbon label information to the respondents' typical milk purchase and eliciting how much less or extra a consumer would pay for milk as the CF label increased or decreased. To lead to a desirable environmental outcome, lowering GHG emissions, the respondent would choose to pay a premium for lower CF milk to help provide an incentive for milk suppliers to

Question 9:

Previously you indicated the following milk characteristics to apply to you:

Characteristic	**Your Answers**
Container Size	*½ Gallon*
Container Type	*Carton*
Production Method	*Conventional*
Price	*$2.09*

Again, assuming milk with the same attributes as described above has a carbon label of 2 lbs per gallon from farm to store…

a. To drink the same amount of similar milk but with a *20%* [16] **higher** 2.4 lb carbon foot print, how much more or less would they pay? (*PCARBONUP*)
1□ +10% **1**□ +5% **2**□ the same **3**□ - 5% **4**□ - 10% □ Other ____

b. To drink the same amount of similar milk but with a *20%* **lower** 1.6 lb carbon foot print, how much more or less would they pay? (*PCARBONDOWN*)
4□ +10% **3**□ +5% **2**□ the same **1**□ - 5% **1**□ - 10% □ Other ____

respond in that fashion or alternatively penalize milk producers that can only supply higher CF milk by being willing to pay less for higher CF milk. Respondents were asked to answer this question by picking a percentage category or their own response. The categories were provided to increase response rate at the cost of potentially introducing bias by suggesting particular price premiums or discounts. As with question 8, the question was asked in both directions to assess whether respondents answered the question consistently. Again, only answers to part b of question 9 would be used if the Pearson correlation coefficient between *PCARBONDOWN* and *PCARBONUP* was greater than 0.3.

Initial attempts to analyze question 9 were to multiply the response category by price adjusted to $/gal to arrive at a cardinal measurement of *WTP* for CF reductions per gallon. However, a respondent could choose, for example, a +5% response and have meant 3.2456%. Hence, an ordered choice model that groups responses into the following categories is more consistent with conventional WTP analyses in the literature.

[16] Note that this question was also asked at the 10% and 40% carbon footprint deviation level. For a 10% deviation, the question would now read…

a. To drink the same amount of similar milk but with a *10%* **higher** 2.2 lb carbon foot print, how much more or less would they pay?
□ +10% □ +5% □ the same □ - 5% □ - 10% □ Other _____

1 = paying less for milk with a lower CF

2 = paying the same for milk with lower CF

WTP

3 = paying up to 5% more for lower CF milk

4 = paying more than 5% for lower CF milk

Using Ordered Probit models for *WTP* measured in this fashion at the three different CF change levels of 10, 20 and 40%, each, allowed whether consumer factors affecting this decision were consistent across different CF change levels. That is, does the amount of CF change affect the distribution of *WTP* responses and are the same consumer factors responsible for driving the response category.

3.3.7 Organic Production Methods and Willingness to Switch from Organic to Conventional on the Basis of CF

As highlighted in chapter 2, a study in the Netherlands supported the contention that organic milk production is likely to have a larger CF per gallon than conventional milk production. To summarize these research results, the following statement was included in the survey prior to asking respondents about their threshold level for switching to lower CF conventional milk from organic milk.

"Organic milk production typically involves using more fuel, feed and labor to produce the same amount of milk compared to producing milk with chemicals to improve efficiency. A gallon of organic milk therefore leads to more greenhouse gas emissions from use of inputs than a gallon of conventional milk. *(By comparison, think of manually pulling weeds on your driveway vs. using chemical weedkiller)*."

Question 10:

Please indicate your level of belief in the above statement about the dairy sector. (*BELIEVE*)

0□ Strongly Disbelieve **0**□ Disbelieve **0**□ Don't know **1**□ Believe **1**□ Strongly Believe

Answers to this question were coded as a dummy variable with *BELIEVE* =1 for respondents that believed that organic milk would have a higher CF and 0 indicated either lack of opinion or disbelief. For organic consumers, it was hypothesized that agreement with this statement would lead to a greater *WTS* and vice versa.

Prior to ascertaining at what CF reduction level consumers would switch from organic to conventional milk the following information was provided:

"Since carbon footprint depends on input use and varies significantly by production method as well as production region and retailing method, the following question is hypothetical.

Assume someone usually consumes organic milk with a higher carbon footprint than conventional milk and sees a carbon footprint label that he/she believes in and prices don't change.

Recent Market Prices for Organic and Conventional Milk for different Packages Sizes. Ranges are across brands and packaging."

Package Size	1 Gallon (3.78 L)	½ Gallon (1.89 L)	Quart (0.95 L)	Pint (0.48 L)
Organic Milk	$6.89 to $7.69	$3.50 to $4.49	$2.19 to $2.49	$1.35 to $1.79
Conventional Milk	$2.66 to $3.48	$1.72 to $2.17	$1.14 to $1.44	$.79 to $1.32

Both conventional and organic milk consumers seek health attributes when purchasing their milk products. An example with conventional milk consumers is when

their purchase decision is based on a lower fat content. Also, organic milk may have the connotation of being good for animals, local food production, personal health benefits, etc. This is seen with such organic attributes as antibiotic and/or hormone free milk. Now the organic consumer is conflicted in the sense that organic milk may be more environmentally harmful from a greenhouse gas perspective while beneficial in the aforementioned characteristics.

The milk price table was reintroduced here to reiterate the price difference between the milk products to see if this information coupled with the information provided in Question 10 regarding higher carbon intensive organic vs. conventional milk production would affect substitution decisions.

Question 11:

At what amount of carbon footprint reduction do you think they would switch from organic milk to conventional milk? (*WTS*)

1□ *they would not switch*

They would switch at a carbon footprint reduction level of

5□ *< 5%* **4**□ *5 -10%* **3**□ *11-20%* **2**□ *21% or more*

Respondents' willingness to substitute organic milk for conventional milk was measured such that the coded response would be directly correlated with ease of dropping organic milk in favor of cheaper and hypothetically lower CF milk. An organic consumer that would not change is therefore assigned to category 1 whereas an organic consumer that would switch to conventional milk for a minor CF reduction of less than 5% reduction would be in category 5.

Again, given the categorical nature of the data, an ordered probit model was used to determine what factors drive the decision to switch from organic to conventional milk and at what CF reduction threshold. The regression used only data from organic milk consuming respondents.

3.3.8 Respondent Demographic Information

The above respondent behavior, knowledge and attitude questions can be compared on the basis of age, gender, household income and size, as well as level of education. Demographic variables were included to possibly identify target markets for promoting CF labeled milk products. Results are expected to aid marketers for companies, government agencies and policy makers by providing insights about CF label effects on consumer demand for milk. Categories to use for demographics in the survey were obtained from the US Census Bureau, American Fact Finder website located at http://fastfacts.census.gov/servlet/ADPGeoSearchByListServlet?ds_name=ACS_2007_1YR_G00_&_lang=en&_ts=321287679459 to be able to compare and contrast survey statistics to the sample statistics.

Questions 12 and 13:

Please indicate your age group: (AGE)

20□ Less than 25 **30**□ 25-34 **40**□ 35-44 **50**□ 45-54 **60**□ 55-64 **70**□ 65+

Question 12 was coded cardinally per age group. "Less than 25" was the initial range scored with a benchmark value of "20". Since most of the age ranges increased by increments of 10, the scores were raised by a value of 10 as well. "25-34", "35-44", "45-54", "55-64" and "65+" were all valued at "30", "40", "50", "60" and "70" respectively.

From this data we created three groupings as modifications. The benchmark group was "Family" which included the responses with 30, 40 and 50 values. "Student" included the responses with a value of 20 and "Empty Nesters" included the responses with 60 and 70 values. Two dummy variables were created; DSTUDENT and DEMPTYN as independent variables for the regressions. There were no a priori expectations related to impact on *WTI*, *WTC*, *WTP* and *WTS* measures. Instead coefficient estimates on these variables may help for target marketing questions.

Please indicate your gender: (GENDER)

1□ Male **0**□ Female

The response to this question was coded as a dummy variable with 1 indicating the male gender. Similar to the age question, there were no a priori expectations related to impact on *WTI*, *WTC*, *WTP* and *WTS* measures.

Question 14:

What best describes your level of education? (Please mark the highest level of education completed) **(EDU)**

0□ Did not complete high school
2□ High school graduate or GED
4□ Some post high school training
6□ Bachelor's degree
9□ Graduate or professional degree

Question 14 was coded cardinally per level of education. 'Did not complete high school' was coded with a score of '0' and 'High school graduate or GED' was the scored as '2'. 'Some post high school training' was assumed approximately 2 years for an associate degree and thus received a score of '4'. 'Bachelor's degree' typically takes four

years to complete from high school graduation and thus was scored as '6'. Lastly, 'Graduate or professional degree' typically takes another three years to complete after Bachelor's degree and thus was scored with '9'. From this data we created three groupings of education level. The benchmark group included respondents that had attained a bachelor's degree which included the responses with a value of '6'. *DHIEDU* included the responses with a value of 9 and *DLOWEDU* included the responses with '4', '2' and '0' values. Again, coefficient estimates on these variables were expected to help with target marketing.

Question 15:

Which one of the following categories best describes your household income before taxes in 2009? (INCOME)

5,000	□ Less than $10,000
17,500	□ $10,000 - $24,999
35,000	□ $25,000 - $44,999
60,000	□ $45,000 - $74,999
112,500	□ $75,000 - $149,999
175,000	□ $150,000 or more

Question 15 was coded using mid-points from the categories. For regression analyses these data were modified to reflect three groupings. The benchmark group was middle income earners included the two middle income categories. The first and last two categories were assigned *DLOWINC* and *DHIGHINC*, respectively. Expectations of income variables are discussed in the added explanatory variable section below.

Question 16:

Including yourself, how many people live in your household? _____ person(s) (HOUSEHOLD)

This question was asked to determine per capita consumption levels and as a variable to group responses for target marketing.

3.3.9 Created Variables

Three variables (*MSHARE*, *DLSHARE* and *DHSHARE*) were created to present the proportion of money spent on milk in relation to respondents' income and to show these proportions per income groups.

*MSHARE = P/SIZE * TQ /(INCOME /* 1,000)

This measure reflects the total weekly milk expenditure as a fraction of each $1,000 of income reported for the year. Two additional dummy variables were created to measure milk expenditure effects in relation to income level by multiplying *MSHARE* with the income dummy variables:

*DLSHARE = MSHARE * DLOWINC* and *DHSHARE = MSHARE * DHIGHINC*

Price and quantity effects relative to income level provide a comprehensive measure of how important milk purchases are in relation to household income. Respondents with high *MSHARE* are expected to pay more attention to milk labels but potentially more so due to budgetary concerns (*DLSHARE*) for the case of low income groups as opposed to those with high income. Milk expenditure is not expected to play a

large role for high income respondents. These variables are included to control for these effects.

3.4 Data Collection Procedure

This research was administered to University of Arkansas faculty, staff and students via e-mail on 11/10/2010 in Fayetteville, Arkansas, USA. The initial email was sent in batches of 200 emails at a time. A response rate of just under 5% was achieved with approximately 295 responses received by 11/15/2010. A reminder e-mail highlighted in Appendix A on 11/17/2010 led to nearly fulfilling the 10% response rate target with 534 complete responses collected by 11/22/2010.

The data was collected and downloaded using the SNAP 9 Professional[17] survey tool and data entries were coded using an Excel spreadsheet. A series of random data checks were performed to ensure that data coding procedures were applied consistently (i.e. 50 random respondents were chosen and their data was cross checked to ensure proper data entry and coding of responses).

3.5 Statistical Analysis

The following statistical tools were used in analyzing the collected data from the survey. Prior to using *PCE* and *SUB* in the regression equations they were analyzed for internal validity and consistency using item total correlation and Cronbach's alpha,

[17] SNAP survey software is efficient, innovative, integrated and user-friendly software which manages four steps in survey research: designing survey questionnaires, publishing survey questionnaires, collecting survey data, and analyzing the survey data. SNAP 9 is the current release of the software and is available free to University employees. SNAP acts as a tool to design the Survey Questionnaire and publish the Questionnaire in several modes, the most common of which is publishing online and sending a link to the intended respondent by email.

respectively. *QWLOWER, QWHIGHER, PCARBONUP* and *PCARBONDOWN* were tested for correlation with a threshold of 0.30 to determine consistent response. Descriptive statistics such as mean, standard deviation and range were used to characterize the data for basic interpretation. Two-way comparisons of means were conducted using the Statterthwaite Welch t-test whereas three-way comparisons of means were performed using the Welch F-test. Lastly, we used nonlinear regression equations to analyze the *WTI, WTP, WTC* and *WTS* responses to determine which independent variables were significant in explaining variance in these responses.

Variables summarized in Table 3.1 and discussed in the previous sections of this chapter were included in the following four basic equations:

(3.1) *WTI* Equation:

$$PLABEL = f(Respondent, Milk, Opinion\ \&\ Knowledge, Demographics, Expenditure)$$

where *Respondent* included variables *DSHOP, DPLASTIC* and *TQ, Milk* included the importance attached to different milk attributes *DFAT, DORGANIC, DBRAND, DSIZE, DFRESH, DPRICE* and *DOTHER, Opinion & Knowledge* included *PCE,* the total scale score on perceived consumer effectiveness and both subjective and objective knowledge measurements *SUB* and *CORRECT, Demographics* included the age dummy variables *DSTUDENT* and *DEMPTYN*, the household income dummy variables *DHIGHINC* and *DLOWINC*, the education dummy variables *DLOWEDU* and *DHIEDU* and gender effects (*GENDER*) and finally, *Expenditure,* captured milk expenditure effects measured by *MSHARE, DLSHARE* and *DHSHARE*;

(3.2) *WTC* Equation:

QWLOWER = g (*Respondent, Milk, Opinion & Knowledge, Demographics, Expenditure*)

using the same explanatory variables as in equation 3.1 but estimated for three subgroups of respondents that were presented with 10%, 20% or 40% carbon label changes excluding those observations with *QWLOWER* < 0 estimated using a binary PROBIT regression technique;

(3.3) *WTP* Equation:

WTP = h (*Respondent, Milk, Opinion & Knowledge, Demographics, Expenditure*)

is again estimated at three different label change levels, but now in an ordered PROBIT model using several response levels for *WTP* as indicated above and finally the;

(3.4) *WTS* Equation:

WTS = i (*Respondent, Milk, Opinion & Knowledge, Demographics, Expenditure*)

was estimated using the subsample of respondents that drank/purchased organic milk as determined by *ORGANIC* = 1. Again an ordered PROBIT model was used for different CF change thresholds as discussed above and an additional variable (*DBELIEVE*) was introduced to reflect whether the respondent either believed that organic milk would have a higher CF or not on the basis of the preamble to question 11.

For all of the above equations, all variables were included in the final regression output with the potential exception of *DPLASTIC, DSHOP*, either of *SUB* or *CORRECT* and the *Milk* variables except for *DPRICE*. These variables were potentially dropped from the equation on the basis of absolute value of the z-statistic being less than 1. This

was done to minimize multicollinearity bias (Gujarati, 1995) and resulted in the following final specifications for each equation including expected sign of coefficient estimates:

Table 3.1 Final Regression Equations and Models used for Data Analysis.

Equation	*WTI*	*WTC*			*WTP*			*WTS*
Dep. Variable	*PLABEL*	*QWLOWER*			*WTP*			*WTS*
Label Deviation	na	*10%*	*20%*	*40%*	*10%*	*20%*	*40%*	*na*
Respondent								
DSHOP	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
DPLASTIC	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
TQ	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
ORGANIC	+	+/-	+/-	+/-	+	+	+	+
Milk								
DFAT	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
DORGANIC	+	+/-	+/-	+/-	+	+	+	-
DSIZE	-	+/-	+/-	+/-	-	-	-	+/-
DOTHER	+	+/-	+/-	+/-	+	+	+	-
DBRAND	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
DFRESH	-	+/-	+/-	+/-	-	-	-	+/-
DPRICE	-	+/-	+/-	+/-	-	-	-	+
Opinon & Knowledge								
PCE	+	+/-	+/-	+/-	+	+	+	+
SUB	+	+/-	+/-	+/-	+	+	+	+
CORRECT	+	+/-	+/-	+/-	+	+	+	+
DBELIEVE	na	na	na	na	na	na	na	+
Demograhpics								
DSTUDENT	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
DEMPTYN	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
DHIGHINC	+	+/-	+/-	+/-	+	+	+	+/-
DLOWINC	-	+/-	+/-	+/-	-	-	-	+/-
DHIEDU	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
DLOWEDU	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
GENDER	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
Expenditure								
DLSHARE	-	+/-	+/-	+/-	-	-	-	+/-
MSHARE	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
DHSHARE	+	+/-	+/-	+/-	+	+	+	+/-

Each equation was evaluated for goodness of fit using appropriate statistics pending regression technique. Marginal effects for independent variables were calculated and evaluated if coefficient estimates had p-values less than 0.10. Predictive success of

the models was also evaluated for the binomial and ordered choice models by comparing actual to predicted responses of explanatory variables.

3.6 Conclusion

Concise publically available information regarding climate change and the dairy industry, milk production methods, milk consumption and carbon label research as presented in Chapter II was utilized in Chapter III to help shape a survey instrument that was intended to provide insights about consumer responses to carbon labeling of milk products. An internet based survey instrument was used on a sample of 3,000 students and 3,000 faculty and staff at the University of Arkansas in the fall of 2010. The responses were analyzed using the outlined statistical procedures.

Chapter Four: Results

4.1 Introduction

This chapter provides a basic summary of the survey data intended to yield insights for companies, marketers, government, economists, policy creators and for future study. The chapter proceeds by i) discussing the response rate and representativeness of the respondents; ii) describing a summary of respondent and milk characteristics, the perceived consumer effectiveness construct, *PCE*, as well as subjective and objective knowledge as differentiated by a) conventional vs. organic; b) shopper vs. non-shopper; c) gender; d) age, income and education groups; and iii) the regression results for *WTI*, *WTC*, *WTP* and *WTS.*

4.2 Response Rate and Representativeness of Survey Sample

A total of 528 usable responses were collected from the initial 534. Given the length and method of the survey, this response rate was deemed acceptable. To what extent the results reported here are representative of the U.S. or even Fayetteville is subject to the reader's interpretation of the comparison of respondent demographics to that of Arkansas and the U.S. as shown in Table 4.1.

Since only University of Arkansas students and faculty/staff were given the survey the results are skewed to a more highly educated response sample than would be representative of Arkansas or the U.S. The sample also is more heavily oriented toward smaller households and a younger demographic with less income.

Table 4.1 Comparison of 2007 Census Demographic Data for Arkansas and U.S. vs. Respondent Sample of this Survey.

	Arkansas	United States	Survey
Median Age	37.0	36.7	32.9
# (%) of obs. *DSTUDENT* (< 25)	(9)	(18)	202 (39)
# (%) of obs. *FAMILY (Base case* 25 – 55)	(56)	(54)	267 (52)
# (%) of obs. *DEMPTYN (> 65)*	(36)	(18)	49 (9)
Average Persons per Household	2.50	2.61	1.89
25 and older of population (less than bachelor's degree)	81.1%	84.5%	15.8%
25 and older of population (bachelor's degree or higher)	19.3%	27.5%	84.2%
Median Family Income	$47,021	$61,173	$44,550
# (%) of obs. *DLOWINC* (< $25,000)	(24)	(24)	210 (42)
# (%) of obs. *MIDINC* ($25,000 – $74,999)	(50)	(44)	211 (42)
# (%) of obs. *DHIGHINC* (> $75,000)	(26)	(32)	84 (17)
Gender			
Male	(49)	(49)	218 (43)
Female	(51)	(51)	293 (57)

Source: U.S. Census Bureau, American Fact Finder, http://fastfacts.census.gov/servlet/ADPGeoSearchByListServlet?ds_name=ACS_2007_1YR_G00_&_lang=en&_ts=321287679459. Accessed April 19, 2011.

4.3 Statistical Summary of Responses by Respondent Group

4.3.1 Consumption, Household Size, Container Type and Size and Price Information

Table 4.2 provides respondent characteristics in terms of amount of milk purchased/consumed, household size, container type, container size and price. As shown in Table 4.2, the majority of respondents were the primary shoppers for their household that on average purchased nearly twice the amount of milk compared to milk drinkers alone. Most consumers (282 or 55%) chose the one gallon, plastic container size followed by the half gallon plastic (128 or 25%) and half gallon carton (63 or 12%). Nonetheless there were 6 respondents purchasing glass containers.

Table 4.2 Respondent Characteristics as Differentiated by Milk Type, Shopping Mode, Gender, Age, Income and Education.

	Quantity(*TQ*)			**Household Size (*HOUSEHOLD)***			**ContainerType (*GLASS+ CARTON*) / (*GLASS + CARTON + PLASTIC*)**			**Size[b,c] (*SIZE*)**			**Price[d] (*P / SIZE*)**		
	Gallons			# of Persons			Fraction			Gallons			$/gallon		
	Avg.	Std. Dev.	# of Obs.	Avg.	Std. Dev.	# of Obs.	Avg.	Std. Dev.	# of Obs.	Avg.	Std. Dev.	# of Obs.	Avg.	Std. Dev.	# of Obs.
Conventional vs.	0.92***	0.80	420	1.91	1.06	422	0.05***	0.23	422	0.81***	0.26	424	3.63***	1.47	418
Organic[a]	0.47	0.43	65	1.74	0.91	65	0.91	0.29	64	0.51	0.20	67	8.10	2.52	67
Shopper vs.	0.90***	0.79	450	2.00***	1.05	452	0.17	0.37	452	0.77	0.27	456	4.26	2.58	451
Non-shopper	0.49	0.48	60	1.00	-	60	0.17	0.38	58	0.76	0.31	60	4.44	2.31	57
Male vs.	0.88	0.81	280	1.70***	0.96	211	0.12**	0.32	211	0.79	0.27	212	3.94***	1.74	208
Female	0.83	0.71	210	2.01	1.08	281	0.20	0.40	278	0.75	0.28	282	4.55	2.69	280
Student	0.66***	0.54	193	1.55***	0.73	194	0.14	0.35	192	0.76	0.28	193	4.10	2.08	192
Age	0.96	0.84	257	2.14	1.16	258	0.19	0.40	258	0.76	0.27	261	4.47	2.53	256
Empty Nest	1.05	1.00	47	1.74	1.03	47	0.11	0.31	46	0.77	0.29	47	4.18	2.39	46
Low	0.72***	0.62	198	1.59***	0.78	199	0.20	0.40	199	0.73**	0.29	199	4.38	2.25	197
Income	0.91	0.88	205	2.01	1.13	206	0.15	0.36	203	0.77	0.27	207	4.29	2.48	205
High	1.01	0.77	82	2.26	1.19	82	0.11	0.32	81	0.83	0.25	82	3.89	1.80	79
Low	0.87	0.89	122	1.89	1.07	122	0.15	0.36	120	0.77	0.27	124	4.24	2.18	120
Education	0.86	0.75	185	1.81	1.02	186	0.14	0.35	186	0.78	0.28	185	4.09	2.13	183
High	0.84	0.70	190	1.93	1.03	191	0.20	0.40	190	0.75	0.27	192	4.53	2.64	191
Overall	0.85	2.12	510	1.89	1.04	512	0.17	0.37	510	0.77	0.27	516	4.28	2.34	508

Notes:

[a] Numbers are averages, standard deviation in parentheses and number of observations in italics, respectively.

[b] Chi-square tests on the distribution on container type and sizes were also performed but many cells had fewer than 5 observations especially in the small size category. Hence average type and size differences were compared using Satterthwaite Welch t-tests or Welch F-tests as appropriate.

[c] The most common size was the 1 gallon container with 291 of 516 observation. The next common sizes were ½ gallon, quart and pint sizes at 195, 23 and 7 observations, respectively.

[d] Price was adjusted to price per gallon by dividing the price paid per container size by the size of the container.

* p-value ≤ 0.1; ** p-value ≤ 0.05; *** p-value ≤ 0.01

While a majority of the respondents purchased/drank conventional milk (425 or 86.4%), 67 respondents (13.6%) indicated they were organic milk purchasers/drinkers. The average price per gallon differed significantly between organic vs. conventional milk as expected and observed in the market. Also, the package size and type were smaller for organic consumers and matched in-store observations. Quantities purchased/consumed were approximately half that of conventional consumption for organic consumers. Relatively few statistically significant differences were found between respondents that shopped for the household vs. those that purchased/drank for their own consumption. While quantity purchased was nearly twice for shoppers compared to non-shoppers, quantity per person in the household was nearly the same. Gender differences centered on container type, price and household size with males preferring plastic, lower prices and they live in smaller households. Statistically significant age differences were somewhat surprisingly few and were marked by younger respondents consuming less milk and living in smaller households. Similar to age, respondents in the lowest income category consumed less milk and lived in smaller households. In addition, they preferred smaller package size.

4.3.2 Importance of Milk Attributes of Fat Content, Container Size, Brand, Freshness, Organic, Price and Other

Table 4.3 exhibits milk attribute differences by respondent characteristics. The overall rankings were statistically significantly different at $p < 0.001$ and revealed a preference ordering from highest to lowest starting with freshness, fat content, price, package size, brand name, organic production and other attributes. Preferences also shifted by respondent group as shown in the table. Respondents drinking conventional

Table 4.3 Respondent Milk Attribute Importance Rankings[a] as Differentiated by Milk Type, Shopping Mode, Gender, Age, Income and Education.

		Fat Content (*DFAT*)		**Container Size (*DSIZE*)**		**Brandname (*DBRAND*)**		**Freshness (*DFRESH*)**		**Organic *DORGANIC*)**		**Price (*DPRICE*)**		**Other[c] (*DOTHER*)**	
	N	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.	Std. Avg.	Dev.
Conventional	423	0.76***	0.43	0.48***	0.50	0.30	0.46	0.88*	0.42	0.09***	0.28	0.74***	0.44	0.05***	0.22
vs. Organic[b]	67	0.57	0.50	0.21	0.41	0.31	0.47	0.78	0.33	0.85	0.36	0.43	0.50	0.19	0.40
Shopper vs.	456	0.73	0 .45	0.44	0.50	0.32*	0.47	0.86	0.35	0.19	0.40	0.71	0.46	0.07	0.26
Non-shopper	59	0.75	0.44	0.51	0.50	0.22	0.42	0.85	0.36	0.20	0.41	0.63	0.49	0.10	0.30
Male vs.	215	0.72	0.45	0.47	0.50	0.32	0.46	0.86	0.35	0.18	0.39	0.74*	0.44	0.05**	0.21
Female	293	0.72	0.45	0.41	0.49	0.30	0.47	0.85	0.36	0.21	0.41	0.68	0.47	0.10	0.29
Student	200	0.72	0.45	0.52**	0.50	0.29	0.45	0.87	0.34	0.17*	0.38	0.70	0.46	0.04**	0.20
Age	266	0.73	0.45	0.38	0.49	0.33	0.47	0.83	0.38	0.24	0.43	0.71	0.45	0.10	0.30
Empty Nest	49	0.67	0.47	0.43	0.50	0.35	0.48	0.92	0.28	0.12	0.33	0.65	0.48	0.08	0.28
Low	207	0.68***	0.47	0.50**	0.50	0.26*	0.44	0.85	0.36	0.18	0.39	0.73**	0.44	0.08	0.28
Income	211	0.70	0.46	0.42	0.50	0.36	0.48	0.85	0.35	0.23	0.42	0.71	0.45	0.07	0.26
High	84	0.87	0.34	0.33	0.47	0.29	0.45	0.87	0.34	0.15	0.36	0.58	0.50	0.06	0.23
Low	126	0.66	0.48	0.53***	0.50	0.37**	0.49	0.87	0.34	0.22	0.42	0.78**	0.42	0.06	0.24
Education	195	0.74	0.44	0.49	0.50	0.24	0.43	0.87	0.34	0.15	0.36	0.70	0.46	0.05	0.22
High	194	0.74	0.44	0.32	0.47	0.35	0.48	0.83	0.38	0.23	0.42	0.65	0.48	0.11	0.31
Overall	528	0.72	0.45	0.44	0.50	0.31	0.46	0.86	0.35	0.20	0.40	0.70	0.46	0.07	0.26

Notes:

[a] Reported in the table is the fraction of total respondents that ranked a particular attribute as most, second- or third-most important among all attributes shown in the table.

[b] Differences in means were compared using Satterthwaite Welch t-tests or Welch F-tests as appropriate.

[c] When a respondent chose other as an important criterion for the choice of milk the most common response was lactose intolerance requiring use of lactose free milk, followed by tight lids to provide a clean appearance of the jug in the shelf.

* p-value ≤ 0.1; ** p-value ≤ 0.05; *** p-value ≤ 0.01

milk attached greater import to fat content, container size, freshness and price than their organic counterpart. By the same token they were less concerned with organic production and other attribute differences. Shoppers exhibited slightly higher brand loyalty than non-shoppers. Gender differences were revealed in greater price conscientiousness by males and less concern over other milk attributes. Age differences were present with respect to container size, organic and other attributes. Low- and middle-income respondents were more price conscientious than high-income groups with fat content playing the largest role among high income respondents. Attention to brand played the largest role for mid-income respondents and low-income respondents valued package size the most. Respondents in the lowest education category attached the most significance to price and container size, respectively, relative to their counterparts. By the same token the least and most educated respondents were more concerned with brand than group of respondents with mid-level education. These results are similar to the Australian case study (Vanclay et al., 2011) in the sense that freshness and container size were the most important and of moderate importance among characteristics to consumers, respectively.

4.3.3 PCE, Subjective and Objective Knowledge

The Perceived Consumer Effectiveness (PCE) construct measured how a respondent felt about their ability to affect the environment. The shaded rows in Table 4.4 were scored using a scale of 1 = Strongly Disagree to 5 = Strongly Agree whereas the non shaded rows were reversed scored (1 = Strongly Agree and 5 = Strongly Disagree). The average total scale score is 16.4 and indicates that respondents on average agreed or

disagreed with the statements. Item total correlation analysis and Cronbach alpha suggest that respondents provided internally valid and reliable responses.

Table 4.4 Summary of survey responses toward Perceived Consumer Effectiveness (PCE), Arkansas, 2010.

	Percent of Responses						
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Number of Responses[a]	Item Total Correlations[b]
PCE 1	It is worthless for the individual consumer to do anything about pollution.						
	59.8	33.2	4.7	0.9	1.3	530	0.50
PCE 2	When I buy products, I try to consider how my use of them will affect the environment and other consumers.						
	4.0	13.0	27.6	43.6	11.8	525	0.48
PCE 3	Since one person cannot have any effect upon pollution and natural resource problems, it doesn't make any difference what I do.						
	50.6	42.6	5.1	1.1	0.6	528	0.60
PCE 4	Each consumer's behavior can have a positive effect on society by purchasing products sold by socially responsible companies.						
	2.3	2.9	13.5	52.3	29.1	526	0.46
Cronbach alpha[c]	0.71		Avg. Total Scale score (PCE):[d]		16.4	521	

[a] Of the 6,000 surveys distributed, 521 observations had responses to all items (individual statements in the table).

[b] Items correlations are the partial correlation coefficients between the individual rows' (items') scored response to the sum of the remaining rows' scores. A correlation greater than 0.30 indicates that the respondents carefully filled in the survey as answers are consistent across items.

[c] Cronbach alpha was calculated by comparing the variance of total scale scores to the variance of individual item variances and adjusting for the number of items in the construct.

[d] This is the average of the sum of responses for each item for all respondents. The higher the score the more positive the respondents perception about affecting the environment. Each respondent could score from a low of 4 to a high of 20.

Using a similar method as that used for *PCE*, the subjective knowledge construct measured the respondents' beliefs about climate change and what affects it. The shaded rows in Table 4.5 were scored using a scale of 1 = Strongly Disagree to 5 = Strongly Agree whereas the non shaded rows were reversed scored (1 = Strongly Agree and 5 = Strongly Disagree). The average total scale score is 12.0 which indicates that the respondents overall agreed or disagreed to the statements. Again, item total correlations

and Cronbach alpha demonstrated that respondents took the time to consistently answer this set of survey questions.

Table 4.5 Summary of survey responses to Subjective Knowledge questions (SUB), Arkansas, 2010.

	Percent of Responses						
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Number of Responses[a]	Item Total Correlations[b]
SUB 1	I do not believe in climate change.						
	43.8	32.0	14.0	6.8	3.4	528	0.63
SUB 2	Climate change is accelerated by human influence.						
	3.1	6.6	17.4	40.2	32.6	512	0.60
SUB 3	Climate change is not affected by changes in green house gas levels in the atmosphere.						
	33.8	40.3	21.2	3.2	1.5	529	0.66
Cronbach alpha[c]	0.79	Avg. Total Scale score (SUB):[d]				12.0	509

Notes:

[a] Of the 6,000 surveys distributed, 509 observations had responses to all items (individual statements in the table).

[b] Items correlations are the partial correlation coefficients between the individual rows' (items') scored response to the sum of the remaining rows' scores. A correlation greater than 0.30 indicates that the respondents carefully filled in the survey as answers are consistent across items.

[c] Cronbach alpha was calculated by comparing the variance of total scale scores to the variance of individual item variances and adjusting for the number of items in the construct.

[d] This is the average of the sum of responses for each item for all respondents. The higher the score the more positive the respondents beliefs and awareness of impact factors for climate change. Each respondent could score from a low of 3 to a high of 15.

The objective knowledge construct measured respondent knowledge regarding greenhouse gas and CF issues using four questions as outlined in chapter 3. 534 respondents answered the objective knowledge construct questions. The results are summarized in Table 4.6 and show that respondents, when choosing to respond, tended to answer the question correctly. Of the 127 respondents that got three correct answers only 14 attempted to answer the fourth question. Of the 139 respondents that got two correct answers only 17 attempted the other two questions. 92% of respondents answered at

least one question. Overall respondents achieved an average of 2.18 correct responses out of four questions asked. These results suggest a need for more GHG education.

Table 4.6 Summary of survey responses of Objective Knowledge (CORRECT), Arkansas, 2010.

# of obs.	# of correct answers	# of Questions Left Unanswered				
		0	1	2	3	4
59	0	6	0	4	11	38
111	1	1	3	9	98	n/a
139	2	5	12	122	n/a	n/a
127	3	14	113	n/a	n/a	n/a
98	4	98	n/a	n/a	n/a	n/a
534		124	128	135	109	38

These three constructs, *PCE*, *SUB* and *CORRECT*, were also compared across respondent characteristics. Table 4.7 suggests that *PCE* scores were statistically significantly higher for organic vs. conventional milk consumers and lower for males and the younger demographic. Subjective beliefs about climate change and how climate change is affected showed gender, income and education differences that were statistically significant. Objective knowledge about climate change did not differ across any of the respondent groups in a statistically significant fashion, however.

4.4 Summary of Findings of Carbon Label Effects

4.4.1 Willingness to Pay for Carbon Label Information (WTI)

Of the 506 responses to the questions about whether someone would pay extra for GHG label information on a per gallon basis, Table 4.8 reveals that only slightly more than one quarter of the respondents would choose to pay nothing or less. The average

Table 4.7 Respondent Perceived Consumer Effectiveness in Modifying the Environment (*PCE*), Subjective (*SUB*) and Objective (*CORRECT*) Knowledge Scores as Differentiated by Milk Type, Shopping Mode, Gender, Age, Income and Education.

	PCE			*SUB*			*CORRECT*		
	Avg.	(Std. Dev.)	n	Avg.	(Std. Dev.)	n	Avg.	(Std. Dev.)	n
Conventional	16.25***	(2.40)	*415*	11.98	(2.53)	*409*	2.18	(1.24)	*425*
vs. Organic[a]	17.38	(2.48)	*66*	12.41	(2.35)	*64*	2.28	(1.33)	*67*
Shopper vs.	16.40	(2.34)	*449*	12.07	(2.50)	*441*	2.21	(1.26)	*460*
Non-shopper	16.34	(2.45)	*59*	11.54	(2.65)	*57*	2.02	(1.27)	*60*
Male vs.	15.99***	(2.64)	*215*	11.58***	(2.75)	*212*	2.29	(1.32)	*218*
Female	16.73	(2.26)	*293*	12.35	(2.27)	*280*	2.16	(1.17)	*293*
Student	16.02***	(2.53)	*202*	11.75	(2.26)	*197*	2.21	(1.22)	*202*
Age	16.66	(2.39)	*262*	12.22	(2.60)	*257*	2.27	(1.23)	*267*
Empty Nest	16.93	(2.22)	*45*	12.21	(3.05)	*43*	1.96	(1.32)	*49*
Low	16.32	(2.49)	*208*	12.09***	(2.28)	*202*	2.30	(1.22)	*210*
Income	16.62	(2.25)	*204*	12.26	(2.52)	*201*	2.25	(1.23)	*211*
High	16.01	(2.74)	*84*	11.12	(2.99)	*81*	2.00	(1.32)	*84*
Low	16.18	(2.19)	*123*	11.49***	(2.23)	*118*	2.09	(1.23)	*128*
Education	16.33	(2.43)	*195*	11.89	(2.56)	*191*	2.19	(1.25)	*196*
High	16.69	(2.61)	*191*	12.51	(2.57)	*188*	2.32	(1.24)	*194*
Overall	16.41	(2.43)	*521*	12.03	(2.51)	*509*	2.18	(1.26)	*534*

Notes:

[a] Numbers are averages, standard deviation in parentheses and number of observations in italics, respectively. Differences in means were compared using the Satterthwaite Welch t-tests or Welch F-tests as appropriate.

* p-value ≤ 0.1; ** p-value ≤ 0.05; *** p-value ≤ 0.01

amount of $0.30 per gallon suggests that this respondent group wanted additional information.

Table 4.8 Descriptive Statistics of Willingness to Pay for Carbon Label Information in $/gal, University of Arkansas, 2010.

	# of Respondents	Min	Max	Mean
Pay More for the Label	372 (73.5%)	$0.01	$3.00	$0.41
Pay Nothing for the Label	130 (25.7%)	$0.00	$0.00	$0.00
Pay Less for the Label	4 (0.8%)	-$0.50	-$0.10	-$0.40
All Respondents	506	-$0.50	$3.00	$0.30

TOBIT model results, shown in Table 4.9, provide coefficient estimates when regressing willingness to pay for carbon label information against respondent

Table 4.9 Summary of statistical results regarding willingness to pay for carbon label information as explained by consumption, milk attribute, consumer opinion & knowledge, demographics and milk expenditure, University of Arkansas, 2010.

Dependent Variable: *PLABEL (left censored at zero)*			
Number of observations			440
Log likelihood function			-314.480
Mc Fadden's Pseudo R^2			0.192
Chi-square			149.31
p-value			<0.001
	Coefficient	Std. Error	p-value
C	-0.532	0.205	0.010
Respondent Characteristics			
TQ[a]	-0.149	0.060	0.013
Milk Attributes			
DPRICE	-0.005	0.055	0.929
Respondent Opinion and Knowledge			
PCE	0.032	0.012	0.008
SUB	0.018	0.012	0.150
CORRECT	-0.006	0.021	0.770
Demographics			
DSTUDENT	0.201	0.065	0.002
DEMPTYN	-0.102	0.098	0.297
GENDER	-0.014	0.050	0.787
DHIEDU	-0.060	0.062	0.336
DLOWEDU	0.029	0.064	0.649
DLOWINC	0.010	0.080	0.902
DHIGHINC	-0.026	0.124	0.832
Milk Expenditure			
MSHARE	1.723	0.866	0.047
DLSHARE	-1.540	0.823	0.061
DHSHARE	2.515	3.389	0.458

[a] *TQ* is the weekly quantity of milk purchased in gallons, *DPRICE* = 1 if respondent ranked the price of milk in the top three compared to fat content, brand, organic, container size, freshness or other attributes, *PCE* is the respondents perceived consumer effectiveness to improve the environment, *SUB* is a subjective knowledge score toward climate change and greenhouse gasses, *CORRECT* is an objective knowledge score about greenhouse gas impacts on climate change, *DSTUDENT* and *DEMPTYN* are 1, respectively if the respondent was either younger or older than the middle age demographic of 25 – 55 years of age, *GENDER* = 1 for male respondents, *DHIEDU* and *DLOWEDU* are 1, respectively, if the respondents level of education was higher or lower than the middle educational level of having a bachelor's degree, *DHIGHINC* and *DLOWINC* are 1, respectively, if the respondent's household income was higher or less than the base level income of $25,000 to $74,999, *MSHARE* is the fraction of weekly milk expenditure relative to household income in thousands of dollars. *DLSHARE* is the interaction of *DLOWINC* with *MSHARE* whereas *DHSHARE* is the interaction of *DHIGHINC* with *MSHARE*.

characteristics, milk attributes, respondent opinion & knowledge, demographic variables and milk expenditure relative to income. A total of 440 responses contained information for all the necessary variables. The model's goodness of fit measured by McFadden's Pseudo R^2 and Chi-square suggest that some variation in the dependent variable is explained by the model.

Since there were 112 of the 440 observations with zero willingness to pay, coefficient estimates are not interpreted in the same fashion as linear OLS estimates. Only marginal effects, as computed in LIMDEP v 9.0, associated with variables exhibiting statistically significance at the $p < .1$ level are summarized in Table 4.10. The marginal effects table for all variables can be found in Appendix C.

Table 4.10 Summary of marginal effects on willingness to pay (PLABEL) for statistically significant explanatory variables.

				Variable	
Variable	Coefficient	S.E.	p-value	Mean	Std. Dev.
PCE	0.022	0.008	0.008	16.35	2.50
DSTUDENT	0.135	0.044	0.002	0.42	0.49
TQ	-0.100	0.040	0.013	0.85	0.75
MSHARE	1.159	0.583	0.047	0.17	0.26
DLSHARE	-1.036	0.554	0.061	0.14	0.27

As seen above, *PCE*, *DSTUDENT* and *MSHARE* all impact *PLABEL* positively. A one unit change in *PCE*, for example increases *PLABEL* by 2.2 ¢ per gallon and a one standard deviation change in *PCE* changes *PLABEL* by 5.5 ¢ per gallon. Hence offering labels to populations with higher *PCE* scores would allow greater potential to recover added cost of adding this information. Also targeting consumers in the *DSTUDENT* category (< 25 years of age), relative to the *FAMILY* age category (25 to 55 years of age), leads to the potential to raise milk price by 13.5 ¢ per gallon when labels are attached.

Increasing the importance of weekly milk expenditure as a fraction of income (in thousands of dollars) raises the willingness to pay for carbon label information in the middle income category. A one standard deviation change in *MSHARE*, raising the fraction of weekly milk expenditure compared to annual income expressed in thousands of dollars by .26, would lead to a 30.1 ¢ (0.26 × 1.159) change in willingness to pay for carbon label information. This milk expenditure effect is, however, significantly lessened for those respondents in the lower income category. A similar one standard deviation change in *DLSHARE* (0.27) would lead to only a 3.3 ¢ (0.27 × (1.159 – 1.036)) change in willingness to pay for carbon label information. Finally increasing level of weekly consumption by one standard deviation (0.75 gal per week) decreases willingness to pay by 7.5 ¢ per gallon. The ability to raise milk prices by attaching carbon labels is thus strongly linked to consumption, milk expenditure and age effects and to a lesser extent related to the environmental attitude of the respondent. Surprisingly, the knowledge coefficients on *SUB* and *CORRECT* had no statistically significant impact on willingness to pay for carbon label information.

4.4.2 Willingness to Change Consumption due to Carbon Label Information (WTC)

There were 524 responses to the question asking whether the respondent would either increase, curtail or leave the milk consumption the same if offered a similar milk product at the same price but with a lower CF. 361 or 68.9% of the respondents choose to "drink the same amount" whereas 154 or 29.4% would drink more with 9 or 1.7% of respondents drinking less. These responses were measured across three different levels of CF reduction (10, 20 and 40% compared to a base level of 2 lb of C per gallon).

Table 4.11 shows the results of three PROBIT models for each of the carbon label deviation levels where consumer choice regarding milk consumption due to labeled reductions in CF could either stay the same or increase. The models explained 9.6%, 12.4% and 16.2% of the variance in the dependent variable as measured by McFadden Pseudo R-square.

The overall model performance in terms of percent of correct prediction of total predictions was 75, 68 and 78% for the 40, 20 and 10% label reduction scenarios, respectively. The predictive success for picking increases in consumption was 24, 41 and 26%, respectively. Predictive success for picking no change in consumption was 95, 83 and 94%.

To interpret the coefficient estimates, marginal effects are presented in Table 4.12 for those explanatory variables highlighted in bold in Table 4.11 that exhibited statistical significance at $p < .1$. A complete listing of all marginal effects is again available in Appendix D. Marginal effects represent the increase in likelihood that a respondent would choose to consume more milk due to a one unit change in the explanatory variable as opposed to not changing their consumption behavior when milk of comparable attributes including price is available with a lower CF label.

From a milk quantity consumption perspective, the results in Table 4.12 suggest that an increase in subjective knowledge (*SUB*) would raise milk consumption with 10% lower CF. Milk producers educating the public about CF information may thus see an

Table 4.11 Maximum Likelihood Estimates of Factors Impacting Consumer Willingness to Consume More Milk as a Result of 10, 20 or 40% Reductions in Carbon Label.

	Carbon Label Reduction from Base level of 2 lbs of C per Gallon								
	40%			**20%**			**10%**		
Total # of obs.	144			128			169		
% no change	71.5			64.1			75.1		
McFadden R^2	0.096			0.124			0.162		
Chi-square	16.48			20.76			30.75		
p-value	0.49			0.14			0.02		
Variable[a]	Coef-ficient	Std. Error	p-value	Coef-ficient	Std. Error	p-value	Coef-ficient	Std. Error	p-value
C	-1.456	1.182	0.218	**-3.171**	1.248	0.011	-1.236	1.129	0.274
Respondent Characteristics									
TQ	0.276	0.315	0.380	-0.082	0.357	0.818	**-0.432**	0.257	0.092
DSHOP	-0.214	0.372	0.566	N/A[b]	N/A	N/A	-0.634	0.418	0.130
Milk Attributes									
DFRESH	N/A	N/A	N/A	**-0.613**	0.341	0.072	N/A	N/A	N/A
DFAT	0.494	0.312	0.113	N/A	N/A	N/A	-0.275	0.285	0.336
DPRICE	0.081	0.279	0.771	0.419	0.275	0.128	-0.008	0.275	0.976
DSIZE	0.155	0.247	0.532	N/A	N/A	N/A	N/A	N/A	N/A
DBRAND	N/A	N/A	N/A	N/A	N/A	N/A	-0.343	0.305	0.262
DORGANIC	N/A	N/A	N/A	-0.509	0.354	0.151	N/A	N/A	N/A
DOTHER	0.420	0.487	0.389	N/A	N/A	N/A	N/A	N/A	N/A
Respondent Opinion & Knowledge									
PCE	0.009	0.053	0.863	0.103	0.065	0.110	-0.010	0.066	0.882
SUB	0.034	0.061	0.576	0.053	0.062	0.390	**0.125**	0.064	0.052
Demographics									
DSTUDENT	**0.892**	0.381	0.019	**0.554**	0.318	0.081	-0.323	0.342	0.344
DEMPTYN	N/A	N/A	N/A	N/A	N/A	N/A	0.399	0.355	0.261
GENDER	0.009	0.244	0.972	-0.043	0.261	0.868	-0.402	0.271	0.139
DHIEDU	-0.131	0.374	0.726	0.381	0.345	0.269	0.162	0.289	0.575
DLOWEDU	-0.403	0.311	0.195	0.108	0.317	0.732	0.457	0.356	0.199
DLOWINC	-0.450	0.477	0.346	0.432	0.451	0.338	0.429	0.387	0.268
DHIGHINC	-0.456	0.750	0.544	0.227	0.809	0.779	**-1.071**	0.629	0.089
Milk Expenditure									
MSHARE	-6.032	5.842	0.302	4.770	6.267	0.447	**5.745**	3.334	0.085
DLSHARE	5.137	5.632	0.362	-4.463	6.025	0.459	-5.021	3.170	0.113
DHSHARE	-6.763	25.564	0.791	-11.501	25.730	0.655	22.591	14.225	0.112

[a] *TQ* is the weekly quantity of milk purchased in gallons, *DFRESH..DOTHER* = 1 if respondent ranked a particular milk attribute in the top three compared to freshness (*DFRESH*),fat content (*DFAT*), price (*DPRICE*), size (*DSIZE*), brand (*DBRAND*), organic (*DORGANIC*) and other (*DOTHER*), *PCE* is the respondents perceived consumer effectiveness to improve the environment, *SUB* is a subjective knowledge score toward climate change and greenhouse gasses, *CORRECT* is an objective knowledge score about greenhouse gas impacts on climate change, *DSTUDENT* and *DEMPTYN* are 1, respectively if the respondent was either younger or older than the middle age demographic of 25 – 55 years of age, *GENDER* = 1 for male respondents, *DHIEDU* and *DLOWEDU* are 1, respectively, if the respondents level of education was higher or lower than the middle educational level of having a bachelor's degree, *DHIGHINC* and *DLOWINC* are 1, respectively, if the respondent's household income was higher or less than the base level income of $25,000 to $74,999, *MSHARE* is the fraction of weekly milk expenditure relative to household income in thousands of dollars. *DLSHARE* is the interaction of *DLOWINC* with *MSHARE* whereas *DHSHARE* is the interaction of *DHIGHINC* with *MSHARE*.

[b] N/A denotes no coefficient estimate as it was dropped from the model on the basis of $|z - \text{stat}| < 1$.

Table 4.12 Summary of marginal effects on willingness to consume (QWLOWER) for statistically significant explanatory variables.

Variable	Carbon Label Reduction	Coefficient	S.E.	p-value	Variable Mean	Variable Std. Dev.	Likely Impact[a]
TQ	10	-0.122	0.072	0.090	0.97	0.89	-0.109
SUB		0.035	0.018	0.048	11.94	2.75	0.096
DHIGHINC		-0.229	0.093	0.015	0.22	0.42	-0.229
MSHARE		1.619	0.938	0.084	0.17	0.29	0.470
DFRESH	20	-0.235	0.133	0.077	0.84	0.36	-0.235
DSTUDENT		0.198	0.110	0.072	0.53	0.50	0.198
DSTUDENT	40	0.282	0.113	0.013	0.53	0.50	0.282

[a] To demonstrate the likely difference in impact across the different variables, the coefficient estimate was multiplied by the variable's std. dev. if the variable was not a dummy variable. For dummy variables the impact is the same as the coefficient estimate. Please see footnote a of Table 4.11 for variable name descriptions.

increase in milk consumption if they label their product with carbon information. Targeting markets with consumer demographics that have a large percent of younger respondents (e.g. schools) leads to increased consumption and in the case of the age dummy variable, this effect is larger, the greater the CF reduction. If milk expenditure were to take on greater importance relative to household income, milk consumption would increase with milk that showed a 10% lower CF level. This effect is large in likely impact but is confounded by findings associated with the *TQ* variable. If respondent consumption behavior were higher (which would also raise *MSHARE*), the likelihood that labeled CF reductions further increases milk consumption is negative. Higher income level (which would lower *MSHARE*) also lowers the likelihood that milk with a lower CF label would be consumed in larger quantities. Finally, the more respondents valued milk freshness, the less likely they were to increase milk consumption due to a label indicating a lower CF.

While these findings are interesting, the importance of these findings is undermined by the fact that specific information about the actual amount of change in quantity was not collected. Hence, the information, while valuable, will be difficult to use for determining consumer behavior change in terms of specific consumption level changes due to carbon label effects. Nonetheless, consumer education about greenhouse gas changes especially if targeted at younger demographics may lead to increased milk consumption if milk is labeled.

4.4.3 Willingness to Pay for Lower Carbon Footprint Milk (WTP)

Respondents could choose to pay less, the same, up to 5%, or a more than 5% higher price when presented with 10, 20 or 40% reductions in CF for the milk they typically purchase. Across all levels of CF label reductions 42 (8.3%) respondents chose to pay less, 204 (40.2%) chose to pay the same, 161 (31.8%) chose to pay up to 5% more and 100 (19.7%) would pay more than an additional 5%. On average, this sample of respondents would therefore pay for lower CF milk. This is encouraging for milk producers as it means that they could pass potential added cost of production on to consumers.

Table 4.13 summarizes the ORDERED PROBIT models used to determine effects of variables for each of the three carbon label reduction levels. The models explained 12.4%, 12.5% and 12.6% of the variance in the dependent variable according to McFadden Pseudo R-squared measure. The predictive successes of the models overall were 52, 44 and 46% for the 40, 20 and 10% carbon label reduction scenarios, respectively. Further detail is available in Table 4.14.

Table 4.13 Summary of statistical results regarding willingness to pay (WTP) as explained by the independent variables at each deviation.

	Carbon Label Reduction from Base level of 2 lbs of C per Gallon								
	40%			**20%**			**10%**		
# of obs.	147			127			169		
McFadden R^2	0.124			0.125			0.126		
Chi-square	45.69			40.79			30.75		
p-value	0.0005			0.0059			0.0001		
Variable[a]	Coef-ficient	Std. Error	p-value	Coef-ficient	Std. Error	p-value	Coef-ficient	Std. Error	p-value
C	0.034	0.876	0.969	-0.180	1.001	0.857	-1.187	0.852	0.163
Respondent Characteristics									
TQ	0.168	0.240	0.486	0.158	0.311	0.612	**-0.346**	0.206	0.093
DSHOP	0.293	0.292	0.315	**1.103**	0.334	0.001	N/A[b]	N/A	N/A
DPLASTIC	N/A	N/A	N/A	0.368	0.334	0.270	**-1.008**	0.353	0.004
Milk Attributes									
DFRESH	**-0.457**	0.268	0.088	**-0.878**	0.294	0.003	**0.586**	0.292	0.044
DFAT	N/A	N/A	N/A	-0.321	0.241	0.183	**0.753**	0.220	0.001
DPRICE	**0.425**	0.230	0.065	0.333	0.232	0.150	0.122	0.217	0.574
DSIZE	**0.331**	0.200	0.098	N/A	N/A	N/A	N/A	N/A	N/A
DBRAND	0.247	0.213	0.247	-0.317	0.241	0.189	N/A	N/A	N/A
DORGANIC	**1.035**	0.282	0.000	**-0.530**	0.317	0.094	**1.015**	0.361	0.005
DOTHER	N/A	N/A	N/A	-0.625	0.415	0.132	**0.832**	0.433	0.055
Respondent Opinion & Knowledge									
PCE	0.061	0.039	0.117	0.073	0.052	0.160	0.015	0.467	0.744
SUB	N/A	N/A	N/A	0.077	0.048	0.109	0.068	0.044	0.121
CORRECT	0.109	0.079	0.166	N/A	N/A	N/A	0.111	0.075	0.141
Demographics									
DSTUDENT	0.227	0.297	0.445	0.063	0.263	0.812	**0.694**	0.272	0.011
DEMPTYN	-0.561	0.512	0.274	-0.302	0.514	0.557	**0.471**	0.284	0.097
GENDER	-0.118	0.194	0.544	-0.167	0.217	0.442	-0.100	0.202	0.619
DHIEDU	-0.085	0.292	0.770	-0.211	0.282	0.453	0.105	0.206	0.610
DLOWEDU	-0.371	0.242	0.125	0.258	0.264	0.327	-0.180	0.270	0.506
DLOWINC	0.024	0.355	0.945	**-0.842**	0.390	0.031	**0.891**	0.316	0.005
DHIGHINC	0.866	0.581	0.136	-0.424	0.612	0.489	-0.200	0.379	0.598
Milk Expenditure									
MSHARE	-1.618	3.880	0.677	-4.860	5.422	0.370	**7.988**	3.233	0.014
DLSHARE	0.852	3.724	0.819	4.364	5.168	0.398	**-8.222**	3.098	0.008
DHSHARE	**-37.635**	19.586	0.055	-10.629	16.715	0.525	**16.106**	9.783	0.100

[a] *TQ* is the weekly quantity of milk purchased in gallons, *DFRESH..DOTHER* = 1 if respondent ranked a particular milk attribute in the top three compared to freshness (*DFRESH*),fat content (*DFAT*), price (*DPRICE*), size (*DSIZE*), brand (*DBRAND*), organic (*DORGANIC*) and other (*DOTHER*), *PCE* is the respondents perceived consumer effectiveness to improve the environment, *SUB* is a subjective knowledge score toward climate change and greenhouse gasses, *CORRECT* is an objective knowledge score about greenhouse gas impacts on climate change, *DSTUDENT* and *DEMPTYN* are 1, respectively if the respondent was either younger or older than the middle age demographic of 25 – 55 years of age, *GENDER* = 1 for male respondents, *DHIEDU* and *DLOWEDU* are 1, respectively, if the respondents level of education was higher or lower than the middle educational level of having a bachelor's degree, *DHIGHINC* and *DLOWINC* are 1, respectively, if the respondent's household income was higher or less than the base level income of $25,000 to $74,999, *MSHARE* is the fraction of weekly milk expenditure relative to household income in thousands of dollars. *DLSHARE* is the interaction of *DLOWINC* with *MSHARE* whereas *DHSHARE* is the interaction of *DHIGHINC* with *MSHARE.*

[b] N/A denotes no coefficient estimate as it was dropped from the model on the basis of |z –stat| < 1.

Table 4.14 Frequencies of actual and predicted outcomes for *WTP* categories for each of the three carbon footprint label reduction scenarios. Except for totals, rows and columns represent actual and predicted values, respectively.

40% Carbon Footprint Reduction Label					
Response Category	Pay Less	Pay the same	Pay up to 5% more	Pay more than 5% extra	Total Actual
Pay Less	**0**	9	1	0	10
Pay the same	0	**43**	10	3	56
Pay up to 5% more more	0	23	**20**	6	49
Pay more than 5% extra	0	9	10	**13**	32
Total Predicted	0	84	41	22	147
20% Carbon Footprint Reduction Label					
Response Category	Pay Less	Pay the same	Pay up to 5% more	Pay more than 5% extra	Total Actual
Pay Less	**2**	15	0	0	17
Pay the same	2	**37**	13	1	53
Pay up to 5% more	2	21	**11**	2	36
Pay more than 5% extra	0	7	8	**6**	21
Total Predicted	6	80	32	9	127
10% Carbon Footprint Reduction Label					
Response Category	Pay Less	Pay the same	Pay up to 5% more	Pay more than 5% extra	Total Actual
Pay Less	**0**	9	1	0	10
Pay the same	0	**50**	21	0	71
Pay up to 5% more	0	34	**12**	8	54
Pay more than 5% extra	0	6	12	**16**	34
Total Predicted	0	99	46	24	169

There were twenty one statistically significant variables affecting *WTP* at $p < .10$. The impact of these explanatory variables is shown in the marginal effects table 4.15 and discussed below. Complete marginal effects tables are found in Appendix E. Note that the table reports the percent likelihood for a respondent to switch between *WTP* categories due to a one unit change in the explanatory variable evaluated at the sample mean of that variable. As such, percentages across *WTP* for a particular variable sum to

Table 4.15 Summary of marginal effects in percent likelihood to switch willingness to pay categories due to carbon label information for statistically significant explanatory variables, University of Arkansas, 2010.

		Respondent Group				
Variable[a]	Carbon Label Reduction	Pay Less	Pay the same	Pay up to 5% more	Pay more than 5% extra	Variable Std. Dev.[b]
TQ	10	2.57	11.15	-5.35	-8.37	0.89
DPLASTIC		13.89	23.63	-20.66	-16.86	
DFRESH		-6.52	-16.38	11.69	11.20	
DFAT		-7.92	-21.35	14.07	15.20	
DORGANIC		-4.43	-31.12	3.75	31.79	
DOTHER		-3.28	-25.84	2.41	26.70	
DSTUDENT		-3.82	-22.29	6.32	19.78	
DEMPTYN		-2.56	-15.36	4.57	13.35	
DLOWINC		-5.34	-28.00	8.57	24.78	
MSHARE		-59.39	-257.74	123.58	193.56	0.30
DLSHARE		61.14	265.30	-127.20	-199.24	0.31
DHSHARE		-119.76	-519.70	249.18	390.28	0.02
DSHOP	20	-28.03	-8.20	22.71	13.52	
DFRESH		9.51	24.12	-9.94	-23.68	
DORGANIC		10.52	9.34	-11.14	-8.73	
DLOWINC		14.66	17.33	-15.81	-16.19	
DFRESH	40	2.95	14.21	-3.77	-13.39	
DPRICE		-4.22	-12.56	6.76	10.02	
DSIZE		-2.76	-10.18	4.35	8.59	
DORGANIC		-5.12	-29.86	1.28	33.70	
DHSHARE		313.42	1164.99	-506.42	-971.98	0.01

[a] See variable name descriptions in Table 4.13.

[b] Standard deviation statistics for variables are provided to put marginal effects into perspective for continuous variables. For dummy variables, a one unit change moves the respondent from one category to the other and standard deviation information is not appropriate. Particularly for *MSHARE* and *MSHARE* interactions it would be reasonable to multiply marginal effects by the standard deviation of the variable when making comparisons across marginal effects of different variables.

zero but the model does not predict how a reduction in one *WTP* category affects the other categories (e.g. for a 2.57% increase in 'pay less' category for a one unit increase in *TQ*, the model does not tell you whether those respondents came from the 'pay the same', 'pay up to 5% more' or 'pay more than 5% extra' categories).

Further, to make comparisons of relative impacts across the variables, it is important to recall that while dummy variables move from 0 to 1 and a one unit change

for marginal effects calculations is reasonable, the same is not true for variables like *TQ*, *MSHARE* and *MSHARE* interactions with the income dummy variables. For this reason, standard deviations are provided in the last column of the table to highlight a more typical move than a one unit change in those variables.

From a marketing perspective, variable effects could be divided into two categories. Those variables that move respondents into the "pay less" or "pay the same" categories, termed "negative" from here on, and those variables that move respondents into the "pay up to 5% more" and "pay more than 5% or extra" categories, termed "positive" from here on.

Overall, the results reveal different reactions to changes in the amount of carbon reduction labeled (10 vs. 20 vs. 40% reductions). Milk expenditure relative to income, *MSHARE*, for example, shows positive ramifications with 10% carbon reduction labels for mid- and high income consumers, no effect with 20% carbon reduction labels and a negative effect for high income consumers at the 40% carbon reduction level.

DORGANIC, the importance of milk production method to be organic, is one of the few variables that has a statistically significant impact across all carbon change levels. For both small and high changes the effect is positive whereas at the 20% deviation level it is negative. Ranking milk freshness as important (*DFRESH*) and *DLOWINC* effects also change direction across deviation levels.

There were no statistically significant gender, education and respondent opinion and knowledge effects. Providing more education about greenhouse gas effects thus

would lead to no impact as modeled here. Target marketing to younger and older consumers had positive effects but only for the 10% deviation scenario.

Buying more milk per week (*TQ*) had a negative effect that would be confounded with *MSHARE* effects. *DPLASTIC* (buying milk in carton or glass containers as opposed to plastic) also had negative effects. *DPLASTIC*, correlated highly with respondents drinking organic milk (Pearson correlation of 0.77) and ranking organic milk as an important milk attribute (Pearson correlation of 0.55), thus dampens the positive effect of *DORGANIC*.

While, on average the carbon label effect was positive in the sense that some respondents were willing to pay extra, the above discussion of marginal effects suggests that few marketing recommendations can be provided given unknown levels of likely carbon reduction possibilities in the milk sector.

4.4.4 Willingness to Switch from Organic to Conventional Milk for Lower Carbon Footprint Milk (WTS)

Of the organic milk purchasing respondents, 67 in total, 56 responses were used to determine at what carbon reduction level, respondents would switch from organic to conventional milk. Unique to this equation compared to the models above, was also the provision of an additional statement that informed respondents of a likely increase in CF for organic milk vs. conventional milk. Note that only 15 or 22.4% of the organic consumers believed in the production statement that organic milk production produces a larger CF than conventional milk production.

The question about switching from organic to conventional milk because of CF changes was posed in such a fashion that a respondent could choose 'not to switch', 'switch with a reduction of 21% or more' all the way to 'switch with as little as a 5% reduction', in all, five response categories.

Table 4.16 suggests that some variation in the model was explained according to the Pseudo R^2 and the Chi-square statistic. Four variables had statistically significant impact at $p < .10$ and the predictive success of the model was 61% overall with greater predictive success at extreme ends of the *WTS* choice spectrum (Table 4.17 – numbers in bold represent correct predictions). Marginal effects, as calculated in LIMDEP v 9.0, of changes in explanatory variables with statistically significant impact are provided in Table 4.18. Again, the complete listing of marginal effects for all explanatory variables can be found in Appendix F.

Marginal effects again show redistribution of respondent categories with a one unit change in explanatory variables. Row percentages add to zero as switching across categories is a zero sum game. For all variables the sign of category changes switch between will not switch and will switch if carbon reductions are greater than 20%, except for *DORGANIC* (ranking organic production as important among several milk attributes). From an organic milk producers perspective, interested in maintaining milk sales under the assumption that CF for organic milk is indeed higher than for conventional milk, a negative number in the "Will not switch" column would be considered negative, whereas a positive number in that column would imply that respondents would choose to remain with organic milk.

Table 4.16 Summary of statistical results regarding willingness to switch (WTS) as explained by the independent variables, University of Arkansas, 2010.

Total # of obs.		56	
McFadden R^2		0.182	
Chi-square		25.28	
p-value		0.089	
Variable[a]	Coef-ficient	Std. Error	p-value
C	-1.573	1.847	0.394
Respondent Characteristics			
TQ	-0.435	0.660	0.510
DPLASTIC	1.063	0.782	0.174
Milk Attributes			
DPRICE	-0.385	0.388	0.321
DSIZE	-0.507	0.495	0.306
DBRAND	0.408	0.433	0.345
DORGANIC	**-1.438**	0.586	0.014
Respondent Opinion & Knowledge			
PCE	0.069	0.083	0.405
CORRECT	-0.134	0.160	0.403
DBELIEVE	-0.210	0.474	0.657
Demographics			
DSTUDENT	-0.117	0.609	0.847
GENDER	**0.963**	0.409	0.019
DHIEDU	0.197	0.533	0.711
DLOWEDU	-0.162	0.665	0.807
DLOWINC	0.773	0.682	0.257
DHIGHINC	-0.668	0.775	0.389
Milk Expenditure			
MSHARE	**15.485**	6.983	0.027
DLSHARE	**-14.876**	6.699	0.026

[a] *TQ* is the weekly quantity of milk purchased in gallons, *DPLASTIC* is 1 if preferred container type is carton or glass as opposed to plastic, *DPRICE..DORGANIC* are 1 if respondent ranked a particular milk attribute in the top three compared to freshness (*DFRESH*),fat content (*DFAT*), price (*DPRICE*), size (*DSIZE*), brand (*DBRAND*), organic (*DORGANIC*) and other (*DOTHER*), *PCE* is the respondents perceived consumer effectiveness to improve the environment, *CORRECT* is an objective knowledge score about greenhouse gas impacts on climate change, *DBELIEVE* is 1 if respondents believed that carbon footprint would be lower for conventional compared to organic milk, *DSTUDENT* is 1 if the respondent was younger than the middle age demographic of 25 – 55 years of age, *GENDER* is 1 for male respondents, *DHIEDU* and *DLOWEDU* are 1, respectively, if the respondents level of education was higher or lower than the middle educational level of having a bachelor's degree, *DHIGHINC* and *DLOWINC* are 1, respectively, if the respondent's household income was higher or less than the base level income of $25,000 to $74,999, *MSHARE* is the fraction of weekly milk expenditure relative to household income in thousands of dollars. *DLSHARE* is the interaction of *DLOWINC* with *MSHARE*.

[b] N/A denotes no coefficient estimate as it was dropped from the model on the basis of |z –stat| < 1.

Table 4.17 Frequencies of actual and predicted outcomes for willingness to switch (*WTS*) categories, University of Arkansas, 2010. Except for totals, rows and columns represent actual and predicted values, respectively.

	Will Switch with Carbon Reductions…					
Response Category	Will not switch	More than 20%	11 – 20%	5 – 10%	Less than 5%	Total Actual
Will not switch	**28**	0	0	3	0	31
> 20%	6	**0**	0	1	0	7
11 – 20%	3	0	**0**	2	0	5
5 – 10%	5	0	0	**5**	1	11
< 5%	0	0	0	1	**1**	2
Total Predicted	42	0	0	12	2	56

Table 4.18 Summary of marginal effects in percent likelihood to change willingness to switch categories due to carbon label information for statistically significant explanatory variables, University of Arkansas, 2010.

	Respondent Group					
	Will Switch with Carbon Reductions…					
Variable[a]	Will not switch	More than 21%	11 – 20%	5 – 10%	Less than 5%	Variable Std. Dev.[b]
GENDER	-36.95	2.51	5.98	26.45	2.01	
DORGANIC	49.46	3.30	-3.29	-41.99	-7.47	
MSHARE	-613.32	81.19	122.61	391.52	18.00	0.22
DLSHARE	589.23	-78.00	-117.79	-376.14	-17.29	0.24

[a] See variable name descriptions in Table 4.16.

[b] Standard deviation statistics for variables are provided to put marginal effects into perspective for continuous variables. For dummy variables, a one unit change moves the respondent from one category to the other and standard deviation information is not appropriate. Particularly for *MSHARE* and *DLSHARE* interactions it would be reasonable to multiply marginal effects by the standard deviation of the variable when making comparisons across marginal effects of different variables.

Male respondents and those spending a more significant share of their income on milk are more likely to switch away from organic milk consumption with new information. Those that value organic milk production have a higher propensity to remain with organic milk despite negative CF implications. Individuals in the low

income category offset the negative effects (from an organic producer standpoint) of milk expenditure observed for the middle and high income category individuals.

Interestingly, respondent opinion and knowledge effects, respondent education level and age were not statistically significant variables. Also, somewhat surprising was a lack of significance in the *DPRICE* variable as lower CF conventional milk would also be significantly cheaper. The result may be a function of the significant difference in price conscientiousness between conventional and organic consumers noted already in Table 4.3.

4.5 Conclusions

Overall, the sample of respondents was less knowledgeable regarding climate change and greenhouse gas issues than expected (Table 4.6). Since the sample of respondents was relatively highly educated (Table 4.1), we hypothesized the respondents to be more knowledgeable regarding these issues. Nonetheless, the survey sample included respondents that believed their consumption/purchase decisions to affect the environment and felt empowered to make a positive impact with their purchasing decisions (Table 4.4). Testing of the *PCE* construct as well as the *SUB* construct showed that respondents provided internally valid and consistent responses. These constructs were subsequently used in models to determine willingness to pay for label information, willingness to modify consumption, willingness to pay for CF reductions as well as determining whether organic respondents would switch away from organic milk to conventional milk on the basis of carbon labels.

Overall, respondents showed a willingness to pay for carbon label information. The ability to raise milk price by providing label information was impacted by environmental attitude, milk expenditure share, consumption and age effects. Surprisingly, the knowledge coefficients on *SUB* and *CORRECT* had no statistically significant impact on willingness to pay for carbon label information.

The second set of models attempted to measure milk consumption behavior changes due to carbon labeling. Results showed that the level of carbon reduction mattered in terms of which variables were significant predictors for respondent either willing or not willing to increase milk consumption in light of a lower CF. Overall, consumer education about greenhouse gas changes especially if targeted at younger demographics was deemed to lead to increased milk consumption if milk is labeled. Nonetheless, quantification of this effect was not possible given the way the question was asked.

The third set of models predicted willingness to pay across different levels of CF reduction. Results showed conflicting responses across the different carbon reduction deviation levels analyzed. No concise recommendations for targeting certain respondents could be made from the results except that an overall tendency to pay for lower CF milk existed.

The final model predicted organic consumer response to carbon label information. Strong respondent convictions about organic milk prevailed to lessen the likelihood of switching away from organic milk to conventional milk on the basis of CF. Nonetheless

25 of 56 respondents did switch with a majority of those requiring only a 5% – 10 % reduction in CF.

Chapter Five: Conclusion

5.1 Introduction

This chapter concludes "Consumer Behavior for Carbon Labeled Milk; Conventional vs. Organic." In this chapter, a summary of limitations of the study is presented. Potential for further research is also discussed.

5.2 Limitations of Study

One limitation of this study was the sample analyzed. Due to time and financial restraints 3,000 students and 3,000 faculty/staff were emailed an invite to the online survey. These email addresses were randomly selected by the University of Arkansas IT department. Hence the sample was not representative of the general milk purchaser/consumer in the United States or in Arkansas.

Another limitation of the survey instrument may have been the question order of the survey and/or the wording of the questions. The questions were organized in a manner that progressed from fairly simple questions to more complex questions. The purpose was to gauge the respondents' knowledge and/or opinions to get their minds thinking on these topics before asking the behavioral questions. It was felt that the survey was ordered in the most effective manner; however it is possible that a better question order exists. It should be noted that survey was pretested with an undergraduate class of Dr. Popp's to help ensure the wording and order of the survey questions were understandable and effective.

Additionally, as is usual with many surveys, the questions could have been phrased better. In particular the willingness to consume more or less question could have

been asked in a fashion that would have provided specific quantity response categories. This would have helped allowed more rigorous quantitative analysis as were possible with willingness to pay.

5.3 Potential for Future Research

With the amount of data collected from the survey coupled with relatively little research on CF labeling, there is great potential for further research and analysis on this topic. Recommendations for expansion of research on this topic include i) broadening to a more representative sample, ii) increasing sample size of organic purchaser/consumer respondents and iii) conducting the study abroad for a comparative analysis between US and European respondents.

First, it is believed approaching and gathering data from actual shoppers in multiple grocery stores nationwide would provide the most representative sample of milk purchasers/consumers. It is proposed to either collect data in store from shoppers and/or provide them the outlet (i.e. link to an online survey, surveys that can be mailed in, etc…) to collect their responses. Ideally, this approach will be implemented in traditional grocery stores and organic stores nationwide to encompass a majority of the cultural diversity associated with different regions.

Secondly, it is obvious that a majority of food shoppers buy their groceries from traditional outlets of grocery stores in the United States. From the data collected, only 56 responses from the organic milk purchasers/consumers contained suitable information for all the necessary variables. This data sample was small and hence relatively few statistically significant results were obtained.

Lastly, it is suggested to broaden the research abroad for a comparative analysis between US and EU consumer attitudes. By doing this, an opportunity exists to compare American purchaser/consumer behavior with other purchaser/consumer behavior in other regions of the world. Thus, it could be determined if and where demand for carbon labeled milk products exists. Initially it was intended to conduct the survey in Berlin, Germany through the Humboldt Universitat ZU Berlin email data base. This was deemed infeasible at that time and it was decided to not pursue the comparative study aspect. However, the survey instrument was partially translated to German and is found in Appendix G. The suggestion remains for a future ATLANTIS student to expand this research though the consortium of EU Universities in the ATLANTIS program.

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APPENDIX

Appendix A

Invitational E-mail

Dear Respondent,

I'm working with my major professor to pursue a Master's degree in the Department of Agricultural Economics and Agribusiness. For my thesis I am conducting research on how milk consumption might be affected by environmental labels on milk. So, if you don't drink milk, we appreciate your time but you need not fill out the survey. If you do drink milk we would like you to complete this survey. Please be sure to answer as many questions as you can and then click the "Submit" button at the end of the survey. You may change your answers by using the "Back" button any time before you click the "Submit" button. If you push the "Reset" button the page you are on will be reset to blank entries. Please fill out the survey only once. If you enter your e-mail address at the end of the survey you will be eligible for a random drawing of three $50 Walmart gift cards. Be assured that your responses will be strictly confidential. The survey should take between 5 and 10 minutes.

Sincerely,

Mus Ozkan

IRB Protocol Number: #10-10-135

Professor Contact: Dr. Michael Popp 479-575-6838

Here's the link: http://uark.edu/ua/atlantis/milklabels10.htm

Reminder E-mail

Dear Respondent,

This e-mail is a follow up to last week's e-mail. Since we don't know if you've responded, if you already have…Thank you…

We'll be in touch with gift card winners in early December. Please do not fill it out again.

For those of you who have not responded, please take 5 minutes to answer. I realize that last time, apostrophes (') were replaced with '?'. I copied and pasted from a WORD document and this issue did not show up in the draft e-mail. I assure you that this is valid and not SPAM. If you have further questions or concerns, please call Dr. Michael Popp at 575-6838.

We've had a few responses and so the chance to win is better than a lottery. If possible, please respond now.

Once again, this research concerns how milk consumption might be affected by environmental labels on milk. So, if you don't drink milk, we appreciate your time but you need not fill out the survey. If you do drink milk we would like you to complete this survey. Please be sure to answer as many questions as you can and then click the "Submit" button at the end of the survey. You may change your answers by using the "Back" button any time before you click the "Submit" button. If you push the "Reset" button the page you are on will be reset to blank entries.

Many thanks, please respond, and Happy Thanksgiving

Mus Ozkan

Here's the link: http://uark.edu/ua/atlantis/milklabels10.htm

IRB Protocol Number: #10-10-135

Professor Contact: Dr. Michael Popp 479-575-6838

Appendix B

1. Do you buy 50% or more of the groceries for your household/yourself? (SHOP)

1 ☐Yes 0☐No

(If respondent answers no, the respondent gets questions 2, 3 as presented in italics below)

2. Please describe your typical milk purchase:

Characteristic	(In each row, please mark the item purchased the most)
Container Size **(SIZE)**	**1**☐ Gallon **0.5** ☐ ½ Gallon **0.25** ☐ Quart **0.125** ☐ Pint or smaller
Container Type **(PLASTIC, CARTON, GLASS)**	**1**☐ Plastic **1** ☐ Carton **1** ☐ Glass
Production Method **(ORGANIC)**	**1**☐ Organic **0** ☐ Conventional
Price of Last Purchase **(P)**	_____ to nearest $0.25 *(use recent market prices below for reference if needed)*

2. Please describe the typical milk product you drink:

Characteristic	*(In each row, please mark the item purchased the most)*
*Container Size **(SIZE)***	***1***☐ *Gallon* ***0.5*** ☐ *½ Gallon* ***0.25***☐ *Quart* ***0.125*** ☐ *Pint or smaller*
*Container Type **(PLASTIC, CARTON, GLASS)***	***1***☐ *Plastic* ***1*** ☐ *Carton* ***1*** ☐ *Glass*
*Production Method **(ORGANIC)***	***1***☐ *Organic* ***0*** ☐ *Conventional*
*Price of Last Purchase **(P)***	_____ *to nearest $0.25 (use recent market prices below for reference if needed)*

Recent Market Prices for Organic and Conventional Milk for different Packages Sizes. Ranges are across brands and packaging.

Package Size	1 Gallon (3.78 L)	½ Gallon (1.89 L)	Quart (0.95 L)	Pint (0.48 L)
Organic Milk	$6.89 to $7.69	$3.50 to $4.49	$2.19 to $2.49	$1.35 to $1.79
Conventional Milk	$2.66 to $3.48	$1.72 to $2.17	$1.14 to $1.44	$.79 to $1.32

3. How much milk do you typically buy per week? (Q)

_____ average gallons per week or please mark appropriate amount below…

0.25☐ Less than ½ gal. **1** ☐ 1 gal **1.5** ☐ 1 to 2 gal. **2.5** ☐ 2 gal. +

Including yourself, how many people that you buy milk for is/are consuming milk in your household? ___ person(s) *(Divide 3a by this answer to obtain quantity per person)* ***(Drinkers)***

2. ***How much milk do you typically drink per week? (Q)***

   _____ *average gallons per week or please mark appropriate amount below…*

   0.0625☐ *Less than one pint.* **0.1875** ☐ *1 pint to 1 quart* **0.625**☐ *1 quart to 1 gal* **1.25** ☐ *1 gal. +*

4. **Of the following milk attributes what are the five most important characteristics to you?**

Characteristic	**Rank** Please rank the top five of the seven characteristics using 1 = most important to 5 = least important)
Package Size **(RSIZE .. 1 to 6)**	☐
Brand **(RBRAND .. 1 to 6)**	☐
Price **(RPRICE .. 1 to 6)**	☐
Fat Content **(RFAT.. 1 to 6)**	☐
Organic **(RORGAINC.. 1 to 6)**	☐
Freshness/Expiration Date **(RFRESH.. 1 to 6)**	☐
Other (please specify **(ROTHER.. 1 to 6 ____)**	☐

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Now that you've told us about your milk consumption, we want to learn more about your attitude and knowledge towards the environment and climate change.

The following question is typically used in research questionnaires to determine your attitude towards the environment. There are no right or wrong answers.

5. Please indicate your level of agreement with the statements in the following table.

	Strongly Disagree	Dis-agree	Neutral	Agree	Strongly Agree
It is worthless for the individual consumer to do anything about pollution. **(PCE1)**	5☐	4☐	3☐	2☐	1☐
When I buy products, I try to consider how my use of them will affect the environment and other consumers. **(PCE2)**	1☐	2☐	3☐	4☐	5☐
Since one person cannot have any effect upon pollution and natural resource problems, it doesn't make any difference what I do. **(PCE3)**	5☐	4☐	3☐	2☐	1☐
Each consumer's behavior can have a positive effect on society by purchasing products sold by socially responsible companies. **(PCE4)**	1☐	2☐	3☐	4☐	5☐

The following question examines your attitude towards climate change and your level of awareness of greenhouse gases and about carbon footprints. Please answer to the best of your knowledge.

6. Please indicate your level of agreement with each of the following statements

Opinion Statements	Strongly Disagree	Dis-agree	Neu-tral	Agree	Strongly Agree
I do not believe in climate change. **(SUB1)**	5☐	4☐	3☐	2☐	1☐
Climate change is accelerated by human influence. **(SUB2)**	1☐	2☐	3☐	4☐	5☐
Climate change is not affected by changes in green house gas levels in the atmosphere. **(SUB3)**	5☐	4☐	3☐	2☐	1☐
Awareness Statements	True		Don't know		False
Carbon dioxide emissions are the *only* greenhouse gas emissions tracked for a product's carbon footprint. **(Correct; Abstain)**	0☐		1☐		1☐
The primary greenhouse gases are nitrous oxide, methane and carbon dioxide and are usually converted to a carbon equivalent for carbon footprint labeling. **(Correct; Abstain)**	1☐		1☐		0☐
The way we grow, process, package, transport and use food products contributes more than 10% of the earth's overall greenhouse gas levels in the atmosphere. **(Correct; Abstain)**	1☐		1☐		0☐
Every consumer has a carbon footprint. **(Correct; Abstain)**	1☐		1☐		0☐

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Since consumer awareness toward the environment has been increasing retailers are beginning to think about providing more information to their customers.

454 g of CO2 is the same as 1 lb of CO2 emissions

TESCO is a large food retailer in the United Kingdom and is currently carbon footprinting their products through the Carbon Trust who certifies the label. To the right is one example of such a label. The carbon footprint is from farm origin to store and captures greenhouse gas emissions in their carbon dioxide (CO_2) equivalent form.

Note that approximately 2 lbs of CO_2 emissions are generated when driving an average car for 3 miles.

The following questions are designed to capture your thoughts about how someone might react to this kind of carbon footprint labeling on milk.

Previously you indicated the following milk characteristics to apply to you:

Characteristic	**Your Answers**
Container Size	*Gallon*
Container Type	*Plastic*
Production Method	*Conventional*
Price	*$x.xx*

7. If a label similar to the TESCO label presented above were added to your typical milk, how much extra would someone pay for this label information? (Plabel)

They would pay no more than $_____per *Gallon* extra for this information.

Characteristic	**Your Answers**
Container Size	*Gallon*
Container Type	*Plastic*
Production Method	*Conventional*
Price	*$x.xx*

8. Assuming the same milk as described above has a carbon label of 2 lbs per gallon from farm to store and price does not change with a different carbon footprint label…

a. If the milk label indicated a *20% (10, 20 or 40)* **higher** 2.4 lb carbon footprint would that person drink or buy *(please circle answer)* ***(Qwhigher)***

-1☐ ***less*** **1**☐ ***more*** **0**☐ ***the same***

b. What if the label decreased by *20% (10, 20 or 40)* to a 1.6 lb carbon footprint *(please circle answer)* ***(Qwlower)8 b***

-1☐ ***less*** **1**☐ ***more*** **0**☐ ***the same***

Characteristic	Your Answers
Container Size	*Gallon*
Container Type	*Plastic*
Production Method	*Conventional*
Price	*$x.xx*

9. Again, assuming milk with the same attributes as described above has a carbon label of 2 lbs per gallon from farm to store…

c. To drink the same amount of similar milk but with a *20% (10, 20 or 40)* **higher** 2.4 lb carbon foot print, how much more or less would they pay? **(Pcarbonup)**

−10□ +10% **−5**□ +5% **0** □ the same **5** □ - 5% **10** □ - 10% □ Other __int____

d. To drink the same amount of similar milk but with a *20% (10, 20 or 40)* **lower** 1.6 lb carbon foot print, how much more or less would they pay? **(Pcarbondown)**

4□ +10% **3**□ +5% **2** □ the same **1** □ - 5% **1** □ - 10% □ Other __int____

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Organic milk production typically involves using more fuel, feed and labor to produce the same amount of milk compared to producing milk with chemicals to improve efficiency. A gallon of organic milk therefore leads to more greenhouse gas emissions from use of inputs than a gallon of conventional milk. *(By comparison, think of manually pulling weeds on your driveway vs. using chemical weedkiller)*.

10. Please indicate your level of belief in the above statement about the dairy sector. (Believe)

0□ Strongly Disbelieve **0** □ Disbelieve **0** □ Don't know **1** □ Believe **1** □ Strongly Believe

Since carbon footprint depends on input use and varies significantly by production method as well as production region and retailing method, the following question is hypothetical.

Assume someone usually consumes organic milk with a higher carbon footprint than conventional milk and sees a carbon footprint label that he/she believes in and prices don't change.

Recent Market Prices for Organic and Conventional Milk for different Packages Sizes. Ranges are across brands and packaging.

Package Size	1 Gallon (3.78 L)	½ Gallon (1.89 L)	Quart (0.95 L)	Pint (0.48 L)
Organic Milk	$6.89 to $7.69	$3.50 to $4.49	$2.19 to $2.49	$1.35 to $1.79
Conventional Milk	$2.66 to $3.48	$1.72 to $2.17	$1.14 to $1.44	$.79 to $1.32

Because of the label they start comparing organic milk to conventional milk…

11. **At what amount of carbon footprint reduction do you think they would switch from organic milk to conventional milk? (CTS)**

1☐ *they would not switch*

They would switch at a carbon footprint reduction level of

5 ☐ *< 5%* **4** ☐ *5 -10%* **3** ☐ *11-20%* **2** ☐ *21% or more*

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12. **Please indicate your age group: (Age)**

20 ☐ Less than 25 **30**☐ 25-34 **40**☐ 35-44 **50**☐ 45-54 **60**☐ 55-64 **70**☐ 65+

13. **Please indicate your gender: (Gender)** **1**☐ Male **0**☐ Female

14. **What best describes your level of education?** (Please mark the highest level of education completed) **(EDU)**

0☐ Did not complete high school

2☐ High school graduate or GED

4☐ Some post high school training

6☐ Bachelor's degree

9☐ Graduate or professional degree

15. Which one of the following categories best describes your household income before taxes in 2009? (Income)

5,000	☐ Less than $10,000
17,500	☐ $10,000 - $24,999
35,000	☐ $25,000 - $44,999
60,000	☐ $45,000 - $74,999
112,500	☐ $75,000 - $149,999
175,000	☐ $150,000 or more

16. Including yourself, how many people live in your household? _____ person(s) (Household)

To participate in the Walmart gift card drawing. Please type in your e-mail so we may contact you in case you win. Be assured that your answers will be handled confidentially.

_____

Thank you for your time.

Appendix C

Table C.1 Summary of marginal effects on willingness to pay (PLABEL) for explanatory variables.

Variable	Coefficient	Standard Error	p-value
PCE	0.022	0.008	0.008
SUB	0.012	0.008	0.150
CORRECT	-0.004	0.014	0.770
DSTUDENT	0.135	0.044	0.002
DEMPTYN	-0.069	0.066	0.296
GENDER	-0.009	0.034	0.787
DHIEDU	-0.040	0.042	0.336
DLOWEDU	0.020	0.043	0.649
DLOWINC	0.007	0.054	0.902
DHIGHINC	-0.018	0.083	0.832
DPRICE	-0.003	0.037	0.929
TQ	-0.100	0.040	0.013
MSHARE1	1.159	0.583	0.047
DLSHARE1	-1.036	0.554	0.061
DHSHARE1	1.692	2.280	0.458

Appendix D

Table D.1 Summary of marginal effects on willingness to consume (QWLOWER) for explanatory variables (40%).

Variable	Coefficient	Standard Error	p-value
PCE	0.003	0.017	0.863
SUB	0.011	0.20	0.577
DSTUDENT	0.282	0.113	0.013
GENDER	0.003	0.080	0.972
DHIEDU	-0.042	0.119	0.722
DLOWEDU	-0.124	0.088	0.162
DLOWINC	-0.148	0.156	0.343
DHIGHINC	-0.133	0.189	0.483
DSHOP	-0.073	0.133	0.582
DFAT	0.147	0.083	0.076
DSIZE	0.051	0.082	0.533
DOTHER	0.151	0.187	0.419
DPRICE	0.026	0.089	0.768
TQ	0.091	0.103	0.379
MSHARE	-1.980	1.910	0.300
DLSHARE	1.686	1.842	0.360
DHSHARE	-2.220	8.389	0.791

Table D.2 Summary of marginal effects on willingness to consume (QWLOWER) for explanatory variables (20%).

Variable	Coefficient	Standard Error	p-value
PCE	0.103	0.065	0.110
SUB	0.053	0.062	0.390
DSTUDENT	0.554	0.318	0.081
GENDER	-0.043	0.261	0.868
DHIEDU	0.381	0.345	0.269
DLOWEDU	0.108	0.317	0.732
DLOWINC	0.432	0.451	0.338
DHIGHINC	0.227	0.809	0.779
DORGANIC	-0.509	0.354	0.151
DFRESH	-0.613	0.341	0.072
DPRICE	0.419	0.275	0.128
TQ	-0.082	0.357	0.818
MSHARE	4.770	6.267	0.447
DLSHARE	-4.463	6.025	0.459
DHSHARE	-11.501	25.730	0.655

Table D.3 Summary of marginal effects on willingness to consume (QWLOWER) for explanatory variables (10%).

Variable	Coefficient	Standard Error	p-value
PCE	-0.003	0.019	0.882
SUB	0.035	0.018	0.048
DSTUDENT	-0.084	0.082	0.304
DEMPTYN	0.125	0.122	0.304
GENDER	-0.109	0.071	0.124
DHIEDU	0.046	0.082	0.576
DLOWEDU	0.143	0.120	0.233
DLOWINC	0.129	0.123	0.294
DHIGHINC	-0.229	0.093	0.015
DSHOP	-0.212	0.156	0.174
DFAT	-0.082	0.089	0.358
DBRAND	-0.091	0.075	0.229
DPRICE	-0.002	0.078	0.976
TQ	-0.122	0.072	0.090
MSHARE	1.619	0.938	0.084
DLSHARE	-1.415	0.892	0.113
DHSHARE	6.367	3.935	0.106

Appendix E

Table E.1 Summary of marginal effects from explanatory variables for WTP categories when a lower carbon footprint milk label was present (40%).

Variable	Marginal effect (%) on WTP categories:			
	Pay Less	Pay Nothing	Pay +5% more	Pay +10% more
PCE	-0.51	-1.89	0.82	1.58
CORRECT	-0.91	-3.37	1.46	2.81
DSTUDENT	-1.93	-6.98	3.09	5.81
DEMPTYN	7.24	14.76	-10.93	-11.07
GENDER	1.00	3.64	-1.61	-3.03
DHIEDU	0.73	2.62	-1.19	-2.16
DLOWEDU	3.63	11.04	-5.86	-8.81
DLOWINC	-0.20	-0.75	0.33	0.63
DHIGHINC	-4.28	-25.55	1.73	28.11
DSHOP	-2.97	-8.66	4.84	6.79
DORGANIC	-5.12	-29.86	1.28	33.70
DBRAND	-1.93	-7.67	2.99	6.60
DSIZE	-2.76	-10.18	4.35	8.59
DFRESH	2.95	14.21	-3.77	-13.39
DPRICE	-4.22	-12.56	6.76	10.02
TQ	-1.40	-5.19	2.25	4.33
MSHARE	13.47	50.08	-21.77	-41.78
DLSHARE	-7.09	-26.36	11.46	21.99
DHSHARE	313.42	1,164.99	-506.42	-971.98

Table E.2 Summary of marginal effects from explanatory variables for WTP categories when a lower carbon footprint milk label was present (20%).

Variable	Marginal effect (%) on WTP categories:			
	Pay Less	Pay Nothing	Pay +5% more	Pay +10% more
PCE	-1.18	-1.70	1.42	1.46
SUB	-1.25	-1.80	1.50	1.54
DSTUDENT	-1.01	-1.45	1.22	1.25
DEMPTYN	5.81	5.67	-6.38	-5.10
GENDER	2.69	3.86	-3.23	-3.33
DHIEDU	3.55	4.72	-4.19	-4.08
DLOWEDU	-3.83	-6.41	4.68	5.56
DLOWINC	14.66	17.33	-15.81	-16.19
DHIGHINC	8.35	7.63	-8.97	-7.01
DSHOP	-28.03	-8.20	22.71	13.52
DPLASTIC	-5.08	-9.49	6.22	8.35
DFAT	4.78	7.93	-5.81	-6.90
DORGANIC	10.52	9.34	-11.14	-8.73
DBRAND	5.57	6.70	-6.40	-5.87
DOTHER	13.85	8.69	-13.47	-9.06
DFRESH	9.51	24.12	-9.94	-23.68
DPRICE	-5.89	-7.01	6.74	6.15
TQ	-2.55	-3.67	3.06	3.15
MSHARE	78.37	112.99	-94.32	-97.04
DLSHARE	-70.37	-101.45	84.69	87.14
DHSHARE	171.41	247.13	-206.29	-212.25

Table E.3 Summary of marginal effects from explanatory variables for WTP categories when a lower carbon footprint milk label was present (10%).

Variable	Marginal effect (%) on WTP categories:			
	Pay Less	Pay Nothing	Pay +5% more	Pay +10% more
PCE	-0.11	-0.49	0.24	0.37
SUB	-0.51	-2.20	1.06	1.65
CORRECT	-0.82	-3.57	1.71	2.68
DSTUDENT	-3.82	-22.29	6.32	19.78
DEMPTYN	-2.56	-15.36	4.57	13.35
GENDER	0.76	3.23	-1.58	-2.41
DHIEDU	-0.78	-3.40	1.62	2.56
DLOWEDU	1.48	5.68	-3.04	-4.12
DLOWINC	-5.34	-28.00	8.57	24.78
DHIGHINC	1.64	6.30	-3.37	-4.57
DPLASTIC	13.89	23.63	-20.66	-16.86
DFAT	-7.92	-21.35	14.07	15.20
DORGANIC	-4.43	-31.12	3.75	31.79
DOTHER	-3.28	-25.84	2.41	26.70
DFRESH	-6.52	-16.38	11.69	11.20
DPRICE	-0.95	-3.91	1.96	2.89
TQ	2.57	11.15	-5.35	-8.37
MSHARE	-59.39	-257.74	123.58	193.56
DLSHARE	61.14	265.30	-127.20	-199.24
DHSHARE	-119.76	-519.70	249.18	390.28

Appendix F

Table F.1 Summary of marginal effects from explanatory variables for WTS categories.

Variable	Marginal effect (%) on WTS categories:				
	Would not Switch	Switch at 21% or more	Switch at 11% - 20%	Switch at 5% - 10%	Switch at < 5%
PCE	-2.72	0.36	0.54	1.74	0.08
CORRECT	5.31	-0.70	-1.06	-3.39	-0.16
GENDER	-36.95	2.51	5.98	26.45	2.01
DSTUDENT	4.63	-0.66	-0.94	-2.90	-0.13
DHIEDU	-7.80	1.06	1.57	4.94	0.23
DLOWEDU	6.37	-0.97	-1.32	-3.91	-0.16
DLOWINC	-30.05	3.05	5.45	20.32	1.23
DHIGHINC	24.58	-5.14	-5.53	-13.44	-0.46
DBELIEVE	8.26	-1.25	-1.71	-5.08	-0.21
DPLASTIC	-35.18	9.08	8.29	17.30	0.50
DORGANIC	49.46	3.30	-3.29	-41.99	-7.47
DBRAND	-16.17	1.63	2.98	10.95	0.61
DSIZE	19.33	-3.49	-4.19	-11.22	-0.43
DPRICE	15.09	-2.16	-3.07	-9.44	-0.42
TQ	17.23	-2.28	-3.45	-11.00	-0.51
MSHARE1	-613.32	81.19	122.61	391.52	18.00
DLSHARE1	589.23	-78.00	-117.79	-376.14	-17.29

Appendix G

1. **Kaufen Sie 50% oder mehr Ihrer Lebensmittel in Ihrem Haushalt/fηr sich selbst?** ☐ Ja ☐ Nein

2. **In der folgenden Tabelle beschreiben Sie bitte Ihren typischen Milcheinkauf:**

Beschreibung	(In each row, please mark the item purchased the most)
Verpackungsgr sse	☐ 1.5 L ☐ 1 L ☐ 0.5 L ☐ 0.5 L oder weniger
Verpackungsmaterial	☐ Plastik ☐ Karton ☐ Glas
Milchproduktionsweise	☐ Organisch ☐ Konventionell ☐ Anders (z.B. Soymilch (_____)
Letzter Einkaufspreis	_____ (innerhalb € 0.15 pro L)

3. **Wieviel Milch kaufen Sie normalerweise pro Woche?** (Bitte einen Durchschnittswert angeben oder eine Box markieren)

Durschnittsverbrauch pro Woche: _____ L

☐ 0.5 L oder weniger ☐ 0.5 bis 1 L ☐ 1 bis 2 L ☐ 2 L oder mehr

4. **Von den folgenden Milcheigenschaften, welche fηnf sind am wichtigsten fηr Sie?**

Eigenschaften	**Rang** Bitte ordnen Sie fηnf von den sieben Eigenschaften von 1 = sehr wichtig bis 5 = am wenigsten wichtig
Verpackungsgr sse	☐
Markenname	☐
Preis	☐
Fettgehalt	☐
Milch ist organisch produziert	☐
Haltbarkeit oder Frische	☐
Andere Eigenschaft (bitte beschreiben_____)	☐

Die folgende Fragestellung wird normalerweise in der Sozialforschung benηtzt um Ihre Einstellung auf Klimaver≅nderung und Naturschutz zu vermitteln. Da gibt es keine richtige oder falsche Antworten.

5. **Tragen Sie bitte Ihre jeweilige Zu- oder Abstimmung mit den folgenden Thesen in der Tabelle ein.**

	Sehr Richtig	*Richtig*	*Neutral*	*Falsch*	*Sehr Falsch*
Als Einzelperson macht es keinen Sinn etwas gegen Umweltverschmutzung zu tun.	☐	☐	☐	☐	☐
Wenn Ich ein Produkt einkaufe versuche Ich an Umwelts- und Sozial-konsequenzen vom Verbrauch zu denken.	☐	☐	☐	☐	☐
Da die Einzelperson keinen messbaren Effekt auf Weltweite Umweltverschmutzungsprobleme hat, macht der Beitrag der Einzelperson keinen Unterschied.	☐	☐	☐	☐	☐
Jede Einkaufsentscheidung kann einen positiven Sozial- beitrag machen weil Produkte von Sozialorientierten Gesch≅ften gekauft werden k ¯nnen.	☐	☐	☐	☐	☐

6. Die folgende Frage soll Ihre Zu-oder Abstimmung mit Klimaver≅nderung erfassen. Wir moechten auch Ihr Kenntniss von Treibhausgasemissionen und 'carbon footprints' erfassen.

Thesen	*Sehr Richtig*	*Richtig*	*Neutral*	*Falsch*	*Sehr Falsch*
Klimaver≅nderung ist ein Trugschluss. (N)	☐	☐	☐	☐	☐
Klimaver≅nderung wird von der Menschheit beschleunigt. (P)	☐	☐	☐	☐	☐
Klimaver≅nderung h≅ngt nicht von Treibhausgasemissionen in der Athmosph≅re ab. (N)	☐	☐	☐	☐	☐
Die Art und Weise von Nahrungsmittelproduktion, -transport, -verpackung , und -verbrauch hat einen grossen Einfluss (> 10%) auf den Inhalt von Treibhausgasen in der Athmosph≅re. (P)	☐	☐	☐	☐	☐
Kenntnisstand	☐	☐	☐	☐	☐
Der 'carbon footprint' von einem Produkt bezieht sich nur auf Kohlendioxidemissionen als Treibhausgas.	☐	☐	☐	☐	☐
Die wichtigsten Treibhausgasemissionen sind Stickstoffdioxid, Kohlendioxid und Methan. Der 'carbon footprint' ist die Umrechnung dieser Gase als Kohlenstoff≅quivalent.	☐	☐	☐	☐	☐
Jeder Verbraucher hat daher einen 'carbon footprint'.	☐	☐	☐	☐	☐
'Carbon footprints' gibt es auch ausserhalb der Nahrungskette.	☐	☐	☐	☐	☐

Untersuchungen in dem Gebiet von Klimaver≅nderung haben festgestellt daβ die Herstellung von organischer Milch mehr Treibhausgasemissionen porduziert als die von herk ¯mmlicher Milch (bzw. 1 L von Organischer Milch bedeutet mehr Treibhausgasemissionen als 1 L von normaler Milch).

7. Bitte beschreiben Sie Ihr Zutrauen mit diesem Forschungsergebnis.

Sehr Zweifelhaft	Zweifelhaft	Neutral	Zutreffend	Sehr Zutreffend
☐	☐	☐	☐	☐

TESCO ist ein grosse Einkaufszentrumkette in England. Heutzutage haben viele Ihrer Lebensmittel ein Etikett mit 'carbon footprint' von Erzeugnis bis Endverbrauch das durch den Carbon Trust vermittelt wird. Rechts finden Sie ein Exemplar von so einem Milchetikett. Lesen Sie Bitte dieses Etikett.

γbersetzung: Der 'carbon footprint' von dieser Milch ist 800 g pro 0.568 L und wir wollen Ihn reduzieren. Recyclen Sie bitte diese Flasche um weitere 40 g zu sparen.

Beantworten Sie bitte die folgenden Fragen als ein typischer Milchverbraucher.
Wir wollen feststellen wie viel jemand fηr extra Information oder fηr Treibhausgasreduzierungen bezahlen wηrde.

Ihr typischer Milch Einkauf bildet die Basis Ihrer Antworten:

Eigenschaft	**Ihre vorherige Angabe**
Verpackungsgr ¯sse	*1 L*
Verpackungsmaterial	*Plastik*
Herstellungsmethode	*Organisch*
Preis	*€x.xx pro L*

8. Wieviel wηrde ein Milch Trinker extra fηr die 'carbon footprint' Information bezahlen?

Jemand wηrde nicht mehr als € _____ pro L extra fηr das 'carbon footprint' Etikett bezahlen.

9. **Mit einem angenommenen *xxx g* Etikett pro L fηr einen typischen Milcheinkauf,**
   (Bitte Meistbetrag und extra oder weniger eintragen)

   a. wηrde jemand € _____ pro L extra / weniger fηr eine xxx g Erh ¯herung bezahlen.

   b. wηrde jemand € _____ pro L extra / weniger fηr eine xxx g Reduzierung bezahlen.

10. **Wiederum mit einem angenommenen *xxx g* Etikett pro L fηr einen typischen Milcheinkauf und mit keiner Preis≅nderung,**
    (Markieren Sie bitte eine box pro Frage)

    a. wηrde jemand ☐ mehr ☐ weniger ☐ genausoviel Milch mit einer xxx g Erh ¯hung trinken?

    b. wηrde jemand ☐ mehr ☐ weniger ☐ genausoviel Milch mit einer xxx g Reduzierung trinken?

11. **Wenn jemand ursprηnglich 'organische' Milch mit einem h ¯heren 'carbon footprint' als normale Milch trinkt, glauben Sie da8 das 'carbon footprint' Etikett zu einer Verbrauchs≅nderung fηhren wηrde?**

    ☐ jemand wηrde weiterhin 'organische' Milch trinken

    Jemand wηrde auf normale Milch umschalten wenn der 'carbonfoot' sich um mindestens

    ☐ *< 5%* ☐ *5-10%* ☐ *11-20%* ☐ *> 20%* *reduzieren w ηrde*

12. **Fηr wieviele Milchtrinker kaufen Sie Milch in Ihrem Haushalt oder fηr sich selbst ein? _____ Person(nen)**

13. **Was ist Ihre Altersgruppe?**

    ☐ jηnger als 25 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64
    ☐ 65 oder ≅lter

14. **Was ist Ihr Geschlecht:** ☐ M≅nnlich ☐ Weiblich

15. **Welchen Erziehungsgrad haben Sie beweltigt?** (Geben sie Bitte nur den h ¯chsten Grad an)

- ☐ Grundschule
- ☐ Realschule
- ☐ Gymnasium / Abitur
- ☐ Universit≅t / Diplom
- ☐ Mehr

16. **Fηr 2009, was war die Bruttoeinkommensgruppe Ihres Haushalts?**

- ☐ Weniger als € 8,000
- ☐ € 8,000 bis € 20,000
- ☐ € 20,000 bis € 36,000
- ☐ € 36,000 bis € 60,000
- ☐ € 60,000 bis € 120,000
- ☐ € 120,000 oder mehr