ARE CONSUMERS WILLING TO PAY FOR GREENHOUSE GAS REDUCING RICE CULTIVARS IN ARKANSAS? FY 2011

Globally agriculture has been one of the major sources of greenhouse gases (GHG). In USA, Agriculture accounted for 7.24% of global GHG emissions. GHG emissions from agriculture have also increased significantly since 1990. Rice is a staple food for a large part of the world's human population. Rice is a labor, water, and energy intensive crop, making it one of the major sources of agricultural anthropogenic GHG emissions. Given the introduction of lower GHG varieties (LGHG), like some hybrid rice, which are higher yielding than conventional rice and use roughly the same input amounts, the American Mid-South rice industry has the opportunity to lower its GHG emission per bushel of rice ratio.

The goal of this project was to explore the possible tradeoffs in valuation by consumers for different attributes discussed above to determine if consumers are willing to pay a price premium for rice varieties with lower GHG emissions in both local and non-local markets.

The results generally showed that consumers are willing to pay a price premium for rice with lower GHG emissions (in this case the hybrid) if they were informed through a label. Results also suggest that consumers are willing to pay a higher premium if the low GHG emitting rice is sold as a "local" product with lower food miles. Perhaps the most striking and interesting finding in this study is the trade-off or equivalency in valuation shown by the subjects between "high GHG/local/low food miles" vs. "low GHG/non-local/high food miles" attributes in the rice samples. This finding is interesting since it implies that rice producers have to be mindful when targeting non-local markets, that is, while they can still benefit from selling a product with lower GHG emissions in the non-local market if their competitors are not labeling their rice products as local and/or having lower food miles, this market advantage disappears when competitors are labeling their conventional rice as local and having lower food miles.

FINAL REPORT

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FSMIP Project Final Report

August 2013

Title: Are Consumers Willing-To-Pay for Greenhouse Gas Reducing Rice Cultivars in Arkansas?

Investigators: Rodolfo M. Nayga, Jr., Lanier Nalley, and Faical Akaichi

Background

Globally agriculture has been one of the major sources of greenhouse gases (GHG). In USA, Agriculture accounted for 7.24% of global GHG emissions. GHG emissions from agriculture have also increased significantly since 1990. Rice is a staple food for a large part of the world's human population. Rice is a labor, water, and energy intensive crop, making it one of the major sources of agricultural anthropogenic GHG emissions. Given the introduction of lower GHG varieties (LGHG), like some hybrid rice, which are higher yielding (approximately 15 -20%) than conventional rice and use roughly the same input amounts, the American Mid-South rice industry has the opportunity to lower its GHG emission per bushel of rice ratio. One of the main barriers to adoption of LGHG however is the cost of seed to producers. Currently all hybrid varieties are released by private industries (as opposed to the cheaper conventional rice released by Universities) and the cost is higher to recoup research and development costs. Given the fact that rice is a true commodity, consumers cannot differentiate LGHG from conventional varieties on their plates. Thus the producer receives no premium for LGHG over conventional rice and only sows LGHG based on cost benefit ratio void of premiums based on environmental attributes. If consumers are

found to have a preference, and are willing to pay for that preference, for rice varieties possessing environmental attributes then economic signals can be conveyed to rice producers who can benefit. This issue is of importance to Arkansas since rice is the most important row crop in the state in terms of value. Specifically, in 2009, about 1.5 million acres of rice were harvested in Arkansas with production totaling close to 100 million hundred weight. This is valued at about 1.3 billion dollars, representing close to 20 percent of total farm level value from commodities in the state.

Arkansas is the largest producer of rice in the United States at approximately 40% of the US crop. Because of the nature of paddy rice production it is the largest GHG emitting row crop in the United States, mainly due to the methane emitted during production. Methane emissions (CH_4) are a direct result of flooded rice cultivation. When fields are flooded, aerobic decomposition of organic material gradually depletes most of the oxygen present in the soil, causing anaerobic soil conditions. Once the environment becomes anaerobic, CH_4 is produced through anaerobic decomposition of soil organic matter by methanogenic bacteria. Some of these CH4 are then transported from the submerged soil to the atmosphere primarily by diffusive transport through the rice plants. All rice varieties in the United States are grown under continuously flooded conditions; hence the higher CH_4 emissions from rice production compared to emissions from other commodities. In Arkansas, rice is the top emitter of GHG among the major crops produced in the state, excluding livestock.

Hybrid rice varieties that are LGHG have recently been introduced in Arkansas and have increased in acreage each year from a share of 0.8% of state total rice acreage in 2002 to 25% in 2008. These varieties can have yields that are 15-20 percent higher than conventional cultivars under the same growing conditions and roughly the same input requirements. This would increase the output per pound of GHG emitted ratio which illustrates input and GHG efficiency. For example, in Arkansas county (the largest rice producing county in Arkansas),

XL729 (a hybrid) variety has been estimated to produce 20 percent less GHG per acre than the most popular conventional variety (i.e., Wells variety) and another hybrid variety, XL745, produces about 13 percent less GHG per acre than the Wells variety (McFadden et al. 2010). Rice producers in Arkansas are facing important adoption issues in terms of seed availability and cost of these two hybrids. Unlike conventional rice varieties which are low cost and released by universities, these hybrid varieties are relatively expensive since they are controlled by one company (Rice Tec). There are also perceptions in the market that these hybrid varieties do not mill well compared to the conventional varieties. More importantly, rice farmers and millers need information about how consumers would value these LGHG considering their less input requirement and lower GHG emissions vis-à-vis the conventional varieties.

Given consumers' increasing concerns about the environment and climate change, the market for sustainable products is expected to expand significantly in the future. Consequently, it is no longer just environmentalists that care about carbon footprints but also major companies. For example, Wal-Mart has proposed a "sustainability index" which includes GHG emissions levels. A preliminary survey on sustainability has been sent out to their vendors. Wal-Mart is also asking their vendors if they are taking pro-active role in measuring and targeting their GHG emissions. Given the size and significant influence of Wal-Mart, this development will have significant impact not just on consumers but also on agricultural producers since it will facilitate and enhance the market for environmentally friendly products.

Objective

Given the possible tradeoffs in valuation for different attributes discussed above, it could be beneficial for producers, wholesalers, retailers and policy makers to understand if

consumers are willing to pay a price premium for rice varieties with lower GHG emissions in both *local and non-local markets.* Again, rice is an interesting case because it is a true commodity where currently all long grain non fragrant rice is a perfect substitute for each other. In this project, a *non-hypothetical experimental auction* was carried out to: 1) assess consumers' preferences and WTP for rice varieties characterized by varying levels of GHG emissions released during the production process; 2) assess consumers' WTP for the origin of rice (i.e. local vs. non-local) and its corresponding food miles (low vs. high food miles); 3) determine the effect on consumers' WTP of possible interactions between the information on GHG emissions, origin and food miles; and 4) compare the premiums consumers' are willing to pay for rice with lower GHG emissions, local rice, and rice with lower food miles as well as assess the variation of these premiums across consumers' attitudes and demographic characteristics. If consumers are found to be willing to pay a price premium for rice varieties with lower GHG emissions even when they are informed that they are not local and have higher food miles, rice producers could be incentivized to produce these varieties for both local and non-local markets. On the other hand, if the price premium that consumers are willing to pay for rice varieties with lower GHG emissions is reduced to zero when they are informed that the rice varieties with lower GHG emissions are not grown locally and have higher food miles, then retailers will have an incentive to sell those varieties associated with lower GHG only in local markets. Finally, if consumers are found to be unwilling to pay a price premium for the varieties with lower GHG emissions, regardless of whether it is produced locally or non-locally, then rice producers will not have a financial incentive from consumers' standpoint to adopt any specific varieties based on environmental attributes, *ceteris paribus*. This might also imply that if a premium was to be sought, a more concretive effort would be needed to promote the environmental benefits of the product and increase people's awareness of climate change issues. This is a pertinent topic given the rise of the

local foods movements and the increased number of farmers markets across the country. How would consumers respond if they were aware that local foods with less food miles were associated with higher GHG emissions per metric unit of a good?

The existing literature is still sparse on consumers' preferences and WTP for food products which are more sustainable in terms of GHG emissions. To our knowledge, this work is a first attempt at using a non-hypothetical value elicitation method (i.e. experimental auctions) to measure and analyze consumers' WTP for *food* products with lower GHG emissions (i.e. GHG emissions released throughout the production process up to the farm gate) and to assess the effect on consumers' WTP of possible "positive" or "negative" interactions between the information on GHG emissions, and the information on the location of origin of the product and its corresponding food miles.

Experimental design

To assess the effect of information on GHG emissions, origin, food miles, and their interactions on consumers' WTP, a non-hypothetical experimental auction (i.e., BDM: Becker, DeGroot and Marschak[1]) was designed and conducted. Experimental auctions were chosen given that they are now an established method used in product valuation research. A big part of its growing popularity is its ability to simulate a real market situation where a consumer can make the decision to buy and actually pay for the product; thus offering to participants real products and allowing for exchange of real money. Hence, experimental auctions tend to provide more accurate WTP values than hypothetical elicitation methods.

[1] In the BDM mechanism, participants are asked to report their WTP for a unit of a specific product. Then, the experimenter randomly chooses one of the participants to randomly draw a single price from a price distribution. All participants with a bid higher than the randomly drawn price are declared winners. Each winner obtains one unit of the auctioned product and pays a price equal to the randomly drawn price (see Becker, DeGroot and Marschak (1961)).

In the experiment, two long grain rice varieties popular in the US mid-South were considered: the conventionally inbred (Wells) and hybrid rice varieties (XL723)[2]. Each rice variety had been produced near and milled in two different locations: Stuttgart (Arkansas) and New Madrid (Missouri). The corresponding food miles are 250 miles for the rice from Stuttgart and 422 miles for the rice from New Madrid to the experimental location in Fayetteville, Arkansas. The estimated amount of GHG emissions, which was presented to participants in the form of CO_2 equivalent (CO_2e) as estimated in McFadden et al. (2012), were 9.97oz (CO_2e) per pound for Wells and 8.21oz per pound XL723.[3] To sum up, four 1-pound rice samples were auctioned: (1) rice A was Wells produced in Stuttgart (AR) with 9.97oz of CO_2e and 250 in food miles; (2) rice B was the hybrid rice (XL723) from Stuttgart (AR) with 8.21oz of CO_2e and with 250 food miles; (3) rice C was Wells produced and milled in New Madrid (MO) with 9.97oz of CO2e and 422 associated food miles; and (4) rice D was XL723 produced and milled in New Madrid (MO) with 8.21oz of CO_2e and 422 associated food miles(see table 1)[4].

A total of 350 consumers were recruited from a panel of 3000 consumers maintained by the University of Arkansas. Recruited subjects were randomly assigned to seven treatments. Sessions were conducted in groups of 10 subjects with each treatment consisting of five sessions. In each treatment, subjects participated in an experimental auction (i.e. BDM) consisting of five bidding rounds. The experimental auction was carried out in November 2011 in Fayetteville (Arkansas)[5]. Participants in all the treatments (except in

[2] Wells is the most popularly sown conventional rice variety in Arkansas which was released by the University of Arkansas Division of Agriculture. XL723 is a high yielding popular hybrid variety in Arkansas released by the private company, Ricetec.

[3] The differences between the CO2 equivalents per pound are attributable to two distinct factors: 1) The hybrid variety yields more and 2) the hybrid variety given its superior disease package requires less inputs and thus trips across the field reducing CO2 per acre and per pound of rice produced.

[4] For ease of identification, the four rice samples were labelled as rice A, rice B, rice C and rice D.

[5] Hence, for participants in our experiment the rice from Stuttgart (AR) is considered to be local rice and the rice from New Madrid (MO) is non-local rice.

treatment one) received the same information in rounds one and five but they received different information, in varying order, in the second, the third and the fourth rounds (see table 2). Specifically, in the first round, participants in each of the seven treatments were invited to visually inspect the four rice samples and were then asked to report their WTP for a one pound bag of each rice sample. In the fifth round of each treatment, participants tasted all the rice samples before reporting their WTP for each one of them. In rounds two, three, and four, participants in the different treatments (except treatment one) received three different information sets (i.e., GHG emissions per one pound bag, food miles to Fayetteville (AR) and production origin) in varying order. Specifically, participants received the three information sets successively in rounds two, three, and four in the following order: GHG emissions, food miles, location of origin in treatment two; GHG emissions, location of origin, food miles in treatment three; food miles, GHG emissions, location of origin in treatment four; food miles, location of origin, GHG emissions in treatment five; location of origin, GHG emissions, food miles in treatment six; and location of origin, food miles, GHG emissions in treatment seven. Participants in treatment one (i.e., the control treatment) did not receive any type of information in each of the five rounds and were just asked to report their WTP based on the appearance of each of the four rice products.

The experimental auction was performed in four steps. In step one, each participant received a unique identification number and was told that he/she would receive a $25 participation fee at the end of the experiment. One of the main determinants of success in experimental auctions is a thorough understanding by participants of the incentive compatibility of the auction mechanism. To achieve this goal, in step two, participants were given a detailed oral explanation about the operating procedures in a BDM auction. During the explanation, participants were free to ask questions to dissipate any doubts about the process. The next step began only after being sure that all participants fully understood how

the auction mechanism works and why it is in their best interest to reveal their true WTP. Before conducting the actual auction, a training session was carried out, auctioning four brands of candy bar to mimic the rice auctions and to further facilitate the learning process.

In step three, participants were invited to physically examine the four samples of rice (i.e., bags of one lb. each of rice). Once all participants finished inspecting the product, each participant was asked to indicate how much he or she would be willing-to-pay for each of the four rice samples based on looks alone. To minimize wealth effects, participants were told that at the end of the auction, one of the four rice samples will be randomly chosen as the "binding product" that would be actually sold in the experiment. In step four, three additional rounds were performed (i.e., rounds two, three, and four). As previously mentioned, participants received a different information set in each round (carbon emission, food miles or location of origin of the rice sample)[6] depending on the treatment, before they were asked to report their WTP for each rice sample. Since treatment one was the control treatment, participants in this treatment did not receive any information in any of these rounds. Several sensory studies have found that taste is a key factor affecting consumers' decision to purchase food products. Therefore, in step five, participants in all treatments were asked to taste the different rice samples to determine if taste could affect consumers' WTP after receiving information on the three attributes of interest: GHG emission, food miles, and the origin of the rice varieties. All the rice products were uniformly cooked in the same type of rice cooker at the same time. Both rice varieties were non-fragrant American long grains with comparable amounts of chalk and brokens. Once the participants finished tasting each of the samples, they were told to report their WTP for a one pound bag of each of the four samples. At the conclusion of the auction (i.e., 5th round), one of the participants was randomly chosen to randomly draw the binding rice sample and the binding round. The same participant was

[6] The information was written on a placard that was then placed close to the corresponding rice sample (see Figure 1).

again asked to randomly draw a single price from a price distribution that ranges from $0.50 to $4.00[7] with an increment of 10 cents. The winner(s) is (are) the participant(s) whose bid(s) is (are) greater than the randomly drawn price. Only the winner(s) in the binding round bought the binding product at the randomly drawn price. At the end of each auction session, participants were asked to complete a questionnaire on various aspects related to their attitudes toward environmentally friendly foods (EFF) as well as some socio-demographic and economic characteristics. Each participant then received $25 for his/her participation. The experiment ended by handing the products to the winner(s) who had to pay the corresponding auction price.

Overall Results

The results generally show that consumers are willing to pay a price premium for rice with lower GHG emissions (in this case the hybrid) if they were informed through a label. Results also suggest that consumers are willing to pay a higher premium if the low GHG emitting rice is sold as a "local" product with lower food miles. Perhaps the most striking and interesting finding in this study is the trade-off or equivalency in valuation shown by the subjects between "high GHG/local/low food miles" vs. "low GHG/non-local/high food miles" attributes in the rice samples. This finding is interesting since it implies that rice producers have to be mindful when targeting non-local markets. For example, while they can still benefit from selling a product with lower GHG emissions in the non-local market if their competitors are not labelling their rice products as local and/or having lower food miles, this market advantage disappears when competitors are labelling their conventional rice as local and having lower food miles.

[7] The price distribution was not revealed to participants.

Benefits from the Project

The findings of this project have important implications for adoption of LGHG rice varieties in Arkansas and the environmental issues that come with the adoption of these products with significantly lower GHG emissions. Rice is the most important row crop in Arkansas in terms of value and is also the highest source of GHG among row crops in the state. Current adoption rates of LGHG varieties are restricted in the state due to a number of reasons discussed previously, including the fact that American long grain rice is viewed as a commodity and not marketed by specific attributes.

The results of the research will assist the Arkansas rice industry, processors and retailers to better target marketing operations. Considering that rice is a major crop in several other states, this project could also serve as a pilot project or model for others that will create wealth in communities through development of market for sustainable rice varieties.

This project represents one of the first attempts at exploring consumers' preferences and willingness to pay for food products with lower GHG emissions. It is also one of the first in the literature to examine the complementarities or tradeoffs between environmental attributes and the "local food" attribute using an incentive compatible value-elicitation method. These issues are now in the forefront of not only many food businesses but also environmental policy initiatives and debates.

Working Paper

Akaichi, F., R.M. Nayga, Jr., and L. Nalley, "Consumers' Willingness to Pay for Rice Varieties: Are there Tradeoffs in Valuation with Respect to Greenhouse Gas Emissions,

Local Production, and Food Miles Attributes?, Working Paper, Department of Agricultural Economics and Agribusiness, University of Arkansas, August 2013.

Presentations

Akaichi, F., R. M. Nayga, Jr. and N. Lanier. 2012. "Are Consumers Willing-to-Pay a price premium for Environmentally Friendlier Foods?" Agricultural and Applied Economics Association Meeting. Seattle, USA, August 12-14.

Akaichi, F., R. M. Nayga, Jr. and N. Lanier. "Do Consumers Make Tradeoffs with Respect to GHG emissions, Local, and Food Miles? 134th European Association of Agricultural Economists (EAAE) seminar, Paris, France, March 21-22, 2013.

Akaichi, F., R. M. Nayga, Jr. and N. Lanier. "Do Consumers Make Tradeoffs with Respect to GHG emissions, Local, and Food Miles? 87th Agricultural Economics Society Annual Conference 2013, University of Warwick, UK, April 08-10.

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Are Consumers Willing-to-Pay a Price Premium for Environmentally Friendlier Foods?

Faical Akaichi*, Rodolfo M. Nayga, Jr & Lanier Nalley****

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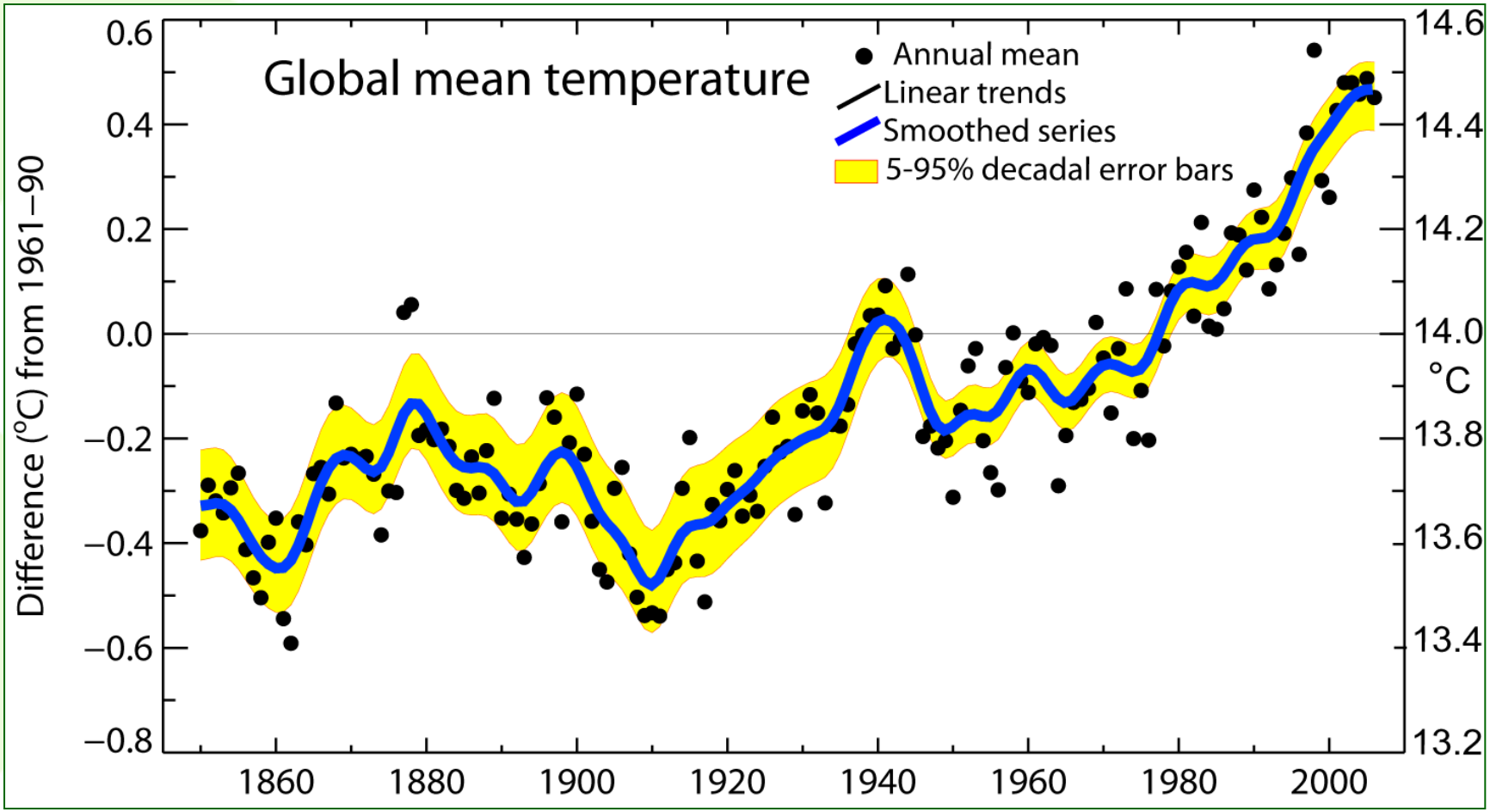
Leading the way in Agriculture and Rural Research, Education and Consulting

1. INTRODUCTION

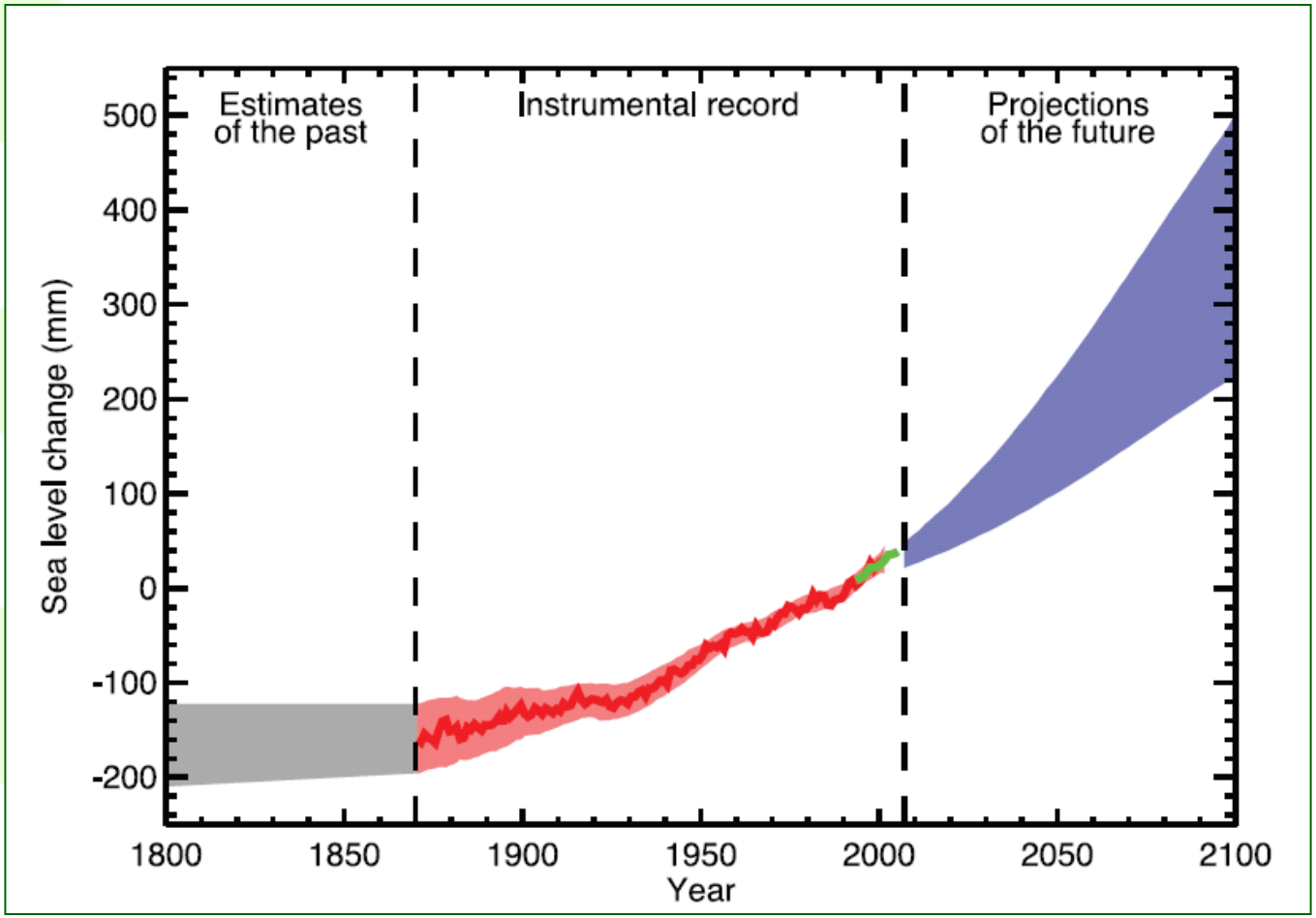
- Climate change has always been part of the Earth's history.

- BUT the change has been speeded up during the last century

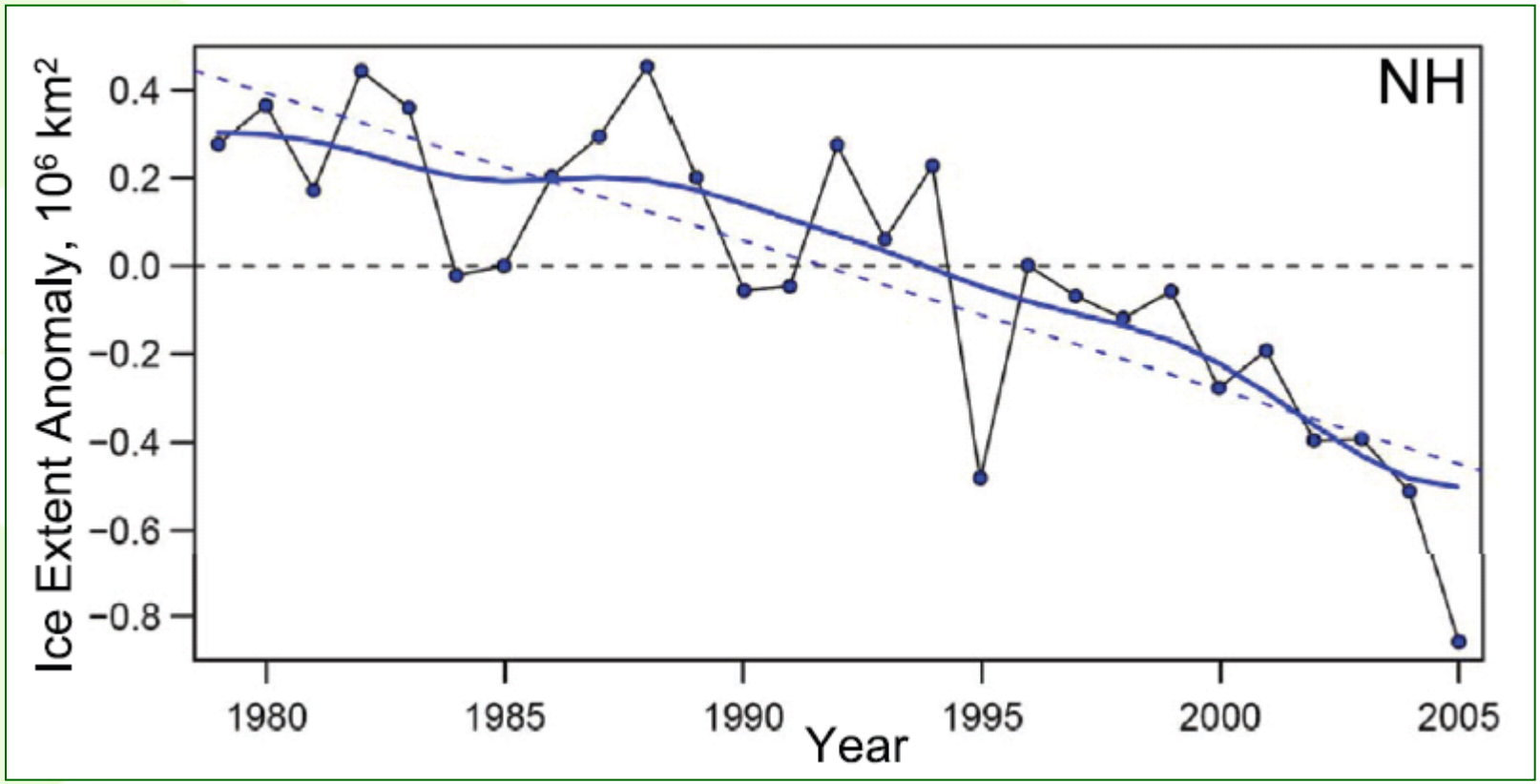
Global mean temperature



Sea level


Estimates of the past
Instrumental record
Projections of the future
Sea level change (mm)
500
400
300
200
100
0
-100
-200
1800
1850
1900
1950
2000
2050
2100
Year

Ice Extent


NH
Ice Extent Anomaly, 10^6 km^2
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
1980
1985
1990
1995
2000
2005
Year

1. INTRODUCTION

- There is a consensus among most climate scientists that the **greenhouse gases (GHG)** generated by human activities are the main cause of the dramatic climate change.

- Agriculture releases between 10% and 12% of the global quantity of GHG emissions and this share is expected to increase in the future due to the escalating demand for food and the increasing mechanization of agriculture.

1. INTRODUCTION

- There is an increasing demand from public sector and private industries (e.g. Walmart) to reduce GHG emissions associated with crop production to the farm gate

- One solution: the implementation of improved management practices and ***production of foods that emit lower GHG emissions***.

1. INTRODUCTION

- Rice production (from seed to farm gate) has been identified as a significant source of atmospheric methane (CH4) emissions from agricultural production.

- Hybrid rice can yield 15-20% more than conventional varieties under the same growing conditions with roughly the same input requirements.

- However, the production cost of hybrid rice is much higher.

1. INTRODUCTION

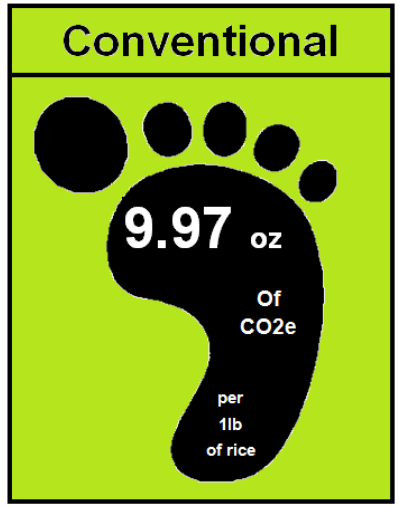
- Given that rice is a true commodity, consumers cannot generally differentiate varieties solely based on appearance. Hence, producers currently have no financial incentive to adopt varieties with embedded environmental characteristics.

- However, if consumers have a preference and are willing to pay a price premium for rice varieties possessing environmental attributes, then economic signals can be passed upstream to rice producers who can possibly benefit by adopting varieties which possess these sought after benefits.

1. INTRODUCTION

- Assessing consumers' willingness to pay (WTP) for environmentally friendlier rice.

vs.



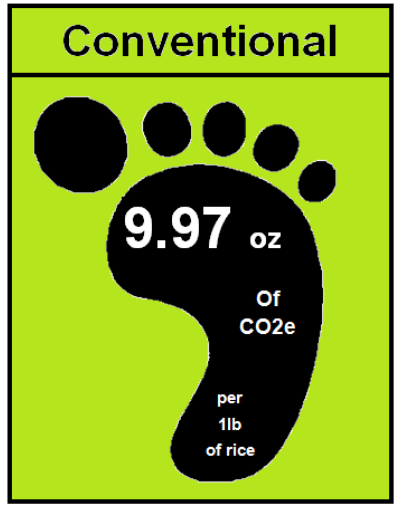
WTP **>** **WTP**

1. INTRODUCTION

- Tradeoff between GHG emissions and the Origin of the product

+

vs.



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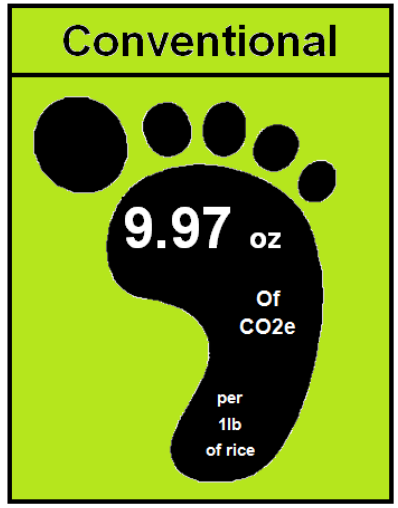
WTP **?** **WTP**

1. INTRODUCTION

- Tradeoff between GHG emissions and food miles

+

vs.



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WTP **?** **WTP**

1. INTRODUCTION

- Tradeoff between GHG emissions, origin and food miles

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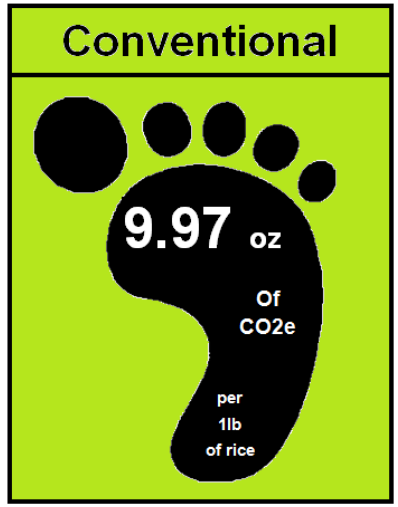
vs.



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WTP **?** **WTP**

1. INTRODUCTION

A non-hypothetical experimental auction was carried out to:

- Assess consumers' preferences and WTP for rice varieties characterized by varying levels of GHG emissions released during the production process.
- Assess consumers' WTP for the origin of rice (i.e. local vs. non-local) and its corresponding food miles (low vs. high food miles).
- Determine the effect on consumers' WTP of possible interactions between the information on GHG emissions, origin and food miles.

2. EXPERIMENTAL DESIGN

- Treatments

Round	T1	T2	T3	T4	T5	T6	T7
1	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.
2	No Inf.	CO_2e	CO_2e	F.Miles	F.Miles	Origin	Origin
3	No Inf.	F.Miles	Origin	CO_2e	Origin	CO_2e	F.Miles
4	No Inf.	Origin	F.Miles	Origin	CO_2e	F.Miles	CO_2e
5	No Inf.	Taste	Taste	Taste	Taste	Taste	Taste
Participants	50	50	50	50	50	50	50

WTP? → 4 rice products

- Lower CO_2e
  - Lower FM Local
  - Higher FM Not Local
- Higher CO_2e
  - Lower FM Local
  - Higher FM Not Local

2. EXPERIMENTAL DESIGN

- Attributes and auctioned products

	Product 1 C-AR	Product 2 H-AR	Product 3 C-MO	Product 4 H-MO
CO_2e	8.21oz/lb	9.97oz/lb	8.21oz/lb	9.97oz/lb
Food Miles	250 miles	250 miles	422 miles	422 miles
Origin	Arkansas	Arkansas	Missouri	Missouri

2. EXPERIMENTAL DESIGN

- Implementation of the experimental auction (BDM)
  - Representative sample of 350 consumers randomly assigned to 7 treatments
  - 5 session per day of 10 participants each
  - Participation fees: Visa debit card of $25
  - Identification number
  - Explanation of the auction working and training session (using candy bars)

2. EXPERIMENTAL DESIGN

- Implementation of the experimental auction (BDM)

Round 1

- Implementation of the experimental auction (BDM)

Round 1

- Implementation of the experimental auction (BDM)

Round 1

ROUND 1			IDENTIFICATION NUMBER:	
Please indicate your willingness to pay for each variety of rice				
Your Willingness to pay	RICE A	RICE B	RICE C	RICE D
	$	$	$	$

2. EXPERIMENTAL DESIGN

- Implementation of the experimental auction (BDM)

Round 2, Round 3 & Round 4 (providing information on CO2e, F.Miles & Origin)

- Implementation of the experimental auction (BDM)

Round 5 (tasting the rice)

2. EXPERIMENTAL DESIGN

- Implementation of the experimental auction (BDM)

Before the exchange

UNIVERSITY OF ARKANSAS
DALE BUMPERS COLLEGE
OF AGRICULTURAL, FOOD & LIFE SCIENCES

Date..... *Hour* .....
Identification number .....

To complete your participation in this market study, please, answer the following series of questions about your consumption habits, your attitudes toward environmentally friendly foods and your socio-demographic characteristics. You can skip any questions you do not feel comfortable answering. All the information provided will be treated anonymously to maintain the confidentiality of your responses.

1. How often do you eat rice?

- ○ Habitually
- ○ Occasionally
- ○ Never (if your answer is "Never", please go to question 3)

2. Do you eat rice (Multiple answers are allowed)

- ○ at home?
- ○ in restaurants ?

3. Do you buy rice?

- ○ Yes (habitually or occasionally)
- ○ Never (if your answer is "Never", please go to question 7)

4. How much rice do you usually buy and how often?

	1 time/ week	1 time/15 days	1time/ month	1 time/ 3months
Frequency				
Quantity (lb)				

5. Approximately, how much rice do you have at home right now?

..... lbs

6. What type of rice do you usually buy?

- ○ Fragrant
- ○ Not fragrant

7. *What are the most important factors you consider when deciding which products you buy? (Multiple answers are allowed)*

- ○ The product's impact on the environment.
- ○ The quality of the product
- ○ The price of the product
- ○ The brand or the brand name of the product
- ○ The origin of the product
- ○ The media (TV etc.)
- ○ My family or/and my friends
- ○ Others (please specify).....

➢ Implementation of the experimental auction (BDM)

Exchange

1 Binding Round

2 Binding Rice

3 Binding Price

Implementation of the experimental auction (BDM)

Determination of buyers

ID	1	2	3	4	5	6	7	8	9	10
WTP	2.30	1.10	4.70	0	3.55	2.95	.50	1.15	3.45	0
	★		★		★	★			★	

Binding price = $1.80

Buyers ID

1

3

5

6

9

Price to pay = $1.80

Quantity = 1lb of the binding rice

3. RESULTS

Table 1: Willingness to pay ($/lb.) for the four rice samples based only on their appearance

Rice product	Value	p-value
H-AR H-MO	1.04 1.09	.40
C-AR C-MO	0.92 0.97	.33
H-AR C-AR	1.04 0.92	**.02**
H-MO C-MO	1.09 0.97	**.03**
H-AR C-MO	1.04 0.97	.16
H-MO C-AR	1.09 0.92	**.00**

3. RESULTS

Table 2: Effect of information and taste on participants' WTP for the rice samples

Rice varieties	Round 1	Round 4	p-value	Round 4	Round 5	p-value	Round 1	Round 5	p-value
H-AR	1.04	1.27	**.00**	1.27	1.23	.51	1.04	1.23	**.00**
C-AR	.92	.95	.55	.95	1.00	.38	.92	1.00	.14
H-MO	1.09	1.07	.69	1.07	1.06	.92	1.09	1.06	.62
C-MO	.97	.84	**.01**	.84	.87	.62	.97	.87	**.04**

3. RESULTS

Table 3: Effect of each type of information on participants' WTP for the rice samples

Treatments	Rice varieties	Round 1	Round 2	p-value	Round 2	Round 4	p-value	Round 1	Round 4	p-value
2 & 3	H-AR	1.12	1.21	.38	1.21	1.38	.15	1.12	1.38	**.02**
	C-AR	.93	.78	.14	.78	.90	.26	.93	.90	.73
	H-MO	1.11	1.20	.42	1.20	1.04	.15	1.11	1.04	.50
	C-MO	1.00	.83	.09	.83	.78	.61	1.00	.78	**.03**
4 & 5	H-AR	.87	.95	.40	.95	1.19	**.02**	.87	1.19	**.00**
	C-AR	.79	.90	.20	.90	.88	.82	.79	.88	.30
	H-MO	.94	.88	.51	.88	.93	.57	.94	.93	.95
	C-MO	.87	.86	.92	.86	.75	.25	.87	.75	.20
6 & 7	H-AR	1.04	1.17	.10	1.17	1.29	.17	1.04	1.29	**.00**
	C-AR	.98	1.13	.08	1.13	1.07	.48	.98	1.07	.33
	H-MO	1.10	1.07	.72	1.07	1.14	.38	1.10	1.14	60
	C-MO	1.00	1.00	.99	1.00	.95	.55	1.00	.95	.55

3. RESULTS

Table 4: Effect of each type of information on participants' price premium: the case of "H-AR – C-MO"

Treatments	Rice varieties	Round 1	Round 2	p-value	Round 2	Round 4	p-value	Round 1	Round 4	p-value
2 & 3	H-AR – C-MO	.12	.38	**.00**	.38	.60	**.02**	.12	.60	**.00**
4 & 5	H-AR – C-MO	.00	.09	.18	.09	.44	**.00**	.00	.44	**.00**
6 & 7	H-AR – C-MO	.03	.17	**.03**	.17	.34	**.02**	.03	.34	**.00**

3. RESULTS

Table 5: Effect of each type of information on participants' price premium

Treatments	Rice varieties	Round 1	Round 2	p-value	Round 2	Round 4	p-value	Round 1	Round 4	p-value
2 & 3	H-AR - C-AR	.19	.43	**.00**	.43	.48	.49	.19	.48	**.00**
	H-MO – C-MO	.11	.37	**.00**	.37	.26	.13	.11	.26	**.04**
4 & 5	C-AR – C-MO	-.08	.04	**.05**	.04	.13	.19	-.08	.13	**.00**
	H-AR – H-MO	-.07	.07	**.00**	.07	.26	**.01**	-.07	.26	**.00**
6 & 7	C-AR – C-MO	-.02	.13	**.00**	.12	.12	.85	-.02	.12	**.02**
	H-AR – H-MO	-.06	.10	**.00**	.10	.15	.49	-.06	.15	**.00**

3. RESULTS

Table 6: Effect of each type of information on participants' price premium

Treatments	Rice varieties	Round 1	Round 2	p-value	Round 2	Round 4	p-value	Round 1	Round 4	p-value
2 & 3	C-AR – C-MO	-.07	-.05	.79	-.05	.12	**.03**	-.07	.12	**.04**
	H-AR – H-MO	-.01	-.01	.96	-.01	.34	**.00**	-.01	.34	**.00**
4 & 5	H-AR - C-AR	.08	.05	.60	.05	.31	**.00**	.08	.31	**.00**
	H-MO – C-MO	.07	.02	.40	.02	.18	**.00**	.07	.18	**.09**
6 & 7	H-AR - C-AR	.06	.04	.82	.04	.22	**.00**	.06	.22	**.00**
	H-MO –C-MO	.10	.07	.65	.07	.19	**.06**	.10	.19	.16

3. RESULTS

Table 7: Effect of each type of information on participants' price premium: the case of "H-MO - C-AR"

Treatments	Rice varieties	Round 1	Round 2	p-value	Round 2	Round 4	p-value	Round 1	Round 4	p-value
2 & 3	H-MO - C-AR	.18	.42	**.00**	.42	.14	**.00**	.18	.14	.60
4 & 5	H-MO - C-AR	.15	-.02	**.03**	-.02	.05	.37	.15	.05	.23
6 & 7	H-MO - C-AR	.12	-.06	**.03**	-.06	.07	**.09**	.12	.07	.63

3. RESULTS

Table 8: Comparison of participants' price premium for the rice attributes (i.e. lower GHG emissions/lower food miles/being grown locally).

Information	Price Premium	p-value
GHG emissions	.23	**.00**
Food Miles	.13	
GHG emissions	.23	**.00**
Origin	.14	
Food Miles	.13	.50
Origin	.14	
GHG emissions	.23	.21
Food Miles + Origin	.27	

4. CONCLUDING REMARKS

- Consumers are willing to pay a price premium for rice labelled as having lower GHG emissions.
- The price premium could be increased if rice producers inform consumers in their local market that the rice is also local and has lower food miles.
- In non-local markets, the price premium that consumers are willing to pay for the rice with lower GHG emissions can decrease significantly if they are informed that the rice is not local and hence has higher food miles.
- Hence, consumers appear to make tradeoffs in valuation of products with respect to GHG emission, local, and food miles attributes.

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Thank you

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