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What Factors Influence Consumers' Willingness to Purchase and Consume Carbon-Labeled Rice: A comparative study between Arkansas and Belgium

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Abstract

Climate change is an issue of growing importance around the globe. As global population increases so does attention focused on human contributions to climate change. One major way humans contribute to climate change is through our diets. Agricultural production is a major source of global greenhouse emissions. It has been estimated that food production is responsible for a large majority of the methane and nitrous oxide which is emitted into our atmosphere each year. Carbon footprint labeling has been developed to give consumers a way to lower their footprint and help lower emissions of greenhouse gasses. At least one retailer, Tesco, in the UK has adopted carbon footprint labeling and affixes them to a large selection of consumer items sold in their stores. Although it can't be assumed that everyone will adopt or even utilize carbon labeling there are things that can be done to encourage adoption and utilization. The main goal of this thesis was to determine what factors lead to a change in consumption or purchasing behavior in favor of a carbon label for respondents from the University of Arkansas in the United States and the University of Ghent in Belgium. Although the respondents sampled for this survey were not representative of the overall populations of either Arkansas or Ghent Belgium their responses did exhibit similarities with the literature. In particular, respondents with higher Perceived Consumer Effectiveness scores were more willing to pay more for a carbon label, regardless of the amount of increase or decrease of the footprint. Also, other significant constructs such as Subjective Knowledge and environmental belief proved to have similar effects on respondents sampled from Arkansas

This thesis is approved for Recommendation
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Chapter One: Introduction

1.1 Contextual Framework

Climate change is a major issue being considered and debated around the world. The U.S. and China are the leading emitters of greenhouse gasses (GHG) followed by the E.U (Sunstein C. R., 2007). Of the many mitigating strategies that have been developed to curb GHG emissions, carbon labeling has emerged as a potential approach to empower consumers to make informed choices to ultimately pressure the production and marketing of goods and services with lower GHG emissions. Currently, carbon labeling schemes in Europe and the U.S. are being introduced.

Diets are responsible for a large proportion of global anthropogenic GHG emissions with food production contributing an estimated 40% of methane (CH_4) and 70% of the nitrous oxide (N_2O) into the atmosphere, globally(Changsheng Li,et al., 2004). Carbon dioxide (CO_2), emitted by the use of fossil fuels in agriculture has been shown to be less important than other GHGs (Sonesson, Davis, and Ziegler, 2009). According to a chart released by the EPA in 2005, CO_2 emitted from the use of fossil fuels makes up approximately 8% of the estimated emissions from agriculture in the United States. (Takle and Hofstrand, 2008). However, food value chains are complex and highly heterogeneous in terms of GHG emissions. Important factors include biological characteristics of production, spatial location, processing requirements and logistic requirements from raw to final product (Sonesson, Davis and Ziegler, 2009). According to the US Census world population clock, world population is estimated to be approximately 6.9 billion as of

February, 2012 and approximately half of those people eat rice at least one meal per day (Changsheng Li,et al, 2004). By 2050, the UN predicts global population to exceed 9 billion people, and to meet food demand the Food and Agricultural Organization (FAO) estimates agricultural output will need to increase by an estimated 70%. Also, according to the FAO, rice is the most consumed grain, ahead of wheat and maize, for the world's population, hence plenty more will need to be produced in order to meet demand in the coming decades.

The most common and well known GHGs found naturally in the atmosphere and emitted by human activities such as farming include CO_2, N_2O, and CH_4. CO_2 is the most well known and most prevalent GHG in the atmosphere and makes up about 80% of the GHGs that are emitted due to human activity. Although less prevalent, N_20 and CH_4 are actually better at trapping heat within the earth than CO2 and is the reason why the concept of global warming potential (GWP) was created so that the effects of each GHG could be compared. The GWP of CO_2 is 1 while the GWP of CH_4 and N_2O is 24 and 296, respectively. This means that 1 ton of CH_4 and 1 ton of N_2O are equivalent to 24 tons and 296 tons of CO_2 (Massey & Ulmer, 2010). Wetland rice[1] makes up approximately 90% of global rice production and has been reported to contribute approximately one quarter of all methane emissions related to human activities (UNFCC).

To meet the challenges that food consumption and a growing global population are placing on agriculture's impact on climate change, rice production will need to change.

[1] IPCC Guidelines for National Greenhouse Gas Inventories defines wetland rice as consisting of irrigated, rain-fed, and deepwater rice. Upland rice is defined as not flooded and producing lower CH_4 emissions than deepwater rice.

Mitigating strategies have been devised to limit net GHG emissions from the production of rice and include better land and water management practices. Rice grown under flooded conditions create an anaerobic soil environment that promotes methane emissions and limiting irrigation of rice paddies has been shown to reduce methane emissions by as much as forty percent or more (Wassmann, Hosen, and Sumfleth, 2009).

If consumers will begin to demand lower GHG emissions from the rice products they purchase/consume, producers will be expected to adopt more efficient land and water management practices in an effort to mitigate their emissions. One proposed way to create a demand for rice products with lower carbon emissions is to provide consumers with information by way of a carbon label.

Whether or not carbon labels on rice products will change consumer purchasing habits is largely unknown but carbon labels have already been placed on many consumer goods by at least one well known retailer in the United Kingdom. Tesco, with the help of The Carbon Trust began providing carbon labels on their store branded products in 2008. Currently, according to Tesco's website the retailer has carbon labels affixed to approximately 120 products including potatoes, light bulbs, milk, washing detergent and many other common consumer items.

Several issues surround the use of carbon labels by consumers. Major issues include consumer knowledge, both subjective and objective, perceived consumer effectiveness (PCE), and consumers' beliefs or attitudes about climate change. Will consumers understand and utilize the information presented in the carbon labels when

making purchasing decisions? Recent research has revealed that consumers often do not understand information on carbon labels (Deans, 2008). One particular retailer's customers were surveyed and it was found that only twenty-eight percent of their customers knew that a carbon footprint related to climate change and approximately forty-four percent thought it related to fair trade (Deans, 2008). However, most of the consumers surveyed thought that the label was an important figure to be considered. Even though most of the consumers that were surveyed wanted the carbon label or thought it was important, a major problem is that most products do not include carbon labels and even knowledgeable consumers do not have the ability to make comparisons between products (Deans, 2008). Objective knowledge (OK) is just one aspect affecting whether or not consumers utilize a label. PCE, a measure of an individual's belief that their actions make a difference in solving a problem may also play an important role in whether or not they are willing to pay for an environmental label (Laskova, 2007). Subjective knowledge (SK) has been shown to be a good predictor of pro-ecological behavior (Ellen, 1994), and is defined as an individual's "subjective perception 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). D'Souza, et al., (2007), state that knowledge of the environment not only involves what one knows about the environment but also includes the beliefs held about it as well.

1.2 Problem Statement

The purpose of this study is to measure associations between consumer knowledge, perceived consumer effectiveness, environmental attitudes or beliefs and consumers'

likelihood of utilizing carbon labels on rice products to change their purchasing habits of rice. Environmental awareness among consumers in the U.S. and in Europe is commonplace; however, awareness doesn't always translate into a willingness to act. Individual consumption is an important factor to consider in mitigating climate change through carbon emissions reduction. Our diets have been shown to be a large contributor to global carbon emissions. Carbon labeling promises to provide a market based approach whereby information is put into the consumers' hands so that each one of us can vote for or against the environment with every purchase. An analysis and comparison of consumer perceptions and subjective and objective knowledge of university populations in Ghent, Belgium and Fayetteville, Arkansas will be assessed in order to better understand the factors that may affect carbon label usage.

1.3 Hypothesis

A survey eliciting responses from a sample of respondents from the University of Arkansas, USA and the University of Ghent, Belgium is expected to yield insights into consumers' awareness, attitudes, and knowledge of environmental issues and a test of willingness to pay for carbon labeling on rice products. Information on several factors such as demographic characteristics, exposure to media, social awareness and cultural differences are collected along with responses to carbon labeling.

Four null hypotheses are tested in this study. Responses to carbon labels on rice are not affected by…

1. Respondents' country of residence;

2. Respondents' PCE scores;

3. Respondents' Subjective knowledge scores;

4. Respondents' attitudes or beliefs about climate change;

In addition to these four hypotheses, this survey was designed to collect information about each respondent's demographic, purchasing and consumption patterns to describe important characteristics which may or may not influence their willingness to alter purchasing or consumption in favor of a carbon label on rice.

1.4 Thesis Structure

An overview of the literature on environmental issues regarding rice production, public awareness of environmental issues and label usage is presented in Chapter II. Chapter III will present the survey design and questionnaire and the rationale for questions which was derived from the review of literature. The results of the analysis will be presented in Chapter IV. Chapter V will present the study conclusions and a discussion of the limitation of the study and suggestions for further research. The results of this research along with suggestions for future research can be used as a guide to aide policy makers and industry in the selection of tools to encourage consumer use of carbon labels.

Chapter Two: Review of the Literature

2.1 Introduction

Globally, the United States is the leading emitter of GHG, second is China and a close third place is the European Union (Baumert, Herzog, & Pershing, 2005). This chapter first highlights the global climate change consequences related to the production of rice. Major issues regarding carbon label use are discussed with references to nutrition and environmental labels. In the first part, a brief background on the science of climate change is presented along with current schemes to mitigate carbon emissions. Finally consumer characteristics and response to environmental labels is discussed.

2.2 Climate Change

According to the International Panel on Climate Change (IPCC), atmospheric carbon has been increasing since the industrial revolution. In the past century, it has been increasing at a faster rate than at any other point in history. Increased levels of CO_2 and other green house gases are responsible for warming the surfaces of land and water (Gitay, et al. 2002). $C0_2$ is one of the seven major GHGs that are credited with affecting the earth's temperature. The greenhouse effect was first discovered by Jean-Baptiste Fourier. The name "greenhouse effect" was coined as a common term because the earth's atmosphere is very similar to the glass in a greenhouse in that it absorbs infrared radiation in much the same way (Haughton, 2005). The greenhouse effect, which is responsible for maintaining the earth's temperature, relies on gases to accomplish its purpose. The main greenhouse gases include nitrogen, oxygen, carbon dioxide, ozone, methane, nitrous oxide,

and water vapor. Water vapor has the greatest effect on warming followed by carbon dioxide (Haughton, 2005).

As science has illustrated, a relationship between increased greenhouse gas concentration in the earth's atmosphere and increasing surface temperatures exists. Governments and citizens around the globe have called for more attention to reducing emissions. One of the results of this increased attention to climate change has been the creation and adoption of the Kyoto protocol[2] The Kyoto protocol was created in 1997 and later entered into force in 2005. It sets emission standards for many of the world's countries. Aside from formal agreements, retailers and manufacturers have worked to do their part to reduce carbon emissions by empowering consumers through various eco labeling schemes.

Radiative forcing is an important term used in the literature when referring to the effects different green house gasses have on warming our planet. The IPCC Working Group I report stated that carbon dioxide is the single most important anthropogenic greenhouse gas (Carlsson-Kanyama, Gonza´lez, 2009). Fossil fuels are the main source of anthropogenic greenhouse gas emissions and methane being the second most important source in regards to radiative forcing (Carlsson-Kanyama, Gonza´lez, 2009). The other important gases that are major contributors to radiative forcing include Halocarbons and nitrous oxide. Different greenhouse gases do not interact in the same way with our atmosphere due to the individual radiative properties of each unique gas.

[2] For further information and to view the original Kyoto protocol document see http://unfccc.int/key_documents/kyoto_protocol/items/6445.php

To explain, a single nitrous oxide molecule is approximately 300 times more efficient at trapping heat in the earth's atmosphere than a molecule of carbon dioxide. A study by Changshent Li, et al. (2004) states that global food production is responsible for contributing to the atmosphere approximately 40% of methane and 70% of the nitrous oxide. Emissions from agriculture vary according to many different factors including varying production methods and soil processes. In cropping operations, mechanization contributes to emissions of carbon dioxide due to the intensive use of fossil fuels by tractors and farm equipment. The use of fertilizers and irrigation systems is another major use of fossil fuels in agriculture which greatly contributes to the sectors overall emissions (Carlsson-Kanyama and Gonza´lez, 2009). Table 2.1 illustrates the radiative forcing of three most common gases associated with agriculture.

Table 2.1: Global Warming Potential of CO2, CH4, and N2O

Global Warming Potential for given time period:	20 years	100 years
CO2	1	1
CH4	72	25
N20	289	298

(IPCC Fourth Assessment Report: Climate Change 2007. Table 2.14)

Methane, referred to in the literature as a non-carbon dioxide greenhouse gas, is formed by the decomposition of organic materials in an environment deprived of oxygen. Production of methane is largely from the result of the digestive processes of ruminants, production of rice under flooded conditions, and from manure stores (Carlsson-Kanyama and Gonza´lez, 2009). Methane is attributed to such products as meat, milk, and rice. The other potent greenhouse gas which is prevalent in agriculture, nitrous oxide, is emitted through the use of petroleum based nitrogen fertilizers and in any situation where

nitrogen in the soil exceeds plant requirements (Carlsson-Kanyama and Gonza´lez, 2009).

Methane and nitrous oxide behave differently in our atmosphere. The two gases are unique in their rates of decay, the way they behave with other atmospheric gases and they also differ in their individual abilities to trap heat in our atmosphere (Carlsson-Kanyama and Gonza´lez, 2009). The term global warming potential (GWP) is a multiplier assigned to different greenhouse gases that allows us to convert them into a carbon dioxide equivalent. For example, Nitrous oxide has a global warming potential of 289. This figure means that a unit of nitrous oxide is 289 more times effective than a unit of carbon dioxide at trapping heat in the atmosphere (Carlsson-Kanyama, Gonza´lez, 2009).

2.3 Environmental impacts of Rice

Rice is produced globally using different production methods. Greenhouse gas emissions from different production methods vary accordingly. Generally, it is accepted that the production of rice is among the most important sources of anthropogenic methane contributing approximately one quarter of methane from human activities (UNFCC). Our diets are responsible for a large proportion of GHG emissions and a change in diet would help to curb emissions (McMichael, et al., 2007). The top five rice producing countries in the world are located in Asia with China producing the most. To put things in perspective, China produces approximately 196,681,170 metric tons (MT)

of rice per year while the US produces approximately 9,972,230 MT per year and is ranked 12th among top rice producing countries in the world (FAOSTAT).

Emissions from rice production vary according to the land and water management practices used. Therefore it can be hard to place a single estimate on how much carbon equivalent emissions are generated by growing and harvesting rice. However, to put things into perspective, rice was compared among pork, and other products including carrots, tomatoes, potatoes, and dry peas (Carlsson-Kanyama, 1998). Below is a table which represents the amount of CO2 equivalent emissions that were generated. Rice has the highest associated carbon equivalent emissions with 6400 g of CO_2 equivalent per Kg produced. Although, as mentioned earlier there are uncertainties associated with the amounts of GHG emitted from rice agriculture, however, it is known that CH_4 is the main GHG associated with its production (Carlsson-Kanyama, 1998).

Table 2.2: Emissions of greenhouse gases in CO2 equivalents per g of CO2 per Kg of carrots, tomatoes, potatoes, pork, rice, and dry peas consumed in Sweden

	Carrots	Tomatoes	Potatoes	Pork	Rice	Dry Peas
g CO2 Equivalents per Kg	500	3300	170	6100	6400	680

(Carlsson-Kanyama, 1998, table 1)

By the year 2050 it has been estimated that the global population is expected to increase by approximately 40 % (McMichael, et al., 2007). If global population increases by this percent without any changes or advances made in the reduction of green house gas emissions, drastic reductions in consumption would be needed to keep emissions at the current estimated levels. To put things in perspective, global population is expected

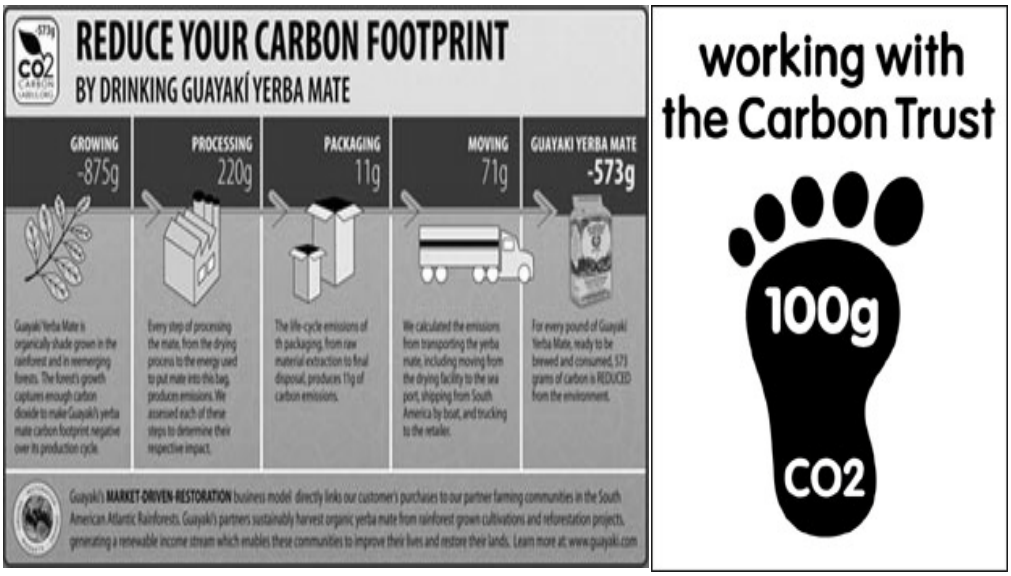
to exceed 9 billion people by the year 2050. According to estimates made by the U.N. most of this increase is expected to take place in the developing regions of the world while the population in industrialized or developed countries is expected to remain relatively stable. Dr. Robert Zeigler, the director general and CEO of the International Rice Research Institute (IRRI) was quoted in an article by The Financial Express in June of 2005 stating that global demand for rice is expected to increase by 50% by 2050 which would mean that carbon equivalent emissions would increase by the same amount during that same time period[3].

2.4 Carbon Labels

Carbon labels are already being placed on many consumer items by a major retailer, Tesco, in the U.K. Tesco has placed carbon labels on many of its products. In a recent article, Tesco announced that it would continue expanding the scope of their carbon labeling program to include grocery items. Since Tesco has begun its labeling program, over two thirds of its customers indicated they understood the term carbon footprint. Over sixty percent have said they seek out products with lower carbon footprints if the product is competitively priced and convenient. Tesco also communicated that approximately ninety-five percent of its customers were actively trying to reduce carbon emissions and eighty-five percent of its customers consider environmental impacts of their purchases (Drake, 2009).

[3] Assuming no change in production, transportation, process technology

Carbon labels provide promising potential to aid consumers in their attempts at reducing their carbon footprints. Tesco utilizes carbon labels provided by The Carbon Trust, a not- for- profit firm located in the U.K. Their label, below, includes a footprint with a number representing how much CO2 is emitted for a particular product during its life cycle. Relatively simple and presumably easy to read, there are other labels being utilized that make comparisons between products difficult. For instance, Carbonlabel.org, a for-profit firm located in North America provides similar labeling services. It has yet another label which communicates to consumers how much carbon is in a given product. In addition to these two major labeling bodies, individual companies have embarked to provide carbon labeling on their own products as well which can further complicate comparisons between competing products.



At the moment, there is not one generally accepted standard for labeling products with regards to carbon emissions. If a product has a carbon label affixed to it, competing products are not likely to have a similar label if they have one at all. This makes it difficult for consumers to make accurate comparisons between products when shopping.

Carbon labels are not the only labels affixed to consumer goods. Labels have been around for years, providing important information to consumers about the products they purchase. For instance, there are nutrition labels which inform consumers about the nutritional content of the food they purchase; organic labels which provide information to customers about the production method used; energy labels that communicate the energy efficiency of appliances they buy. There are also labels which inform consumers about various things that may or may not be in certain products they buy such as labels indicating a presence or absence of genetically modified foods (GMO). With so much information available to consumers, market inefficiencies can exist when there are asymmetries between the information demanded and the information provided. These types of inefficiencies can only be solved if consumers pay attention to the information provided and are able to make sense of it in the course of their decision making (Verbeke, 2005).

In previous research (Panzone, 2010), various policy instruments were analyzed to determine the best way to influence sustainable consumption[4]. In the research,

[4]The Oslo Symposium in 1994 proposed a working definition of sustainable consumption as "the use of goods and services that respond to basic needs and bring a better quality of

consumers were presented with five different policy choices that were designed to motivate them to purchase the more environmentally friendly food alternatives. The policy instruments analyzed included the following:

A. Price instrument: a subsidy or an exogenous price change that favors the least polluting alternative ;
B. Quantity instrument: a ban or an exogenous removal of the most polluting alternative;
C. Information instrument: a label informing consumers about the carbon footprint of their alternatives.

After consumers were surveyed and the data analyzed, it was found that the most effective policy approach to sustainable consumption included quantity instruments which removes the most polluting choice for consumers (Panzone, 2010). Banning options for consumers based on the polluting potential of the given product would be difficult if not impossible to implement in real life. The research concluded that an information instrument such as labeling was the most effective approach to encouraging increased sustainable consumption (Panzone, 2010).

As research has found carbon labeling to be effective at encouraging sustainable consumption among consumers at grocery stores, research has also acknowledged that there are underlying factors which influence consumers' likelihood of utilizing new information to change their purchasing habits. Two factors which most influence sustainable change are consumer motives and trust in personal responsibility (Panzone, 2010). Revealing and somewhat surprising, the research found that belief in climate

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life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations."

change had a negative impact on change (Panzone, 2010). Moreover, it was also found that social motives were also associated with having a negative impact on sustainable change (Panzone, 2010). The authors suggested that more environmentally conscious consumers likely are less willing to change their purchasing habits because they have already switched to more environmentally friendly purchasing habits. (Panzone, 2010).

There are certain factors that have been linked to increased acceptance and use of labels, for instance, nutritional labels have been widely studied and some of the findings are that education, gender, available time for shopping, and level of dietary awareness have all been found to influence label use and acceptance (Drichoutis, et al.,2006). Literature has also reported that type of household, location of household (urban, rural), and knowledge also have impacts upon nutrition label use (Drichoutis, et al., 2006).

As more attention has been given to environmental issues, products have begun to include various environmental labels or eco-labels. Environmental labels include labels that communicate information about how a particular product affects the environment. Some examples of eco-labels include labels that indicate a given product is recyclable or made of recycled products or labels that indicate a certain product is energy efficient as in the United States energy star program where a star on appliances implies they are energy efficient.

Some of the same factors that affect nutrition label use may also affect whether or not consumers will utilize environmental labels. "Just like unit pricing helps the

consumer obtain the goal of value for money and nutrition declarations health related goals, environmental labeling helps consumers obtain environmental goals" (Thogersen 2000, p. 289).

Environmental labels have potential to be effective tools if consumers notice, understand, and value them when making decisions. Trust, knowledge, and consumers' environmental goals are all factors that impact whether or not environmental labels are utilized. If consumers do not believe or are uninformed of environmental issues they likely will not value products bearing an environmental label. Hence, a product bearing a label containing important information about its environmental performance will only make a difference in the consumers' decision making if he or she desires an environmentally friendly product. (Thogersen, 2000). Use of nutrition labels has generally been found to influence consumers' decision making because they desire to avoid unhealthy food choices. Moreover, nutrition labels are reported to have a much greater effect when they are combined with informative marketing to educate consumers (Drichoutis, et al.,2006). If consumers are educated, have knowledge of diet and nutrition facts, they are more likely to utilize nutrition labels. The same may also apply to carbon labels. Furthermore, if consumers believe that their individual actions can make a difference, they may be more likely to engage in pro-environmental behaviors such as purchasing of green products (Laskova, 2007). The perception that consumers' individual action can have an impact on collective issues such as climate change is known as perceived consumer effectiveness.

2.5 Consumer Characteristics and Response to Labels

2.5.1 Perceived Consumer Effectiveness

Perceived Consumer Effectiveness (PCE) has been defined in the literature as a construct that measures the degree to which a person believes his or her individual actions make a difference (Ellen, Weiner and Cobb-Walgren, 1991). Previous research has found that PCE as a construct "provides the greatest insight into ecologically conscious consumer behavior" (Straughan and Roberts, 1999). In fact, numerous studies have found the PCE construct to be stronger than many other variables including demographic and psychographic variables when it comes to predicting whether or not consumers will engage in ecologically conscious consumer behavior (ECCB) (Straughan and Roberts, 1999). Even though PCE is a strong indicator of ECCB, it should not be treated as a measure of general concern for the environment or its role is likely to be understated (Ellen, Weiner and Cobb-Walgren, 1991).

2.5.2 Knowledge

Although PCE is a strong predictor of a person's willingness to act, it is not the only factor that is appropriate to determine whether or not consumers will likely place a value on carbon labels. Knowledge also is believed to play a key role in shaping consumers' decisions and buying patterns. There are two types of knowledge bases that have been widely studied in previous research and are applied here, subjective knowledge (SK) and objective knowledge (OK).

Subjective knowledge is defined as a person's own assessment of the level of knowledge they attain on a given issue or subject while objective knowledge relates to what a person actually knows (Carlson, et al., 2008). In consumer research, knowledge is known to be a major influence in the decision process. As a construct, research has shown knowledge to be both relevant and significant affecting the gathering, organizing and use of information in the decision making process of consumers. It plays a role in the evaluation of goods and services by consumers as well (Laroche, Bergeron, Barbaro-Forleo, 2001).

Even though it is commonly accepted in consumer research that knowledge is a significant and relevant construct (Alba and Hutchinson, 1987), some studies show otherwise. Maloney and Ward (1973) show that environmental knowledge and ecologically favorable behavior are not significantly linked. Meanwhile, other research shows that environmentally friendly behavior and increased levels of environmental knowledge to be significantly linked (Vining and Ebreo, 1990). Another study also shows a link between knowledge about environmental issues and a willingness to pay for green products (Amyx, et al., 1994).

Previous research indicates that greater knowledge of nutrition increases efficiency and perceived benefits of label use to consumers while driving down the costs associated with using them. Moreover, it has been shown that a relationship exists between nutrition knowledge or subjective knowledge and use of certain nutrients (Drichoutis, et al., 2006). Both subjective and objective knowledge measures have been

found to affect consumer decision making and especially information acquisition by consumers (House, 2004).

Self rated and actual knowledge levels were assessed in a previous study on their effects upon consumer acceptance of biotechnology between the United States (U.S.) and the European Union (E.U.). In the study, it was found that willingness to accept genetically modified (GM) foods increased with increasing levels of self rated knowledge (House, 2004). Also, it was found that willingness to accept GM foods was not significantly related to actual knowledge (House, 2004). Furthermore, it was concluded that subjective knowledge which was related to education was an important factor in determining whether or not consumers would be willing to eat GM foods (House, 2004).

In a previous study conducted on consumer preferences for organic, eco-labeled, and regular apples, it was found that eco-labeled apples were an intermediary choice (Loureiro, et al., 2001). Results from the study showed that shoppers with larger families often preferred conventional apples due to their lower costs. Willingness to pay increased for eco-labeled apples among consumers who were female and in households with children under the age of 18. Also, concerns about food safety and environmental attitudes were linked to an increased likelihood that consumers would be willing to pay a premium for eco-labeled apples (Loureiro, et al., 2001). The estimated average premium that consumers were willing to pay for eco-labeled apples was only $0.05.

2.6 Summary

Carbon, as measured in the earth's atmosphere, has been increasing since the industrial revolution and it has been increasing at a faster rate than at any other point in history. International attention is now being paid to climate change and, as a result, governments, policy makers, companies and individuals are looking for ways to cut their carbon emissions. Research has proven that our diets are major contributors to man-made carbon emissions and their environmental impact should not be ignored in mitigation strategies.

By 2050 it is estimated that global population could reach nine billion people. Most of this growth is expected to occur in developing regions of the world such as Latin America, Asia, and Africa. Asia which holds the largest percentage of the developing world's population produces and consumes approximately 90% of the world's rice. In order to curb greenhouse gas emissions, agriculture will need to be part of the solution and reductions in emissions from rice will need to take place.

Previous research found that the most effective policy approach to sustainable consumption included a quantity instrument which removes the most polluting choice for consumers (Panzone, 2010). However, banning options for consumers would be difficult if not impossible to implement in real life. It was concluded that an information instrument such as labeling was the most effective approach to encouraging increased sustainable consumption.

Many studies have been done on the various types of labels on consumer products and the willingness of consumers to accept and pay for those labels. Nutrition labels and labels indicating whether or not food products contained GMOs were reviewed. It was found that PCE, SK and OK were determining factors on label use in the research examined. This study therefore will investigate whether these factors may also affect an individual's likelihood of utilizing carbon or eco-labels to change their purchasing habits for rice. These constructs will be utilized in the comparative study conducted between the US and Belgium consumers.

Chapter Three: Methodology

3.1 Introduction

This chapter discusses the survey design and questionnaire that was presented to a random sample of respondents in Belgium at the University of Ghent and at the University of Arkansas in the United States. The design of the sample frame is discussed first, and then a rationale why this particular survey methodology was chosen is presented. The questionnaire and the reason for the inclusion of specific questions are discussed. The next section presents the procedures utilized for collecting survey data. The final section of the chapter describes the analytical framework used to evaluate the responses. The email communications which were sent to potential respondents in both the United States and in Belgium can be found in Appendix A. Appendix B provides the actual survey.

A sample of potential respondents from the University of Arkansas was randomly selected from an email list provided by the University's Information Technology Services. The sample was evenly split between faculty and staff (3,000) and students (3,000). In order to sufficiently test all hypotheses our goal was to generate approximately 600 completed surveys. Anticipating a likely 10% response rate this meant that we had to distribute the survey to at least 6,000 total potential respondents, which easily ruled out other less feasible alternatives to collecting responses such as telephone interviews or mailing surveys. Respondents were then sent an email with a link to one of three different surveys. In order to encourage responses, a $50 prepaid Visa gift card was promised for three randomly selected respondents. Due to privacy policy, potential respondents at the University of Ghent had to be selected in a different manner. At the University of Ghent,

an email list of faculty, staff, and students could not be furnished from their IT department thus respondents were generated informally from classmates, professors, and their friends and acquaintances. Respondents from the University of Ghent were also encouraged to complete the survey with the same chance of winning one of three randomly selected $50 prepaid Visa gift cards.

3.2 Rationale for Survey Tool Selection

To collect a complete set of data from consumers of rice with as broad of a range of demographic factors as possible, a survey tool assessing preferences, perceived consumer effectiveness (PCE), subjective knowledge (SK) and Objective knowledge (OK) was needed. It quickly became evident that this would require a relatively large number of questions. As a result the idea of doing in-store surveys was rejected as response bias of shoppers with limited time was anticipated. The only other feasible options left were phone interviews, focus groups, mail, or internet surveys. Phone interviews were eliminated due to lack of sampling frames, time constraints, and financing as international calls would have been too costly. Mailing surveys was also ruled out due to postage costs. This left the most cost advantageous option which was using the internet. Using the internet to email 6,000 randomly selected respondents at the University of Arkansas saved time and money. Email addresses were provided by the University of Arkansas' Information Technology Services at no cost. Also, software support for designing the survey questionnaire in a online framework was available in the department of Agricultural Economics and Agribusiness. This option allowed the survey to be distributed internationally at the University of Ghent with marginal effort that included having the

survey translated into Flemish, the native language for respondents in Belgium. This was done gratis by a graduate student (Valeri Natanelov) at the University of Ghent. As a result of the informal development of the sample frame only 90 responses were generated from the email solicitations sent to friends and acquaintances in Belgium compared to the 564 responses that were received from the University of Arkansas mass email solicitation. It is thought that a response bias could potentially exist for any of the above alternative survey methods as individuals with stronger opinions about the environment may be more likely to respond than others. To counter that, the prepaid gift card was utilized to increase the response rate.

To collect enough data to analyze the effects of consumers' willingness to pay (WTP) and willingness to consume (WTC) rice based on its carbon footprint (CF), the survey was divided into three different versions varying only by the hypothetical amount of willingness to consume (WTC) produced by the rice "typically' purchased or consumed by the respondent. The first survey distributed had changes in reduction of CF of 20%, the second version had a change of 40%, and the third a change of 60%. In Arkansas, each version of the survey (20%, 40%, and 60%) was sent to 2,000 emails.

3.3 Survey Tool Description and Rationale

The three surveys that were distributed were designed with three main objectives in mind: i) obtain a PCE score for all respondents; ii) assess objective and subjective knowledge levels of respondents as it pertains to climate change; and iii) identify each respondent's purchasing and consumption habits of rice (types of rice, production methods, organic vs. non-organic, package sizes and importance of various product attributes such as

carbon footprint, taste, and appearance etc.). Questions used to measure WTP and WTC were asked along with various questions about demographic information such as education, income and household size among others to fully understand their impacts on the given responses. Appendix B contains a complete survey while a discussion of the rationale for each question is given below.

3.3.1 Purchase/Consumption Characteristics

The first two questions were asked to gain an understanding about each respondent's role in purchasing or consuming rice for their household, while questions 3-11 were asked to gain an understanding about the purchase/consumption habits of respondents with regard to rice.

The first question asked respondents if they purchased 50% or more of the groceries for their household, and was asked to determine whether the respondent was the main decision maker with regard to purchasing of groceries. It is reasoned that primary shoppers may place more weight on their purchase/consumption decision than those that are not responsible for purchasing the majority of the groceries for their households. The second question asked if respondents purchased rice. It was not assumed that every respondent purchased rice and therefore this question served to help separate those respondents that don't typically purchase rice.

The third question asked respondents what percentage of the time they ate home-cooked rice. This question required respondents fill in the blank with a number ranging from 1-10 to represent an approximate percentage they consume rice at home, and was

included to determine which respondents were eating the majority of their rice at home. This is deemed important because a respondent may be the primary shopper and may purchase rice but rarely eat it at home. If a respondent consumes most of their rice away from home they are shifting environmental decisions to another purchaser (restaurant or other purchaser).

The fourth question was presented to respondents to gain an understanding of the characteristics of the rice they purchased/consumed. Typical purchasing characteristics could potentially exhibit significant correlations with other survey questions. For example, a consumer which typically purchases organic rice may be willing to change their purchasing or consumption in favor of a carbon label.

The fifth question asked respondents how many people in their household consume rice they purchase. It was important to include in the survey so that it would be possible to calculate per capita consumption. Also, shoppers that are purchasing for larger households may not be willing to pay a premium for a carbon label as they may be more sensitive to incremental price increases.

Question six asked respondents to indicate the number of meals they consumed rice in the previous two week period. This question helped to provide an idea of how often rice is consumed by each respondent and his or her corresponding household. This information was deemed to be important as it may have an impact on how willing each respondent may be to pay a premium for a carbon label on the rice they typically purchase.

Question seven asked respondents to list the importance of various product attributes of rice from 1-7; with one being not important at all and 7 being extremely important. This question gives insight into what factors are most important in the decision making process for each respondent. Respondents that rated carbon footprint and production method may be willing to pay more for a carbon label as they may be more sensitive to environmental issues. Furthermore, respondents placing more importance on other factors such as price may be less willing to pay a premium for a carbon label on rice they typically purchase/consume.

Question eight was included in the survey to generate a Perceived Consumer Effectiveness (PCE) score for each respondent. The construct mixes both positive and negative statements and asks respondents to rank their level of agreement with each statement. Responses were ranked from 1-5, with 1 being very low to 5 being high. PCE scores are discussed in the literature review (chapter 2) and it is commonly used to associate environmental awareness with consumer choice. To derive a proper score for this construct, the responses to this question had to be coded as shown in appendix B, with positive and negative statements reversing numerical order.

Question nine presented respondents with three different sets of questions measuring their opinions and knowledge about climate change. The opinion statements were included to gain an understanding of each respondent's level of belief concerning climate change. As discussed in the literature, subjective knowledge has been known to play an important role in decision making. Respondents were also asked to provide their level of objective knowledge concerning climate change. Aside from asking respondents

to simply provide a “True,” “False,” or “Don’t Know” response, they were asked to rank their level of certainty regarding their answers so that a level of confidence could be gained from their responses. The third set of questions asked respondents to indicate how much they believed they knew about climate change. This is a measure of subjective knowledge and is also thought to have an important role in consumer decisions. It is hypothesized that the more a consumer believes he or she knows about climate change, the more likely they are to place a value on decisions which affect it. For instance, if a consumer believes they know a lot about climate change they may be more willing to place a premium on a carbon label. Scores for subjective knowledge range from 3-15 with higher scores expected to correlate with a willingness to place a premium on carbon labels or at the very least a reduction in CF values.

Before collecting willingness to pay (WTP) information from respondents, the information below about what a typical carbon label is and what it might look like were presented.

TESCO is a large food retailer in the United Kingdom and is currently carbon labeling their products through the Carbon Trust. Below is one example of what a carbon label looks like.

The label to the left is an example of what a carbon footprint label might look like. It indicates how much greenhouse gas converted to a carbon equivalent is emitted into the atmosphere for the production of a given product such as rice.

Question ten required respondents to indicate the maximum percent more they would pay for a carbon label on rice. The main focus of this question was to ascertain an upper limit to the premium that each respondent attached to the value of a carbon label. Question eleven had four parts designed to discover how respondents would value an increase or decrease in Carbon Footprints. They were asked if they would change the amounts of rice they would purchase or consume based on an increase or decrease in the carbon footprint indicted on the label. This is the question where the survey differed. Respondents in Arkansas and Belgium were given one of three different surveys that differed by the amount of increase/decrease in carbon footprint of 20, 40, or 60 percent. Within Arkansas, 36%, 38.6%, and 25.4% of respondents were presented with 20%, 40% and 60% questions respectively. In Belgium, 40%, 34.4%, and 25.6% of respondents were presented with 20%, 40% and 60% questions respectively. This question provided insight into whether or not respondents would be willing to pay or consume what percent more or less for carbon labels on their typical rice purchases.

Question twelve asked respondents to reveal their gender. Gender was deemed important because it was hypothesized that females place a higher value on the

environment than do males and thus may be willing to pay a premium for a carbon label. Question thirteen asked respondents to reveal their age by selecting the appropriate age group. Age groups were taken to gain insight into whether or not age plays a role in determining whether or not respondents placed a value on carbon labels.

Question fourteen asked respondents to indicate their appropriate race. Race categories were also taken from the census questionnaire to gain insight into whether or not there are any significant relationships between it and any of the other survey questions. Question fifteen asked respondents to indicate the appropriate level of educational attainment. It is believed that education may play a role in respondents PCE, SK or environmental belief scores and subsequently their willingness to pay or consume in favor of a carbon label. This question was derived from the census questionnaire (US Census Bureau).

Question sixteen asked respondents to indicate their level of household income. This question was used to determine whether or not household income plays a role in respondents' willingness to pay a premium for carbon labels. It is hypothesized that the more disposable income an individual has the more likely that person will be willing to pay for a carbon label.

Question number seventeen asked respondents to indicate the number of persons living in their respective household. This question was included to determine the per capita consumption of rice in the respondents' household.

3.4 Data Collection Procedure

Questionnaires were simultaneously sent to students, faculty and staff at the Universities of Arkansas in the United States and Ghent in Belgium on **02/07/2011.** The initial email was sent out in batches of 200 at a time until all 6,000 emails were sent to respondents at the University of Arkansas. At the same time, about 20 emails were sent to classmates, faculty and staff at the University of Ghent in Belgium. Within two weeks of the initial email, 387 responses from the University of Arkansas had been received. This translates to a 6.45% response rate. Since only friends and colleagues were sent an email asking for responses no reminder emails were sent to Belgian participants, however, to the emails that had not yet generated a response from the University of Arkansas, a second reminder email was sent out. Collection of responses ended on the first of March, 2011. At that point, there were a total of 564 responses from the University of Arkansas in the U.S. and 90 from the University of Ghent in Belgium. This represents a 9.4% response rate from the University of Arkansas. Since there was no sampling frame a response rate could not be calculated for respondents in Belgium.

3.5 Statistical Analysis

Survey data was administered to respondents using SNAP software[5] and the data was statistically analyzed using SPSS v19[6]. The first step in analyzing survey data

[5] SNAP survey software manages survey research by designing, publishing, collecting data, and analyzing survey data. SNAP 9 is the current release of the software and is available free to University employees.

[6] SPSS (Statistical Software Package for the Social Sciences) by IBM is used by market researchers, health researchers, survey companies, government, education researchers and others to manipulate and analyze data. Version 19 was released in August, 2010.

involved generating frequency analysis for survey questions to provide a general understanding of how respondents answered the survey. After frequency analyses were run, mean responses were compared between groups of respondents to discover where significant differences existed. Pearson Chi Square tests were calculated to determine the level of significance between responses. For this study, anything above a .05 level of significance was rejected. To further explore statistically significant differences in responses, post hoc analysis was done in SAS using an lsmeans function.

Chapter Four: Results

4.1 Introduction

This chapter presents an analysis of the data collected from respondents in the US and in Belgium. It provides detailed information useful for understanding the value of carbon labeling for rice. This chapter presents information about the response rate and demographic characteristics of respondents, provides a discussion that compares groups of respondents, and reports the results of estimated relationships among knowledge, PCE, and environmental belief constructs.

4.2 Response Rate

A total of 564 responses were valid from the initial 6,000 emails sent to students, faculty and staff at the University of Arkansas and 90 valid responses were collected from the University of Ghent in Belgium. Since a university population demographic was chosen to participate in the survey, results may differ from a more general population. Table 4.1 below shows the distribution of age, income, education, and gender of survey respondents from the University of Arkansas and the University of Ghent in Belgium.

Table 4.1 Characteristics of respondents from the University of Arkansas in the United States and the University of Ghent in Belgium.

	Arkansas	**Belgium**
Total Respondents	564	90
Age group		
% of obs. (age group <25)	57.5	31.5
% of obs. (age group 25-34)	21.7	31.5
% of obs. (age group 35-44)	7.7	15.7
% of obs. (age group 45-54)	7.9	11.2
% of obs. (age group 55-64)	4.1	7.9
% of obs. (age 65+)	1.1	2.2
Average Household Size	2.51	2.82
Household Income		
%of obs. (<$10,000)	32.1	18.1
%of obs. ($10K-$24,999)	21.2	16.9
% of obs. ($25K-$44,999)	15.4	39.8
% of obs. ($45K-$74,999)	14.0	18.1
% of obs. ($75K-$149,999)	12.6	6.0
% of obs. ($150K +)	4.7	1.2
Education Level		
% of obs. (HS grad or GED)	16.4	9.1
% of obs. (Some Post H.S. training)	23.6	1.1
%of obs. (Bachelor's degree)	32.3	25.0
% of obs. (Graduate or Professional degree)	27.7	64.8
Gender		
Male	42.6	50.6
Female	57.4	49.4
Race		
% of obs. (American Indian)	.7	0
% of obs. (Asian)	5.1	1.1
% of obs. (Black or of African descent)	3.7	0
% of obs. (Hispanic/latino/or of Spanish origin)	2.5	3.3
% of obs. (Native Hawiian or other Pacific islander)	0	0
% of obs. (White)	79.6	92.2

From table 4.1 above, it is clear the majority of respondents are younger, from households with fewer than three people and which have a household income of approximately $45,000 or less. Respondents from Belgium are approximately evenly split

between male and female. In Arkansas, slightly more females took part in the survey than did males. Education level is the only demographic that noticeably differs between respondents in Belgium and Arkansas. In Belgium, a majority of the respondents have a graduate or professional degree while only 27.75% have the same or comparable educational attainment in Arkansas. To put the demographics from above into perspective we list some of the results from the 2010 US census for comparison. According to the US census 50.8% of the population in the US is Female, median household income is $51,914, average household size is approximately 2.59, and approximately 30.4% of Americans 25 and older hold at least a bachelors. Comparable census data for Belgium could not be located.

The first survey question asked respondents if they purchased 50% or more of the groceries for their household. A total of 86 and 554 respondents answered this question from Belgium and the US respectively. Among Belgian respondents, approximately 74.1% purchased 50% or more of the groceries for their households. Among respondents in the US, approximately 82.0% of the respondents said they purchased 50% or more of the groceries in their households. Overall, the difference between the proportion of respondents that were and were not primary grocery shoppers for their households was not significantly different between the US and Belgium. The Pearson Chi square measure was .07 which is not significant at a 95% confidence level. Table 4.2 presents survey responses about grocery and rice purchasing.

The second question asked respondents whether or not they purchased rice. In Belgium, an overwhelming majority (96.8%) of primary purchasers purchased rice while

all of the non-primary-purchasers indicated they typically do not purchase rice. As for respondents in Arkansas, a similar pattern emerges with 83.6% of primary purchasers indicating they typically purchase rice and 100% of non-primary purchasers indicating they do not purchase rice.

Table 4.2: Percentage of primary purchasers which purchase rice

	% of	Purchase Rice			
Belgium:	Total	Yes	*n*	No	*n*
Primary-Purchaser	74.1%	96.8%	63	3.2%	2
Non-Primary-Purchaser	25.9%	0%	0	100%	22
Total Respondents in Belgium: 85					
Arkansas:					
Primary-Purchaser	82.0%	83.6%	377	16.4%	74
Non-Primary-Purchaser	18.0%	0%	0	100%	99
Total respondents in Arkansas: 550					

	Pearson Chi-Square:	*p*:
Belgium:	75.443	.000
Arkansas	332.356	.000

The third question asked respondents to indicate how many times the rice they ate was home cooked. Belgians on average ate home cooked rice approximately 80% of the time while US respondents only ate home cooked rice approximately 64% of the time. The differences between means were significant at the 99% confidence level. Results are presented in table 4.3 below.

Table 4.3
Question: When you eat rice, how many times out of ten is it home cooked?

		Belgium		Arkansas	
		n	**%**	***n***	**%**
Times Cooked at home:	0	1	1.2	36	6.7
	1	3	3.7	41	7.6
	2	5	6.2	46	8.5
	3	2	2.5	19	3.5
	4	0	0	12	2.2
	5	1	1.2	54	10.0
	6	2	2.5	24	4.4
	7	3	3.7	31	5.7
	8	13	16.0	54	10.0
	9	25	30.9	94	17.4
	10	26	32.1	129	23.9

Mean number of times rice cooked at home:	Belgium: 7.98	Arkansas: 6.36	*f*: 16.143	*p*: .000

The fourth question in the survey asked respondents to list details about the rice they typically bought or consumed. The characteristics analyzed include: production method (organic, non-organic), type of rice (white or brown), aromatic or non aromatic, par-boiled or non-par-boiled and short or long grain. Respondents were also asked to report on the package size of rice they typically purchased or consumed; however due to the open-ended nature of the package size question the answers were insufficient for analysis.

Respondents were asked to provide information about whether or not they purchased/consumed organic or non-organic rice. Chi Square tests showed that Belgium and Arkansas respondents did not differ in the percent of purchases that were organic versus non-organic (table 4.4). In both places, the majority of rice purchased/consumed was non-organic. It can be concluded rice purchased and consumed in Belgium and the

US are not significantly different from one another with respect to production method (organic, non-organic). Results are listed in table 4.4.

Table 4.4
Attributes of rice purchased/consumed

	% of	Do you Purchase Rice?			
Belgium:	Total	Yes	*n*	No	*n*
Organic	17.7%	15.5%	9	23.8%	5
Non-Organic	82.3%	84.5%	49	76.2%	16
Total respondents: 79					
Arkansas:					
Organic	23.5%	24.9%	93	19.7%	28
Non-Organic	76.5%	75.1%	280	80.3%	114
Total respondents: 515					

	Pearson Chi-Square:	*p*:
Belgium:	.727	.506
Arkansas:	1.556	.245

Consumption of white vs. brown rice was the next question respondents reported. In Belgium and Arkansas, the majority of respondents indicated they purchased/consumed white rice. Table 4.5 shows that there is not a significant difference between those who do and do not purchase rice with regards to consumption of white or brown rice within Belgium, however the chi square measure for respondents in the US is highly significant.

Table 4.5
Attributes of rice purchased/consumed

	% of	Do you Purchase Rice?			
Belgium:	Total	Yes	*n*	No	*n*
White	80%	81.4%	48	76.2%	16
Brown	20%	18.6%	11	23.8%	5
Total respondents: 80					
Arkansas:					
White	61.9%	57.7%	210	72.3%	107
Brown	38.1%	42.3%	154	27.7%	41
Total respondents: 512					

	Pearson Chi-Square:	*p*:
Belgium:	.258	.751
Arkansas:	9.518	.003

Whether or not consumers typically purchase/consume aromatic or non-aromatic was another point of interest in determining typical consumption patterns between US and Belgian respondents. Table 4.6 shows that the majority of respondents in Belgium and Arkansas purchase/consume non-aromatic rice. In Belgium, there is a significant difference between respondents which purchase and consume aromatic and non-aromatic rice, however, among respondents in Arkansas the difference between groups is not significantly different.

Table 4.6
Attributes of rice purchased/consumed

	% of	Do you Purchase Rice?			
Belgium:	Total	Yes	*n*	No	*n*
Aromatic	32.9%	42.1%	24	5.3%	1
Non-Aromatic	67.1%	57.9%	33	94.7%	18
Total respondents: 76					
Arkansas:					
Aromatic	39.8%	38.8%	99	43%	34
Non-Aromatic	60.2%	61.2%	156	57%	45
Total respondents: 334					

	Pearson Chi-Square:	*p*:
Belgium:	8.76	.004
Arkansas:	.447	.513

Table 4.7 shows that the majority of respondents in Belgium and Arkansas purchase/consume long grain rice. The chi square measure of differences between purchase/consumption patterns of short and long grain rice between the US and Belgium is significant. Therefore we can say that significantly more Belgian respondents purchase/consume long grain rice than respondents in Arkansas. Interestingly, respondents in Arkansas that do not typically purchase rice were evenly split between consuming short and long-grain rice while the majority of those that purchase rice indicated they typically purchase long grain rice.

Table 4.7
Attributes of rice purchased/consumed

	% of	Do you Purchase Rice?			
Belgium:	Total	Yes	*n*	No	*n*
Short-Grain	18.2%	17.9%	10	19%	4
Long-Grain	81.8%	82.1%	46	81%	17
Total respondents: 77					
Arkansas:					
Short-Grain	40.3%	36.6%	107	50%	54
Long-Grain	59.7%	63.4%	185	50%	54
Total respondents: 400					

	Pearson Chi-Square:	*p*:
Belgium:	.015	1.00
Arkansas:	5.848	.021

4.3 Mean Comparisons

In order to assess how many people in each household consume rice, we asked each respondent to report the total number of people in their household that consumed rice which they purchased. In Belgium, the average number of people per household consuming rice that was purchased is 2.47, while the average for US respondents is only slightly less at 2.21 people per household. Table 4.2.1 shows that there is not a significant difference between the number of people per household consuming rice in Arkansas and Belgium.

Table 4.2.1 Mean number of people per household consuming rice

Including yourself how many	Country	Mean	*f:*	*p:*
People in your household	Belgium	2.47		
Consume rice?	USA	2.21	2.375	.124

All respondents were asked to report how many meals they consumed rice in the last 14 days. Table 4.2.2 shows Belgian respondents reported that they consumed rice on average 3.14 times during the last 14 days. Respondents in the US indicated that they consumed rice on an average of 3.58 times during the last 14 days. Again, there is not a significant difference between the proportion of meals in which rice is consumed in the home between respondents in Arkansas and Belgium.

Table 4.2.2 Mean number of meals consumed per two week period

During the last 14 days	Country	Mean	*f:*	*p*
How many meals did	Belgium	3.14		
You consume rice?	USA	3.58	.796	.372

After respondents were asked about the frequency of rice consumption they were asked to rate the importance of nine product attributes of rice on a scale from 1 to 7; with one being not important at all and seven being extremely important. Table 4.2.3.a shows there are significant differences between country and attributes. Table 4.2.3.d illustrates where the differences exist between individual attribute ratings within each location (Arkansas, Belgium). The letters indicate where the differences exist between individual attributes. Within Arkansas, the only attributes that are not significantly different from one another are brand and production method. The two highest ranked attributes of rice in both locations are taste and type of rice. Moreover, taste and type of rice were the only attributes that were significantly different from all other attribute ratings for respondents in Belgium. Carbon footprint received the lowest overall rating of importance among respondents in Arkansas and Belgium. Brand was rated the second least important attribute among respondents in Arkansas and Belgium.

Table 4.2.3.a: Analysis of Variance

Source	DF	Sum of Squares	Mean Square	Error DF	F Value	Pr > F
Country	1	43.110337	43.110337	651.72	5.83	0.0160
Attribute	8	2362.2523	295.281544	5126	120.88	<.0001
Attribute* Country	8	175.69677	21.962096	5126	8.99	<.0001
Person (Country)	648	4819.5762	7.437618	5126	3.04	<.0001
Residual	5126	12522	2.442793	5126		

Table 4.2.3.b: Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr>F
Country	1	649	6.02	0.0144
Attribute	8	5131	120.88	<.0001
Attribute*Country	8	5131	9.11	<.0001

Table 4.2.3.c: Fit Statistics

-2 Res Log Likelihood	22361.2
AIC (smaller is better)	22365.2
AICC (smaller is better)	22365.2
BIC (smaller is better)	22374.1

Table 4.2.3.d: Mean Score: Differences between Attribute Rating of Importance, Arkansas & Belgium (Purchasers)

	Arkansas		Belgium
Attribute	Mean rating:	Attribute	Mean rating:
Taste	5.97 a	Taste	5.79 a
Type of Rice	5.63 b	Prod. Mthd.	4.96 b, e, g, h, i
Price	5.13 c	Type of Rice	4.33 c
Appearance	4.67 d	Price	4.10 d, e, f
Pkg. Size	4.32 e	Appearance	3.65 e, b, d, g, h
Origin	3.52 f	Pkg. Size	3.48 f, d
Prod. Mthd.	3.22 g, h	Origin	3.40 g, b, e. h, i
Brand	3.13 g, h	Brand	3.37 h, b, e, g, i
CF	2.90 i	CF	3.18 i, b, g, h

*Letters are used to indicate statistical equivalence of importance among attributes

After respondents were asked to rank the level of various product attributes of rice they were then shown four different statements and asked to indicate to what extent they agreed with each statement. Answer choices for each of the four statements ranged from 1 to five; with one being "strongly disagree" and 5 being "strongly agree." After responding to the following four questions, A PCE score was calculated for each respondent. Question eight on the survey which is illustrated in appendix B shows how each statement below was scored. After each statement received an individual score, they were aggregated to arrive at a PCE score for each respondent with the highest possible score being 20. A higher PCE score implies that the respondent believes that their individual behavior affects the environment. Subjective knowledge and environmental belief scores were generated in the same way[7]. The higher subjective knowledge score implies that the respondent believes they know more about climate change and the higher environmental

[7] Objective knowledge questions were also included, but pre-testing failed to identify the confusion associated with the question design. This resulted in an inadequate response and ultimately an inability to utilize the responses received from the objective knowledge questions.

belief score implies that the respondent more strongly believes in the existence of climate change.

The PCE statements are:

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

The Subjective knowledge statements are:

1. My friends consider me an expert when talking about climate change.
2. I am very well aware of what climate change is or means.
3. As compared to another person my age, I believe I know a lot about climate change.

The Environmental belief statements are:

1. I do not believe in climate change.
2. Climate change is accelerated by human influence.
3. Climate Change is not affected by changes in green house gas levels in the atmosphere

Table 4.2.4a compares mean PCE, Enviro, and SK scores for respondents by location, gender, education, income, and age. Table 4.2.4b through 4.2.4e; illustrate the results of tukeys post-hoc test to show where significant differences exist between groups of means. Mean environmental belief scores were the only construct measure that exhibited significant differences between respondents in Arkansas and Belgium. Belgian respondents are more likely to believe in climate change than the Arkansas counterparts. Gender exhibited significant differences in mean PCE and SK values with females having

a higher reported mean PCE score and males having higher reported mean SK values. Mean Enviro scores were not significantly different between males and females. Respondents were asked to report the highest level of education they had attained and mean PCE scores were significantly higher for higher levels of educational attainment.

Table 4.2.4.b shows that respondents with a graduate or professional degree have significantly different PCE scores than do their counterparts with only a high school education. Respondents were asked to report their level of household income so that comparisons could be made between it and other survey questions. Mean Enviro scores were the only construct that exhibited significant differences among levels of household income. Table 4.4.4.c illustrates that environmental belief scores significantly differ between groups earning between $75k-$149k and the group that earns less than $10k. Age was compared across the three constructs and significant differences existed between it and Enviro and SK scores. Table 4.2.4.d shows that significant differences between age and environmental belief scores exist between respondents younger than 25 years

Table 4.2.4.a: Mean PCE, Enviro, and SK Scores compared across location, gender, education, income, and age (Arkansas and Belgium combined)

	PCE	*n*	*f*	Enviro	*n*	*f*	SK	*n*	*f*
Arkansas	15.92	553		11.81	86		8.38	88	
Belgium	16.18	88	.786	12.88	555	14.421***	8.72	555	1.160
Male	15.49	267		11.80	271		9.31	270	
Female	16.34	349	17.124***	12.10	345	2.302	7.73	349	53.927***
H.S.	15.29	100		11.61	99		8.12	99	
Post H.S.	15.96	129		11.58	132		8.11	131	
Bachelors	15.93	199		11.92	201		8.30	200	
Grad or Pro	16.27	211	3.504**	12.38	207	3.794	8.82	211	2.323
<10k	15.76	191		11.58	193		8.17	189	
10k-24,999	15.88	130		12.10	130		8.60	132	
25k-44,999	15.90	117		12.17	115		8.82	119	
45k-74,999	16.05	92		12.10	91		8.21	92	
75k-149,999	16.41	74		12.55	75		8.38	74	
150k or more	16.19	27	.783	11.19	27	2.659**	8.19	27	1.056
<25years	15.74	336		11.61	339		8.28	334	
25-34	15.91	145		12.44	143		8.86	145	
35-44	16.54	56		12.53	55		8.00	56	
45-54	16.50	50		11.98	51		7.92	53	
55-64	15.97	29		12.11	28		8.83	29	
65+	17.42	7	1.999	12.71	7	3.226***	10.38	8	2.447**

**$p \leq .05$; ***$p \leq .01$

Table 4.2.4.b: Differences between means of significant factors: Education vs. PCE

(A)H.S.	A, B, C
(B)Some Post H.S.	A, B, C, D
(C)Bachelors	A, B, C, D
(D)Grad or Pro	B, C, D

Table 4.2.4.c: Differences between means of significant factors: Income vs. Enviro-belief

(A)<10k	A, B, C, D, F
(B) 10k-24,999	A, B, C, D, E, F
(C) 25k-44,999	A, B, C, D, E, F
(D) 45k-74,999	A, B, C, D, E, F
(E) 75k-149,999	B, C, D, E, F
(F) 150k or more	A, B, C, D, E, F

Table 4.2.4.d: Differences between means of significant factors: Age vs. Enviro-belief

(A)<25 years	A, C, D, E, F
(B) 25-34	B, C, D, E, F
(C) 35-44	A, B, C, D, E, F
(D) 45-54	A, B, C, D, E, F
(E) 55-64	A, B, C, D, E, F
(F) 65 +	A, B, C, D, E, F

Table 4.2.4.e: Differences between means of significant factors: Age vs. Subjective Knowledge

(A)<25 years	A, B, C, D, E, F,
(B) 25-34	A, B, C, D, E, F,
(C) 35-44	A, B, C, D, E, F,
(D) 45-54	A, B, C, D, E, F,
(E) 55-64	A, B, C, D, E, F,
(F) 65 +	A, B, C, D, E, F,

After respondents answered various attitude and knowledge questions they were then asked a series of questions about purchasing and consumption patterns which depended upon hypothetical increases or decreases in carbon footprints which were based on their reported typical purchase or consumption. Respondents were asked if they would pay more or less and consume more or less if carbon footprints increased or decreased. PCE scores of respondents, along with Subjective Knowledge (SK) Scores, and Environmental belief (Enviro) scores are compared to the following variables by: location (US, Belgium), whether or not they will pay or consume more/not more, and less/not less depending upon increase/decrease in carbon footprint.

Survey questions ten and eleven consisted of several open-ended questions which required respondents to fill in the percentage more or less they would be willing to pay or consume based on an increase or decrease of the CF on the carbon label. This open-ended question type yielded unreliable results. Aside from reporting a percentage, respondents

were also required to choose if they would pay/consume more/not more or less/not less. This answer choice yielded enough data to perform appropriate analysis. The following tables 4.2.5-4.2.8 reveal that the amount of increase/decrease of CF on the carbon label, for the most part, did not affect respondents' willingness to alter purchasing or consumption. In one instance, a significant difference was found between the reported level of CF on the carbon label and Belgian respondents' willingness to consume more if the carbon foot print decreased. Table 4.2.8 reveals that the greater the change in CF reported on the label, more respondents were willing to alter their consumption in favor of a greater reduction in CF. The difference existed between respondents' willingness to alter consumption in favor of a decrease in CF at the 20% and the 60% levels.

Table 4.2.5: If Carbon Footprint Increases (20%; 40%; 60% for both Arkansas and Belgium combined), Will Respondent Pay Less or Not Less?*

Location	CF Amount	NL%:	Less%:	Total:
Belgium	20%	65.7	34.3	35
	40%	44.8	55.2	29
	60%	63.6	36.4	22
	Total:	58.1	41.9	86
	CF Amount:	NL%:	Less%:	Total:
Arkansas:	20%	56.8	43.2	190
	40%	49.3	50.7	209
	60%	48.9	51.1	137
	Total:	51.9%	48.1%	536

Location:	Pearson Chi Square:	*p:*
Belgium	3.210	.201
Arkansas	2.924	.232

**Not Less= same amount or more*

Table 4.2.6: If Carbon Footprint Decreases (20%; 40%; 60% for both Arkansas and Belgium combined), Will Respondent Pay More or Not More?*

Location	CF Amount	NM %:	More %:	Total:
Belgium	20%	58.8	41.2	34
	40%	34.5	65.5	29
	60%	45.0	55.0	20
	Total:	47.0%	53.0%	83
	CF Amount:	NM %:	More %:	Total:
Arkansas:	20%	52.9	47.1	191
	40%	45.5	54.5	213
	60%	44.9	55.1	138
	Total:	48.0%	52.0%	542

Location:	Pearson Chi Square:	*p:*
Belgium	3.764	.152
Arkansas	2.860	.239

**Not More=same amount or less*

Table 4.2.7: If Carbon Footprint Increases (20%; 40%; 60% for both Arkansas and Belgium combined), Will Respondents Consume Less or Not Less?*

Location	CF Amount	NL%:	Less%:	Total:
Belgium	20%	54.3	45.7	35
	40%	71.4	28.6	28
	60%	50.0	50.0	22
	Total:	58.8%	41.2%	85
	CF Amount:	NL%:	Less%:	Total:
Arkansas:	20%	69.5	30.5	190
	40%	60.5	39.5	210
	60%	61.6	38.4	138
	Total:	63.9%	36.1%	538

Location:	Pearson Chi Square:	*p:*
Belgium	2.841	.242
Arkansas	3.946	.139

*Not Less= same amount or more

Table 4.2.8: If Carbon Footprint Decreases (20%; 40%; 60% for both Arkansas and Belgium combined), Will Respondent Consume More or Not More?*

Location	CF Amount		NM %:	More %:	Total:
Belgium	20%	A	83.3	16.7	36
	40%	A B	78.6	21.4	28
	60%	B	50.0	50.0	22
		Total:	73.3%	26.7%	86
	CF Amount:		NM %:	More %:	Total:
Arkansas:	20%		72.1	27.9	190
	40%		67.0	33.0	209
	60%		72.1	27.9	136
		Total:	70.1%	29.9%	535

Location:	Pearson Chi Square:	*p:*
Belgium	8.343	.015
Arkansas	1.580	.454

**Not More=same amount or less*

After mean PCE, Enviro, and SK scores were compared across all demographic factors they were compared against respondents' willingness to alter purchasing and consumption patterns based on carbon labels on rice. Table 4.2.9 shows the mean comparison between PCE, Enviro, and SK values and whether or not respondents indicated they would be willing to consume less or not less if the carbon footprint on the carbon label increased. In Arkansas, respondents that chose to consume less for a carbon label if it increased had significantly higher average Enviro, and SK scores than did those that chose to consume either the same amount or more (not less). Associated p-values are .000 which is significant at the 99% confidence level. Therefore, we can conclude that for respondents in Arkansas that are willing to consume less for a carbon label if the reported level of carbon increases have significantly higher Enviro and SK values than do respondents that indicated they would not consume less (same amount or more). Surprisingly mean PCE values for respondents in Arkansas that chose to consume less if carbon foot prints on rice

increased however were significantly lower than those that chose to either consume the same amount or more (not less). The differences between mean Enviro scores of respondents in Belgium did not differ significantly between those that were willing to consume less and those that were not willing to consume less (same amount or more). Unexpectedly and similar with the Arkansas sample, PCE scores for Belgian respondents were lower for those willing to consume less (15.66) than those not willing to consume less (16.82).

Table 4.2.9: Comparison of Means: PCE, Enviro, & SK: If carbon Footprint increases will respondents consume less or not less (all surveys combined 20%; 40%; 60%)

Belgium:	PCE	*n*	*f*	Enviro	*n*	*f*	SK	*n*	*f*
Less	15.66	34		13.15	33		9.73	34	
Not Less	16.82	50	6.644**	12.75	49	.682	8.10	50	8.615***
Arkansas:									
Less	15.38	191		12.65	190		8.92	191	
Not Less	16.94	340	48.441***	11.38	342	35.039***	7.97	341	15.188***

**$p \leq .05$; ***$p \leq .01$

Table 4.2.10 shows mean PCE, Enviro, and SK scores for respondents that were willing to pay less or not less (same amount or more) for respondents in Arkansas and Belgium. Respondents in Arkansas who were willing to pay less if the carbon footprint increased (same amount or more) are associated with significantly higher mean PCE, Enviro, and SK scores. This however was not the case for respondents in Belgium with only a higher mean SK value being significantly different between those willing to pay less for a higher carbon footprint.

Table 4.2.10: Comparison of Means: PCE; Enviro; SK: If carbon Footprint increases will respondents pay less not less (all surveys combined 20%;40%;60%)

Belgium:	PCE	*n*	*f*	Enviro	*n*	*f*	SK	*n*	*f*
Less	15.91	36		13.32	34		9.63	36	
Not Less	16.20	49	.388	12.53	49	2.707	8.14	49	7.215***
Arkansas:									
Less	16.74	255		12.66	254		8.70	255	
Not Less	15.19	275	51.560***	11.06	276	62.853***	8.01	275	8.383***

**$p \leq .05$; ***$p \leq .01$

Table 4.2.11 shows mean PCE, Enviro, and SK values for respondents willing to consume more or not more (same amount or less) if the carbon label on rice decreases. Respondents in Arkansas willing to consume more rice if the carbon label decreased exhibited significantly higher mean PCE and Enviro scores. SK scores were not significantly different for the same respondents in Arkansas. Mean PCE values for respondents in Belgium were the only construct which showed significant differences where those with a higher PCE score were more willing to consume more if the carbon footprint decreases.

Table 4.2.11: Comparison of Means: PCE; Enviro; SK: If carbon Footprint decreases will respondents consume more or not more (all surveys combined 20%;40%;60%)

Belgium	PCE	*n*	*f*	Enviro	*n*	*f*	SK	*n*	*f*
More	17.17	23		13.65	23		9.47	23	
Not More	15.79	62	7.804***	12.66	60	3.689	8.53	62	2.229
Arkansas:									
More	16.67	155		12.47	159		8.66	156	
Not More	15.63	373	18.118***	11.54	370	16.438***	8.16	373	3.635

**$p \leq .05$; ***$p \leq .01$

Table 4.2.12 shows mean PCE, Enviro, and SK values for respondents in Arkansas and Belgium that were willing to pay more or not more (same amount or less) if the carbon label on rice decreased. Mean PCE, Enviro, and SK values were significantly higher for

the group of respondents in Arkansas that were willing to pay more if the carbon label decreased. For respondents in Belgium, none of the constructs exhibited significant differences.

Table 4.2.12: Comparison of Means: PCE; Enviro; SK: If carbon Footprint decreases will respondents pay more or not more (all surveys combined 20%;40%;60%).

Belgium:	PCE	*n*	*f*	Enviro	*n*	*f*	SK	*n*	*f*
More	16.09	44		13.18	43		8.90	44	
Not More	16.07	39	.001	12.55	38	1.747	8.92	38	.000
Arkansas:									
More	16.75	278		12.60	279		8.82	278	
Not More	15.08	257	61.652***	11.04	257	59.996***	7.84	258	16.820***

**$p \leq .05$; ***$p \leq .01$

4.4 Hypothesis Testing

After all mean comparisons were made it is revealed that the first null hypothesis (respondent's country of residence) could not be rejected. There were no significant differences between respondents' place of residence (Belgium, Arkansas) and their willingness to alter consumption or purchasing decisions based on a carbon footprint. The second null hypothesis states that responses to carbon labels on rice are not affected by respondents' PCE scores. This null hypothesis was tested and rejected for respondents in Arkansas and in some instances in Belgium. Table 4.2.6 shows that PCE does affect responses to carbon labels on rice when respondents are asked if they will alter their consumption if carbon footprints increase. Interesting and unexpected, PCE scores for respondents willing to consume less if carbon footprints increased in Belgium and Arkansas were significantly lower than those that were not willing to consume less (same amount or more). Although there is a significant difference between the two groups, it was assumed that PCE scores would have been higher for the group willing to consume less. In

all other instances, respondents in Arkansas exhibited significantly higher PCE scores for those willing to consume more, pay more, and pay less vs. those that were not willing to consume more, pay more, and pay less. Respondents in Belgium only exhibited significant differences in two of the four questions which measured respondents' willingness to change purchasing and consumption based on carbon labels (tables 4.2.10 & 4.2.12). The third null hypothesis (responses to carbon labels are not affected by OK scores) could neither be accepted nor rejected because responses to the OK construct were insufficient.

The fourth null hypothesis states that responses to carbon labels on rice are not affected by respondents' SK scores. This null hypothesis was rejected for three of the consumption/purchase questions by respondents in Arkansas and for two among respondents in Belgium. Table 4.2.6 shows that SK does affect responses to carbon labels on rice when respondents are asked if they will alter their consumption if carbon footprints increase. Respondents in Belgium and Arkansas exhibited significantly higher SK scores for those willing to consume less versus those not willing to consume less (same amount or more). Table 4.2.7 shows that SK scores are significantly higher for respondents in Belgium and Arkansas that are willing to pay less if a carbon label on rice increases. Table 4.2.8 shows that there are no significant difference between respondents' SK scores among those that were willing to consume more or not more if a carbon footprint decreases for respondents in Arkansas and Belgium. Thus, the null hypothesis cannot be rejected in this instance. Table 4.2.9 shows that the null hypothesis can be rejected for respondents in Arkansas but not for respondents in Belgium.

The fifth null hypothesis (responses to carbon labels on rice are not affected by respondents' beliefs about climate change) was rejected for respondents in Arkansas, however, it was not rejected for respondents in Belgium. For respondents in Arkansas, environmental belief does significantly affect their consumption and purchasing decisions based on carbon labels on rice. Tables 4.12-4.15, show that respondents in Arkansas willing to consume less/pay less when carbon labels increase and consume more/pay more when carbon labels decrease exhibit significantly higher mean environmental belief scores. Respondents in Belgium do not exhibit significant differences and thus we cannot reject the null hypothesis for those respondents.

4.5 Summary

This study focuses on the effect that PCE, SK, environmental belief, and place of residence have on respondents' willingness to alter their purchasing or consumption in favor of a carbon label and footprint level on their typical rice purchases. PCE was found to have a significant impact on respondent's willingness to alter their purchases or consumption in favor of carbon labeling on rice. Straughan and Roberts (1999) indicates PCE is positively correlated with ecologically conscious consumer behavior. In this study, PCE was significantly and positively correlated with respondents in Arkansas who were willing to: pay less if carbon footprint increased, pay more if carbon footprint decreases, consume less if carbon footprint increases, and consume more if carbon footprint decreases. Among respondents in Belgium, PCE was significantly and positively correlated with respondents who were willing to: consume less if carbon footprint increases, and consume more if carbon footprint decreases.

Similar to PCE, knowledge was proven to be an important construct measuring whether or not respondents would be willing to alter their purchasing or consumption in favor of carbon labels on rice. A review of literature has revealed inconclusive results with some studies showing different findings. Maloney and Ward (1973) show that environmental knowledge and ecologically favorable consumer behavior are not significantly linked. However, another study (Vinning and Ebreo, 1990), show knowledge and ecologically favorable behavior to be significantly linked. Results in this study reveal that SK is significantly and positively correlated with respondents in Arkansas who were willing to: pay less if carbon footprint increases, pay more if carbon footprint decreases, and consume less if carbon footprint increases. Also, somewhat significant was their willingness to consume more if carbon footprint decreased. Among respondents in Belgium, SK was only significantly and positively correlated with their willingness to consume less if carbon labels increased.

Environmental belief or attitudes were found to be significantly and positively correlated with respondents in Arkansas who were willing to: pay less if carbon footprints increased, pay more if carbon footprint decreases, consume less if carbon footprint increases, and consume more if carbon footprint decreases. Among respondents in Belgium, environmental belief was not significantly correlated with any of the measures assessing their willingness to alter consumption or purchasing based on a carbon label on rice. According to Laroche et al., (2001), an individual's perception of the environment may have an impact upon his or her willingness to pay more for green products. The Arkansas sample parallels Laroche et al.'s findings (2001). Those with a higher

environmental belief score were more willing to alter their purchasing and consumption in favor of a carbon footprint on rice.

Aside from the three major constructs just discussed, demographic factors have been studied for their impacts on consumer behavior. According to Straughan & Roberts (1999), place of residence has been studied for its impact on environmental concern. Straughan and Roberts (1999) also mention previous studies which indicated that individuals living in more urban areas have a higher likelihood of possessing more favorable attitudes towards environmental issues. Compared to Arkansas, Belgium is more urban; however, respondents from Belgium did not have significantly higher PCE scores. Environmental belief scores were significantly different between locations of residence, with higher mean scores going to respondents in Belgium. This supports the theory that respondents from more urban areas tend to be more environmentally aware than respondents from more rural areas (Straughan & Roberts, 1999).

According to this research the amount of increase/decrease in CF on a carbon label had no effect on respondents' willingness to alter purchasing or consumption in favor of a carbon label. The factors which had the most effect on respondents' willingness to alter purchasing and consumption were PCE, SK, and environmental belief scores. Perhaps the amounts of CF increase/decrease presented in the survey were not enough to affect respondents' willingness to alter their purchasing or consumption. Moreover, since carbon labeling is not commonplace, respondents may not fully understand the amount of CF presented on the labels.

These findings may be useful to implement as part of a green company's marketing plan. In most cases, there were significant differences with individuals with higher PCE, Enviro score, and subjective knowledge. Providing a brief fact about environmental issues on a package and informing consumers how that particular product helps them make a difference may help green companies extract a premium for their eco-friendly or green products. Advertising with intent to educate could influence all three factors mentioned above. This study suggests that consumers do not fully understand what carbon foot-printing means. As Verbeke suggested in his study (2005), in order to solve market inefficiencies related to asymmetries in information, consumers must be willing to not only pay attention to the information but be able to process it as well. Consumers are not familiar with or educated on how to interpret the labels. Education on carbon's effects could increase an individual's perception of his or her effectiveness, his or her knowledge level, and his or her beliefs on the state of the environment. These findings suggests that to promote carbon labels, education through advertising could alter consumption and purchasing patterns.

Chapter Five: Conclusions

5.1 Introduction

Findings presented in the previous chapter indicate that the three main constructs SK, environmental belief, and PCE all have significant effects on respondents' willingness to alter purchasing and consumption in favor of rice with labels indicating decreased carbon footprints. This chapter discusses key findings and strengths and weaknesses of the research approach. Suggestions for future research are also presented.

5.2 Key Findings

- Out of 9 attributes found in table 4.2.3d, carbon label was lowest of importance for both Arkansans and Belgians. Numerous other factors outweigh carbon, such as taste, type of rice, and price.

- This study suggests that amount of increase or decrease of carbon footprint did not affect willingness to alter purchasing or consumption patterns.

- Although PCE, Enviro score, and SK all influenced the pattern of consumption and purchasing, none of them were the "perfect" predictor of behavior. In at least one case, each had "surprising" results. This study did not find one "fool proof" predictor of behavior.

-To simplify, table 5.2.1 illustrates the relationship among increasing and decreasing carbon footprints and respondents' actions as compared to their PCE, enviro, and SK scores. If carbon footprints increased, respondents in Belgium that chose to pay less had lower PCE scores than those that chose to pay more. This was unexpected and the results

were also insignificant. Respondents in Arkansas that chose to pay less had higher PCE scores than those that chose to pay more or the same amount which was expected and as the asterisks indicate the results were significant. As expected, respondents choosing to pay less for increased carbon footprints had higher Enviro and SK scores than did those that chose to pay the same amount or more. Respondents choosing to consume less with increased carbon footprints had lower than expected PCE scores than did those that chose to consume the same amount or more for respondents in Arkansas and Belgium. Enviro and SK scores moved in the expected direction for respondents in Arkansas and Belgium with higher scores for those choosing to consume less for increased carbon footprints.

PCE and Enviro scores moved in the expected direction for respondents in Arkansas and Belgium that chose to pay more and consume more if carbon foot prints decreased. SK scores generally moved in the expected direction for respondents choosing to pay and consume more if carbon footprints decreased. The only deviation from expectations occurred for respondents in Belgium that chose to pay more if carbon footprints decreased.

Table 5.2.1: Relationship between constructs and responses towards carbon footprints on rice;

		PCE		Enviro		SK	
CF +	Pay Less	- Belgium	+ *** Arkansas	+ Belgium	+*** Arkansas	+*** Belgium	+*** Arkansas
	Consume Less	-*** Belgium	-*** Arkansas	+ Belgium	+*** Arkansas	+*** Belgium	+*** Arkansas
CF -	Pay More	+ Belgium	+*** Arkansas	+ Belgium	+*** Arkansas	- Belgium	+*** Arkansas
	Consume More	+*** Belgium	+*** Arkansas	+ Belgium	+*** Arkansas	+ Belgium	+ Arkansas

5.3 Limitations

This survey had a number of limitations. The first major limitation to this study included its sampling method. To save money and time, the survey was administered via email to university contacts which provided a convenient sampling frame. The University of Arkansas Information Technology Services provided email addresses to 3,000 faculty and staff and 3,000 students which generated a sufficient response. The University of Gent in Belgium however has more strict rules for accessing email addresses even for research and was unable to provide email contacts to administer the survey among students, faculty and staff. Instead, I had to rely on personal and professional contacts at the university. This method generated a marginal response compared to the University of Arkansas, making comparisons and statistical tests difficult to rely upon. For example, in many instances p-values were often below .05 for respondents from Arkansas while p-values for respondents from Belgium were over .05. This is likely due to a very small sample size compared to that of Arkansas.

The second limitation was survey design. The questions were pretested using Dr. Wailes's research group members and administered by SNAP, online software for delivering internet based surveys. One major problem involved the question outline of objective knowledge questions. The way this question was administered confused respondents and instead of providing a true/false answer and their certainty of that answer, they often just answered one or the other and not both as intended. This yielded a response that could not be analyzed because it was impossible to determine if the answer they gave was a true/false answer or a certainty answer. Perhaps this question could have been

presented in another way that would be less confusing for the survey taker. For instance, after the true/false answer was given it would have been less confusing if the program went question by question, asking one at a time in order.

Another problem with the survey was the use of open-ended questions. In the survey, respondents were asked to provide amounts they would be willing to pay for carbon labels. Instead of giving them a range of percentages, they were allowed to type anything in the blank they desired; this resulted in an inadequate response. Because there was a percent sign next to the blank on the question, they were expected to place a whole number and not decimals. The resulting answers were often confusing, with many respondents placing fractions, decimals and whole numbers. This was hard to discern if they meant a very small percent or something else. For example, sometimes a respondent would reply with .15. Did they mean 15% or .15%? These responses could not be used because it was uncertain what their response meant.

Lastly, there could have been a better survey order. Survey questions progressed from simple non-intrusive to more personal and belief centric. The survey questions were ordered in a logical sense; however, it is possible that a better order exists which could have yielded a better response.

5.4 Suggestions for future research

Due to the limited scope of this research project, there is plenty of opportunity to expand and improve on this work by i) increasing sample size from Belgium to include a more representative sample, ii) collecting surveys from actual grocery customers, iii)

improving upon the survey questions themselves in order to elicit a more accurate response that can be better analyzed, and iv) possibly conducting in-store or online auctions to elicit a willingness to pay measure for carbon labels on rice.

First, this research project could benefit from a larger sample from Belgium. This would likely require the graduate student or perhaps his or her agent to be present to administer the survey to grocery shoppers or other contacts. This is especially true, due to the privacy restrictions at the University of Gent which restricts access to email lists.

This project was completed by administering and gathering survey data from university contacts which included faculty, staff, and students. Approaching actual shoppers in a grocery store would provide a better representative sample of actual rice purchasers. This approach could be executed by visiting grocery stores in both Belgium and the US. Perhaps providing multiple ways for the survey to be completed could yield better results. For instance, allowing customers the option to complete the survey in store, by mail, or by providing an online link to the survey for later completion.

In future research, this survey can easily be improved by learning from the initial mistakes made. For instance, any open ended questions could be altered to include better closed-ended responses. The presentation of the objective knowledge construct within the survey could be altered to elicit a better response that would allow it to be analyzed. Perhaps there exists a better way to present the survey questions that would obtain more dependable responses. Lastly, this research project could be improved by including an

auction element which may produce a dependable willingness to pay measure for carbon labeling on rice.

Bibliography

Alba, Joseph W, and J. Wesley Hutchinson. 1987. "Dimensions of Consumer Expertise." *Journal of Consumer Research* 13:411-454.

Amyx, D. A., P. F. DeJong, X Lin, G. Chakraborty, and J. L. Weiner. 1994. "Influencers of Purchase Intentions For Ecologically Safe Products: An Exploratory Study." *American Marketing Association Winter Educators' Conference.* Chicago, Il: American Marketing Association 341-347.

Baumert, Kevin A., Timothy Herzog, and Jonathan Pershing. 2005. *Navigating The Numbers: Greenhouse Gas Data And International Climate Policy.* World Resources Institute.

Carlson, Jay P., Leslie H. Vincent, David M. Hardesty, and William O. Bearden. 2008. "Objective and Subjective Knowledge Relationships: A Quantitative Analysis of Consumer Research Findings." *Journal of Consumer Research* 35:864-876.

Carlsson-Kanyama, Annika. 1998. "Climate Change and Dietary Choices-How Can Emissions of Greenhouse Gases From Food Consumption Be Reduced?" *Food Policy* 23:277-293.

Carlsson-Kanyama, Annika, and Alejandro D Gonzalez. 2009 . "Potential Contributions of FoodConsumption Patterns to Climate Change." *American Journal of Clinical Nutrition* 89:1704-1709.

Deans, David. January 18, 2008. "Carbon labels-A green mark too far?" *Climate Change Corp*.

Drake, Isobel. May 4, 2009. "Australian Food News." *Australian Food News.* http://www.ausfoodnews.com.au/2009/05/04/tesco-expands-use-of-carbon-label-on-grocery-products.html (accessed August 21, 2010).

Drichoutis, Andreas C, Panagiotis Lazaridis, and Rodolfo M Nayaga. 2006. "Consumer's Use of Nutritional Labels: A review of research studies and issues." *Academy of Marketing Science Review* 2006:1-22.

D'Souza, Clare, Mehdi Taghian, and Rajiv Khosla. 2007. "Examination of Environmental Beliefs and Its Impact On The Influence Of Price, Quality, and Demographic Characteristics With Respect To Green Purchase Intention." *Journal of Targeting, Measurement and Analysis for Marketing* 15:69-78.

Ellen, Pam S, Joshua L. Wiener, and Cathy Cobb-Walgren. 1991. "The Role of Perceived Consumer Effectiveness in Motivating Environmentally Conscious Behaviors." *Journal of Public Policy and Marketing* 10:102-117.

Ellen, Pam Scholder. 1994. "Do We Know What We Need to Know-Objective and Subjective Knowledge Effects on Pro-Ecological Behaviors." *Journal of Business Research*, 30:43-52.

FAOSTAT. *FAOSTAT Countries by commodity.* http://faostat.fao.org/site/339/default.aspx (accessed March 11, 2011).

Gitay, Habiba, Avelino Suarez, David John Dokken, and Robert T. Watson. 2002. *Climate Change and Biodiversity: IPCC Technial Paper V.* Intergovernmenatl Panel on Climate Change.

Haughton, John. May 4, 2005. "Global Warming." *Institute of Physics Publishing*.

House, Lisa, et al. 2004. "Objective and Subjective Knowledge: Impacts on Consumer Demand For Genetically Modified foods In The United States and The European Union." *The Journal of Agrobiotechnology Management & Economics* 7:113-123.

Laroche, Michel, Jasmin Bergeron, and Guido Barbaro-Forleo. 2001. "Targeting Consumers Who Are Willing To Pay More For Environmentally Friendly Products." *TheJournal of Consumer Research* 18:503-520.

Laskova, A. 2007. "Perceived Consumer Effectiveness and Environmental Concerns." *13th Asia Pacific Management Conference.* Melbourne, Australia: La Trobe University, 206-209.

Li, Changsheng, et al. 2004. "Modeling Greenhouse Gas Emissions From Rice-Based Production Systems: Sensitivity And Upscaling." *Global Biogeochemical Cycles* 18.

Loureiro, Maria L., Jill J. McCluskey, and Ron C. Mittelhammer. 2001. "Assessing Consumer Preferences For Organic, Eco-Labeled, and Regular Apples." *Journal of Agricultural and Resource Economics* 26:404-416.

Maloney, Michael P., and Michael P. Ward. 1973. "Ecology: Let's Hear From The People: An Objective Scale For The Measurement of Ecological Attitudes and Knowledge." *American Psychologist* 28:583-586.

Massey, Ray, and Ulmer Ann. August 2010. "Agriculture and Greenhouse Gas Emissions." *University of Missouri Extension.* http://extension.missouri.edu/p/g310 (accessed February 20, 2012).

McMichael, Anthony J, John W Powles, Colin D Butler, and Ricardo Uauy. October 6-12, 2007. "Energy and Health 5: Food, Livestock Production, Energy, Climate Change, and Health." *The Lancet* 370:1253-1263.

O. Boucher, J. Haigh, D. Hauglustaine, J. Haywood, G. Myhre, T. Nakajima, G.Y. Shi, S. Solomon. 2001. *Climate Change 2001: A Scientific Basis.* Cambridge, U.K.: Cambridge University Press.

Panzone, Luca A, Grischa Perino, Timothy Swanson, and Denise Leung. 2010. "Is my food basket carbon friendly? Testing for the best instrument to generate sustainable food consumption." *119th EAAE Seminar "Sustainability in the Food Sector: Rethinking the Relationship between the Agro-food System and the Natural, Social, Economic and Institutional Environments'.* Capri, Italy.

Pieniak, Zuzanna, Joris Aertsens, and Wim Verbeke. 2010. "Subjective and Objective Knowledge as Determinants of Organic Vegetables Consumption." *Food Quality and Preference* 21:581-588.

Pierrehumbert, Raymond T. Dec 9, 2004. "Warming The World." *Nature* 432:677.

Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). 2007. *IPCC Fourth Assessment Report: Climate Change 2007.* Cambridge University Press.

Sonesson, Ulf, Jennifer Davis, and Friederike Ziegler. 2009. *Food Production and Emissions of Greenhouse Gases: An Overview of the Climate Impact of Different Product Groups.* Lund, Sweden: The Swedish Institute for Food and Biotechnology.

Straughan, Robert, and James Roberts. 1999. "Environmental Segmentation Alternatives: A Look at Green Consumer Behavior in The New Millennium." *Journal of Consumer Marketing* 16:558-575.

Subak, Susan. 1999. "Global Environmental costs of beef production." *Ecological Economics* 30:79-91.

Sunstein, Cass R. 2007. *THE WORLD VS. THE UNITED STATES AND CHINA? THE COMPLEX CLIMATE CHANGE INCENTIVES of the Leading Greenhouse Gas Emiters.* UCLA review.

Takle, Eugene, and Don Hofstrand. April 2008. "Global Warming-Agriculture's Impact on Greenhouse Gas Emissions." *Ag Decision Maker*. www.extension.iastate.edu/agdmarticles/others/takap08.html (accessed February 22, 2012).

The Financial Express. June 27, 2005. http://www.financialexpress.com/news/global-demand-for-rice-to-increase-50-by-2050-says-zeigler/143891/0 (accessed February 12, 2012).

Thogersen, John. 2000. "Psychological Determinants of Paying Attention to Eco-Labels in Purchase Decisions: Model Development and Multinational Validation." *Journal of Consumer Policy* 23:285-313.

United Nations Convention on Climate Change (UNFCC). *United Nations Convention on Climate Change: Information Sheet 22.* http://unfccc.int/resource/docs/publications/infokit_2002_en.pdf (accessed March 11, 2011).

United Nations. *UNFPA.* 2009. http://www.unfpa.org/pds/trends.htm (accessed September 18, 2010).

US Census Bureau. "US Census Bureau Questionnaire." http://www.census.gov/schools/pdf/2010form_info.pdf (accessed January 7, 2011).

Verbeke, Wim. 2005. "Agriculture and the Food Industry in the Information Age. "*European Review of Agricultural Economics* 32:347-368.

Vining, J., and A. Ebreo. 1990. "What Makes A Recycler? A Comparison of Recyclers and Nonrecyclers." *Journal of Environmental Behavior* 22:55-73.

Wassmann, Reiner, Yasukazu Hosen, and Kay Sumfleth. 2009. *Agriculture and Climate Change: An Agenda for Negotiation in Copenhagen Reducing Methane Emissions from Irrigated Rice.* Brief, Washington, D.C.: International Food Policy Research Institute.

Appendix

Appendix A

Invitational E-mail

University of Gent

Hello,

My name is John Kelley and I am currently working on a research project with the University of Gent. A link has been attached to this email which will take you to a survey that has been created to investigate whether or not consumers place a value on carbon labels. This original research project is being done in cooperation with the Atlantis programme which is designed to bring a global perspective to European and US graduate education. I am asking you to be a part of my research by anonymously responding to the questions in the survey. After you have finished answering the entire survey, please forward it to your friends and colleagues. In order for me to obtain statistically significant results, I will need at least 600 respondents. As a thank you, the University has provided a chance for each respondent to receive one of three prepaid visa gift cards in the amount of $50 US dollars.

Invitational E-mail

University of Arkansas

Hello,

My name is John Kelley and I am currently working on a research project with the University of Arkansas and Gent. A link has been attached to this email which will take you to a survey that has been created to investigate whether or not consumers place a value on carbon labels. This original research project is being done in cooperation with the Atlantis programme which is designed to bring a global perspective to European and US graduate education. I am asking you to be a part of my research by anonymously responding to the questions in the survey. As a thank you, the University has provided a chance for each respondent to receive one of three prepaid visa gift cards in the amount of $50 US dollars.

Appendix B

1. Do you purchase 50% or more of the groceries for your household/yourself? □**YES** □ **NO**

2. Do you purchase rice? □Yes □No

3. When you eat rice, how many times out of ten is it home-cooked? ___

4. Please describe the typical rice you purchase/consume:

Characteristic	In each row, please circle the item purchased most
Package size	
Production Method	Organic, non-Organic
Type of rice:	White, Brown
	Aromatic, Non Aromatic
	Par Boiled, Non-Par Boiled
	Short grain, Long Grain
Price of last Purchase	____

5. Including yourself, how many people in your household consume rice that you purchase?

_____number of person(s)

6. During the last 14 days, how many meals did you consume rice? _____

7. Which of the following attributes are the most important to you when you purchase/consume rice?

Attribute	Rank (Please rank the following attributes on a continuous scale 1= not important at all; 7=extremely important)
Type of rice: White, Brown, etc..	
Brand	
Price	
Production method; organic/Non-Organic	
Package Size	
Carbon footprint	
taste	
appearance	
origin	

8. **The following statements are typically used in research questionnaires to determine your attitudes towards the environment. There are no, right or wrong, answers.**

Please indicate your level of agreement with the following statements.

(Please mark each row with your level of agreement from Strongly Disagree (SD) to Strongly Agree (SA))

	SD	D	N	A	SA
It is worthless for the individual consumer to do anything about pollution	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.	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.	5	4	3	2	1
Each consumer's behavior can have a positive effect on society by purchasing products sold by socially responsible companies.	1	2	3	4	5

9. The following statements are targeted at examining your attitudes towards climate change and your level of awareness of greenhouse gases and carbon footprints.

Please indicate your level of agreement with the following statements (SD=Strongly Disagree to SA=Strongly Agree)

Opinion Statements:	**SD**	**D**	**N**	**A**	**SA**
I do not believe in climate change.	5	4	3	2	1
Climate change is accelerated by human influence.	1	2	3	4	5
Climate Change is not affected by changes in green house gas levels in the atmosphere	5	4	3	2	1

Awareness Statements:	**True**	**False**	**Level of certainty (1-5 scale. 1=very uncertain. 5=very certain**	**Don't know**
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				
All green house gases can be converted to a carbon dioxide equivalent for carbon footprint labeling				
Growing, processing, packaging, transporting and use of food products contributes more than 10% of the earth's greenhouse gas levels in the atmosphere				
Every consumer has a carbon footprint.				
Rice production contributes to climate change through the emissions of greenhouse gases				

Questions	SD	D	N	A	SA
My friends consider me an expert when talking about climate change.	**1**	**2**	**3**	**4**	**5**
As compared to another person my age, I believe I know a lot about climate change.	**1**	**2**	**3**	**4**	**5**
I am very well aware of what climate change is or means.	**1**	**2**	**3**	**4**	**5**

10. The following questions are designed to elicit your response about what you would be willing to pay for this type of labeling.

Above you indicated your typical purchase of rice to be the following:

Characteristic	In each row, please circle the item purchased most
Package size	
Production Method	Organic/Non-Organic
Price of last Purchase	

The information to the right will propagate from question #4 from above on the online version. Do not fill this

11. Assume your typical purchase has a carbon label of 1,000 grams of CO_2 per pound of rice

a. Would you change the amount you pay for the same purchase if the label indicates that the carbon footprint has <u>increased</u> by 200 grams?

I would pay more, less, or same amount
If carbon label increased by 20% amount I would be willing to pay in percent ___

b. If the label indicates that the carbon footprint has decreased by 200 grams

I would pay more, less, or same amount
If carbon label decreased by 20%, amount I would be willing to pay in percent__

c. Would you change the amount you consume for the same purchase if the label indicates that the carbon footprint has <u>increased</u> by 200 grams?

I would consume more, less, or same amount
If carbon label increased by 20% amount I would be willing to consume (in percent) ___

d. If the label indicates that the carbon footprint has decreased by 200 grams

I would consume more, less, or same amount
If carbon label decreased by 20%, amount I would be willing to consume (in percent) ____

12. Please indicate your gender: □Male □Female

13. Please indicate your age group

□Less than 25
□25-34
□35-44
□45-54
□55-64
□65+

14. Please check all that apply regarding your race.

□American Indian or Alaskan Native
□Asian
□Black or of African Descent
□Hispanic/Latino/or of Spanish Origin
□Native Hawaiian or other Pacific Islander
□White

15. What is the highest level of education you have completed?

□Did not complete High School
□High School graduate or GED
□Some post High School training
□Bachelor's degree
□Graduate or professional degree

16. Which one of the following categories best describes you total household income before taxes in 2009?

□Less than $10,000

□$10,000-$24,999

□$25,000-$44,999

□$45,000-$74,999

□$75,000-$149,999

□$150,000 or more

17. Including myself, number of persons living in my household _____