Consumer Perceptions of Sustainable Farming Practices: A Best-Worst Scenario

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Building on existing work evaluating food-attribute labels, we use data collected in 2010 from a national web-based survey of 1,002 households to examine consumer inferences and valuations of food products promoted as "sustainably produced." A best-worst scale framework was implemented to identify how consumers define "sustainably produced" and their preferences for each of the sustainable farming practices considered. The results suggest that consumers perceive farm size and local production as important elements of sustainable agriculture while economic attributes exhibit a significant amount of heterogeneity, indicating segmentation in the sample and the potential for targeted marketing.

Key Words: best-worst, consumer perceptions, sustainably produced food

Food produced using sustainable production practices is receiving increasing attention in both public and private arenas as a greater number of food products are being marketed and labeled using "sustainable" or "sustainably produced" certification schemes for differentiation. As sustainably produced food has gained market momentum, questions have arisen among researchers and marketers regarding what consumers perceive when faced with the label "sustainably produced." Specifically, consumers want to know what claims of sustainability imply about the environmental, economic, and social factors associated with production and farmers want to know what consumers are willing to pay for this value-added attribute before either party invests heavily in sustainability certification.

The attributes that consumers desire in terms of food system sustainability recently have been studied in more detail. For example, a framework for evaluating consumer priorities with regard to sustainable food was built by Clonan et al. (2010) based on seven guiding principles of sustainability put forth by Sustain,[1] an alliance for better food and farming. The authors used a five-point Likert Scale embedded in a structured questionnaire to explore attitudes toward sustainability components such as fair trade, organic and local production, and animal welfare. The study found that consumers responded

[1] See www.sustainweb.org/sustainablefood.

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positively to environmental responsibility metrics related to how their food was produced. Similarly, using a discrete choice modeling method for evaluating consumer attitudes regarding sustainability claims on food products, Saunders et al. (2010) focused on results from a Likert Scale rating of sustainability attributes in the context of carbon emissions and other contributions to global climate change. However, the relatively limited literature on sustainable food labels generally has not focused on identifying attributes of sustainability that consumers believe are or should be important components of a "sustainably produced" labeling scheme.

Batte (2010) reviewed several studies that identified consumer-driven changes in food marketing channels related to sustainable food claims. In the review, Batte identified three studies that supported the importance of consumer demand in food-product-differentiation schemes. The first, a study by Onozaka and Thilmany McFadden (2010), found evidence from a conjoint choice experiment of significant heterogeneity in valuing various food-differentiation claims among shoppers in various marketing venues. They noted that the consistent significance of self-perceived efficacy in the psychographic model suggested that consumers who believe they have a role to play in improving sustainability tend to value sustainable product claims more. In another study, Onozaka and Thilmany McFadden (2011) explored the increasing use of sustainable food labels by analyzing the interactive effects of sustainable production claims and found that products that were locally grown were the most highly valued. The authors suggest that consumers' preference for local food extends beyond basic quality characteristics. Increasingly, it is related to sustaining the local economy by supporting the area's farmers and conserving local farm land. Batte (2010) concluded that further research was needed to identify how consumer demand for sustainably produced food is affected by the perceived importance of environmental, economic, and social attributes used to differentiate products through certification and labeling.

To address the void in the literature related to attributes of sustainability that are important to consumers, we use a best-worst scaling framework to examine consumer beliefs about the meaning of "sustainably produced" in the context of food labels. Best-worst choice modeling is a relatively new technique for analyzing consumer preferences or beliefs. It has been applied in a variety of settings, including public health research by Flynn et al. (2007) and international agribusiness marketing studies by Umberger, Stringer, and Mueller (2010) and by Scarpa et al. (2011), to estimate desired tourism benefits. In an agricultural and food system context, best-worst choice designs and analyses have been previously demonstrated using empirical examples involving the wine market by Casini and Corsi (2009), Cohen (2009), and Mueller and Rungie (2009). More closely related to our work is a study by Lusk and Parker (2009), which used best-worst scaling techniques to identify the methods preferred by consumers for improving (reducing) the fat content in ground beef. Most closely related to the current study is one by Lusk and Briggeman (2009), which determined consumers' relative attitudes toward value-added food attributes such as safety, nutrition, taste, and price using the best-worst framework. Here, we examine consumer attitudes toward value-added sustainable production attributes in a similar fashion.

The primary purposes of this study are threefold. One goal is to introduce an economic application of best-worst scaling for measuring the importance of production attributes in consumer decision-making in the context of food systems. Additionally, we seek to identify consumers' perceptions of the environmental, economic, and social indicators of sustainability currently used by third-party agricultural certifiers as farm/ranch-level evaluation with a goal of identifying the indicators that consumers see as important components of food production. Finally, we aim to assess consumer heterogeneity in perceptions of the importance of sustainable farming practices when choosing "sustainably produced" food for insight into potential marketing strengths for third-party certifiers.

Research Methodology

Best-Worst Scaling

Marketing surveys that measure attribute importance most often use a Likert Scale ranking approach. However, the method has several known weaknesses. First, scaled rating systems do not force respondents to make tradeoffs between attributes. Additionally, Likert-Scale-ranked data defy natural interpretation outside of the survey context. To address these issues, we implemented a best-worst design to investigate preferences for and perceptions of alternative sustainable farming practices. The survey instrument used to collect consumer data was designed to simplify the choice task for respondents.

Best-worst analysis requires survey respondents to choose the most important and least important attributes from a set of competing options simultaneously. This method is commonly referred to as "maximum difference scaling" since the attributes chosen should maximize the difference in utility realized by a respondent on an underlying scale of preference. The measured level of importance from the best-worst data analysis is applied to a standardized ratio scale that determines the percentage difference in importance across attributes with more certainty. The theoretical foundation for this analysis is provided by Marley and Louviere (2005) in their development of probabilistic models for analyzing best-worst choice tasks.

Best-worst scaling, as originally devised by Flynn and Louviere (1992), is capable of addressing relative impacts on utility across attributes that traditional discrete choice questions cannot. To observe tradeoff behavior in a best-worst model, the specification of attributes from a choice set of competing alternatives is repeated over a number of variable choice subsets. In this way, best-worst tasks provide more information than single choice designs while forcing respondents to consider the extremes of their utility space. Ideally, the stated preference outlined in each best-worst scenario approximates observed consumer behavior in retail markets. We created each choice set using a 210 main-effects orthogonal experimental design[2] that was balanced with ten attributes, each exhibiting two levels. The specific attributes chosen for inclusion are described in the next subsection and further outlined under Data Collection. The orthogonal experimental design yielded twelve alternative choice sets, which were broken into two blocks and randomized across participants. Each block contained two questions that involved five alternatives, three questions that involved six alternatives, and one question that included all ten alternatives. The presence or absence of each sustainable farming attribute was independent across choice subsets, allowing for identification of relative

[2] *Linear Models and Analysis of Variance: Concepts, Models, and Applications*, Volume II, David W. Stockburger, Southwest Missouri State University, 1993.

preferences on a ratio scale. The additional utility or disutility from moving between attribute levels was estimated using a logit model framework.

Sustainability Attributes

The U.S. Department of Agriculture's (USDA's) National Institute of Food and Agriculture (NIFA) provides limited information on the purported sustainability of particular farming and ranching practices. At a national level, sustainable agriculture was first addressed by Congress in the 1990 Farm Bill (Public Law 101-624, Title XVI, Subtitle A, Section 1603), which defined sustainable agriculture as used within the bill.

> *The term* sustainable agriculture *means an integrated system of plant and animal production practices having a site-specific application that will, over the long term:*
>
> - *satisfy human food and fiber needs*
> - *enhance environmental quality and the natural resource base upon which the agricultural economy depends*
> - *make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls*
> - *sustain the economic viability of farm operations*
> - *enhance the quality of life for farmers and society as a whole.*

However, USDA also warned that "guidelines about what specific practices meet long-term environmental, economic, and social goals and constitute sustainable agriculture [are] still under debate" (National Agricultural Library (NAL) 2009, p. 1). Therefore, when developing our consumer survey to determine perceptions of practical farm-level components of a sustainable production system, we followed USDA's advice and included environmental, economic, and social attributes of sustainability that address the last two points of the preceding definition.

The USDA website provides links (NAL 2009) to a handful of groups that have developed standards and provide certification services based on those standards. The first one listed by USDA is Food Alliance (*www.foodalliance.org*), a nonprofit organization that developed standards and operates a voluntary certification program. Food Alliance is the most comprehensive certification program for sustainable food production in North America. It employs independent third-party inspectors to audit Food-Alliance-certified businesses to determine that they continue to meet the program's standards and criteria. Food Alliance outlines its crop- and livestock-specific certification criteria and provides the following general requirements for certified production.

- Provide safe and fair working conditions
- Ensure the health and humane treatment of animals
- No use of hormones or subtherapeutic antibiotics
- No genetically modified crops or livestock

- Reduce pesticide use and toxicity
- Protect soil and water quality
- Protect and enhance wildlife habitat
- Continuously improve management practices

Many farming practices with sustainability characteristics could have been included for the purposes of this study. We adhered as closely as possible to Food Alliance's whole farm/ranch evaluation criteria for crops and livestock when choosing the sustainability attributes to include in the survey. Those criteria are publicly available online and from the authors upon request. Because there currently is no government-sponsored certification of sustainable food production, all claims of "sustainably produced" found on food product labels in the United States are certified by private third parties such as Food Alliance or by the farm of origin. We are interested in identifying the certification-guided environmental, economic, and social attributes that consumers perceive as important indicators of sustainability when faced with these kinds of purchasing decisions.

The set of attributes used in this study offers insight into perceived dimensions of sustainability and provides opportunities for expansion in future work. Due to the nature of the variable choice sets, the analysis that follows is conditional on the set of evaluated attributes (farming practices) and should not be interpreted as informing sustainability attributes outside of this context.

Data Collection

To our knowledge, this study is the first to use best-worst scaling to measure consumer perceptions of the importance of production attributes in the context of food system sustainability. We chose best-worst scaling because we are especially interested in determining the relative importance of sustainable agricultural certification criteria currently used in food markets. To collect consumer data for the analysis, we disseminated a national web-based survey of 1,002 households in the summer and fall of 2010. Consumer respondents were recruited by Decipher, a marketing-research and survey-programming company. A summary of the population demographic statistics is provided in Table 1.

We developed two versions of the survey based on the product to be purchased—one for apples and one for beef. Table 2 lists the sustainable farming practices included in accordance with Food Alliance's crop-specific (apple) and livestock-specific (beef) evaluation criteria as the best-worst attributes from which survey respondents would choose. Many of these practices fall under current organic-certification guidelines endorsed by USDA, and all are components of sustainable farm certification by Food Alliance. The attributes span the three-pronged sustainability framework suggested by Callens and Tyteca (1999) and are in line with NIFA's use of environmental, economic, and social metrics for evaluation (NAL 2007).

We developed the choice sets for the analysis around ten attributes that each were divided into two levels indicating the presence or absence of a given farming practice. Consumers were shown a set of attributes and were asked to indicate the one that was most important (best) and the one that was least important (worst) in repeated choice opportunities in which the set of

Table 1. Demographic Variables and Summary Statistics of Survey Participants

Variable Definition	Apples	Beef
Gender		
1 = Male; 2 = Female	1.476	1.516
Total participants	500	502
Age		
Average age in years	51.48	50.92
Adults and Children		
Number of adults in household	2.062	2.048
Number of children in household	0.48	0.51
Meals		
Number of meals/week with product	6.64	3.19
Shop: Percent of Total Shopping at Location		
Grocery store	81.97	81.16
Health food store	8.49	9.20
Food co-op	2.05	1.90
Convenience store	3.00	4.42
Farmers market	3.72	5.24
Butcher	4.38	2.92
Assistance: Percent		
1 = On food assistance	13.2	11.95
2 = Not on food assistance	86.8	88.05
Education: Percent by Highest Level Completed		
1 = Did not graduate from high school	2.2	2.59
2 = Graduated from high school, no college	17.8	18.12
3 = Attended college, no degree earned	28.8	33.67
4 = Attended college, associate or trade degree earned	15.4	12.55
5 = Attended college, bachelor’s degree earned	24.6	22.52
6 = Graduate or advanced degree earned	11.2	10.56
Household Income: Percent by Range of Pretax Income		
1 = Less than $20,000	20.8	19.12
2 = $20,000–$39,999	26.4	28.88
3 = $40,000–$59,999	18.4	21.51
4 = $60,000–$79,999	17.6	11.95
5 = $80,000–$99,999	8.2	7.57
6 = $100,000–$119,999	3.8	4.98
7 = $120,000–$139,999	1.8	2.39
8 = $140,000–$159,999	1.4	1.20
9 = More than $160,000	1.6	2.39

Table 2. Apple and Beef Survey Attributes

Apple Survey Attributes	Beef Survey Attributes
Ground cover management	Prohibited use of antibiotics
Limited fertilizer use	Prohibited use of growth hormones
Limited pesticide use	Prohibited use of genetically modified livestock
Limited herbicide use	Animal health and safety
Pollinator management	Pastured feed and waste management
Preventative pest control	Preventative pest control
Farm size	Farm size
Geographic level of production	Geographic level of production
Consumer food prices	Consumer food prices
Financial stability of farmers	Financial stability of farmers

attributes in each question varied. In theory, each respondent undertook the task of identifying every possible pair of attributes, calculating the difference in utility between each attribute pair, and choosing the pair that maximized the utility difference. This method is an extension of Thurstone's (1927) paired comparison method, which is used frequently in psychological research. In maximum-difference scaling, distances between pairs of attributes are modeled as pair-wise utilities and estimated in relation to a single attribute level rather than to an entire scenario. All of the participants in the apple survey faced the following scenario and a similar extension was used in the beef survey.

Survey Question Example
Which one of the following aspects of apple farming do you believe is the most and least important in a sustainable apple production system? Please check only one in each column.

Least Important		**Most Important**
___	Ground cover and area management practices are employed	___
___	Little to no chemical pesticides are used for pest management	___
___	Pollinator management is employed	___
___	Other pests are controlled using preventative measures and habitat controls	___
___	Production, distribution, and sale is done locally	___
___	Consumer food prices are affordable	___

The main-effects orthogonal experimental design ensured that each potential best-worst pair appeared twice in a blocked section of six choice sets and that each attribute was seen by the respondent four times in this portion of the survey. Definitions were provided for six of the production attributes. We did not define the economic attributes; they were left to interpretation by each respondent. Those definitions are included in the Appendix, which is available from the authors.

Analysis

Two primary approaches are used to analyze the best-worst ranked data. Paired models are implemented to make inferences about the latent utility scale while marginal (count-based) models aggregate best and worst choices over all of the pairs that include a given attribute level to model choice frequencies. Both methods employ the same measurement properties and can be analyzed at a respondent or a sample level and will yield similar results. For brevity, we omit the simpler marginal specification and analysis. It is included in the Appendix, which is available from the authors upon request.

Consider a choice set that has $J = 6$ attributes. Therefore, there are $J(J-1) = 30$ possible best-worst combinations. The particular pair of attributes chosen by the consumer represents one choice out of $J(J-1) = 30$ possible pairs in a given choice set that maximizes the difference in how important the consumer perceives the attributes to be.

Let λ_j formally represent the location of attribute j on the underlying scale of importance. Therefore, the latent unobservable level of importance for individual i is given by

$$I_{ij} = \lambda_j + \mathbf{e}_{ij} \tag{1}$$

where $\mathbf{e}_{ij}$ is the random error. The probability that the consumer will choose item j as most important and item k as least important is equal to the probability that the difference between I_{ij} and I_{ik} is greater than all other $J(J-1)-1$ possible differences in the choice set. If $\mathbf{e}_{ij}$ is independently and identically distributed, λ_j can be estimated for attribute j in a conditional logit framework. The equation to be estimated is

$$choice_i = \alpha + \lambda_1 L_1 + \lambda_2 L_2 + \ldots + \lambda_J L_J + \mathbf{e}_i \tag{2}$$

where each L_j corresponds to one of the J attributes included in a given choice set. Each attribute is an alternative-specific regressor that takes a value in [−1, 0, 1].

Using the conditional logit parameter estimates (λ_j), the probability that attribute j is chosen as most important (best) and attribute k is chosen as least important (worst) is given by

$$\text{Prob}(j = best \cap k = worst) = \frac{e^{\lambda_j - \lambda_k}}{\sum_{s=1}^{J}\sum_{t=1}^{J} e^{\lambda_s - \lambda_t - J}}. \tag{3}$$

The parameter estimates represent the share of importance for the given attribute relative to the attribute ranked least important, normalized to zero. To return results that are consistent with standardized ratio scaling techniques, the share of importance for each attribute, which equals the forecasted probability of being chosen as most important, takes the following form.

$$Share_j = \frac{e^{\lambda_j}}{\sum_{i=1}^{J} e^{\lambda_i}} \tag{4}$$

The preference shares must sum to one across all ten sustainable farming attributes. The preceding equation should be interpreted as the importance of attribute *j* on a ratio scale. The share of preference for a given attribute reflects both the true importance of the attribute and the relative uncertainty regarding the importance consumers place on the attribute. However, this specification neglects consumer heterogeneity. The estimation requires an assumption that all individuals in the sample must place the same level of importance on each value once they are ranked.

To explore consumer heterogeneity more deeply, we employed a latent-class cluster analysis, a clustering technique that assumes that individuals belong to one of a predetermined number of latent classes. The Bayesian Information Criterion (BIC) allows us to determine the optimal number of latent clusters. It involves minimizing within-cluster variance and maximizing across-cluster variance. The probability of membership in a given latent class is estimated using logit model parameters. The latent-class cluster analysis uses the individual best-worst scores as the dependent variables in this model. Covariation across individual best-worst scores measures unobserved utility gains and losses associated with inclusion or exclusion of a given attribute for each respondent.

Results

The raw data contained 1,002 observations (rows of data), one for each respondent. Within each respondent's observation, each of the six questions involved two variables (most important and least important production attribute), leading to twelve variables. This type of data is commonly referred to as "wide form." Using statistical software, the wide-form data set was transformed into what is commonly referred to as "long form" data in which a single observation provides data for one alternative for each individual. If a given best-worst question offers the respondent J attributes, the long-form data will have $J(J-1)$ observations for that question because each alternative is now thought of as a potential best-worst pairing of the J potential attributes. Each observation for a given question includes J explanatory variables, one for each production attribute included in a choice set. In any given observation, all but two of the production attributes take a value of 0. For the two remaining attributes in the observation, one production attribute takes a value of 1 (chosen as the most important) and the other takes a value of −1 (chosen as the least important). Thus, each of the $J(J-1)$ observations refers to a unique pair of production attributes that could be chosen as best and worst by the respondent simultaneously. Over these $J(J-1)$ observations, the variable choice takes a value of 0 for all but one observation, which refers to the actual best-worst pair chosen by the respondent for that question, and that variable choice takes a value of 1. Table 3 provides an example of a wide-form data observation.

Table 3. Wide-form Data Example

ID	Q15 Options	Q15 Best	Q15 Worst
1	5	1	2
2	5	3	2
3	5	5	4
4	5	3	1

In the wide-form example, there are four survey respondents referred to by identification numbers 1 through 4. "Q15 Options" refers to the number of attributes (5) contained in choice set 15 (question 15) and is the same for all respondents. "Q15 Best" refers to the attribute chosen by the respondent as most important in choice set 15 and, similarly, "Q15 Worst" refers to the attribute chosen by the respondent as least important in that choice set. In this case, respondent 3 answered question 15 by choosing attribute 5 as most important and attribute 4 as least important.

In Table 4, a portion of the wide-form example has been transformed into the long form. As previously noted, respondent 3 is presented with five sustainable farming production attributes in question 15. Thus, there are twenty (5 × 4) possible best-worst pairs from which to choose, corresponding to the twenty observations (rows of data). In each row, the five production attributes, labeled Q15-1 through Q15-5 for simplicity, take a value in [−1, 0, 1]. For example, the first row refers to the possibility that attribute 1 will be chosen as least important and attribute 2 as most important. The second row refers to the possibility that attribute 1 will be chosen as least important and attribute 3 as most important and so on. We see from the wide-form data that respondent 3 answered question 15 by choosing attribute 5 as most important and attribute 4 as least important. In the long-form version of the data, that choice is reflected in the variable taking a value of 1 for the observation that corresponds to that specific best-worst pair and 0 everywhere else.

Table 4. Long-form Data Example

ID	Choice	Q15-1	Q15-2	Q15-3	Q15-4	Q15-5
3	0	–1	1	0	0	0
3	0	–1	0	1	0	0
3	0	–1	0	0	1	0
3	0	–1	0	0	0	1
3	0	0	–1	1	0	0
3	0	0	–1	0	1	0
3	0	0	–1	0	0	1
3	0	1	–1	0	0	0
3	0	0	0	–1	1	0
3	0	0	0	–1	0	1
3	0	1	0	–1	0	0
3	0	0	1	–1	0	0
3	**1**	**0**	**0**	**0**	**–1**	**1**
3	0	1	0	0	–1	0
3	0	0	1	0	–1	0
3	0	0	0	1	–1	0
3	0	1	0	0	0	–1
3	0	0	1	0	0	–1
3	0	0	0	1	0	–1
3	0	0	0	0	1	–1

We use the long-form data in a logit-model analysis. Summary statistics from conditional logit model analyses are shown in Tables 6 (apples) and 7 (beef). The regression parameters are transformed into preference shares, allowing us to make interpretations that are more intuitive. The preference shares sum to one, and each represents the proportional share of importance for the given attribute relative to a value for consumer food prices, which is normalized to zero.

We randomly assigned half of the respondents to the survey on apple production practices and half to the survey on beef practices. We compare the results for apples and beef in Table 5**.** Those results indicate that the attribute corresponding to "farm size is small and corporate involvement is limited" had the highest preference share. As noted earlier, preference share parameters report the importance of a given sustainable farming production attribute on a ratio scale that reflects both the true importance of the attribute and relative

Table 5. Relative Importance of Sustainable Production Attributes: Logit Estimates

Apples			Beef		
Attribute	**λ**	**Preference Share**	**Attribute**	**λ**	**Preference Share**
Farm size is small and corporate involvement is limited	1.77 (0.05)	0.28	Farm size is small and corporate involvement is limited	1.41 (0.05)	0.28
Pollinator management is employed	1.25 (0.06)	0.15	Production, distribution, and sale is done locally	1.09 (0.06)	0.17
Ground cover and area management practices are employed	1.22 (0.06)	0.13	Pests are controlled using preventative measures and cultural and nutritional controls	0.80 (0.06)	0.12
Production, distribution, and sale is done locally	1.08 (0.06)	0.12	Feed is pasture-based and waste management systems are employed	0.47 (0.06)	0.09
Other pests are controlled using preventative measures and habitat controls	0.90 (0.05)	0.09	Prohibit use of subtherapeutic antibiotics	0.43 (0.06)	0.08
Fertilizer and nutrient materials are used minimally	0.78 (0.06)	0.08	Farmers are financially stable	0.34 (0.06)	0.08
Little to no chemical herbicides are used for weed management	0.56 (0.05)	0.06	Prohibit use of genetically modified livestock	0.23 (0.06)	0.07
Farmers are financially stable	0.29 (0.05)	0.04	Prohibit use of growth hormones	−0.08 (0.05)	0.05
Little to no chemical pesticides are used for pest management	0.14 (0.05)	0.03	Animal health and safety are protected	−0.10 (0.05)	0.04
Consumer food prices are affordable	Dropped	0.02	Consumer food prices are affordable	Dropped	0.02

uncertainty regarding its importance conveyed as the probability that the attribute is picked as more important than any other. After farm size, pollinator management received the next largest share. Worth noting is the moderately high share of the attribute corresponding to "production, distribution, and sale is done locally" at a little less than half the share of farm size. The attribute "Consumer food prices are affordable" was most often chosen as least important in every scenario and was therefore set as the base category.

These results can also be interpreted in relative magnitude. For example, pollinator management is inferred to be roughly half as important to the sampled consumers as farm size. In fact, in a sustainable agricultural system, farm size is a little more than twice as important as local production, distribution, and sale. The use of off-farm chemical inputs such as fertilizers, herbicides, and pesticides was three to four times less important than farm size and only marginally more important than consumer food prices. Overall, this sample of consumers indicated that the four economic attributes of sustainability included in this study fell near the boundaries of their utility spectrum.

As in the apple survey, respondents in the beef survey gave the largest preference share to the attribute corresponding to "farm size is small and corporate involvement is limited," followed by "production, distribution, and sale is done locally," suggesting that the locality of meat production is more important to consumers than the locality of apple production. This difference could be attributable to the fact that beef production is less place-specific than apple production since apples may not be able to be produced in the local climate. The ratio-scaled values indicate that locality is between one-half and three-quarters as important as farm size. The attribute corresponding to "animal health and safety is protected" had the lowest preference share other than affordable consumer food prices. The use of growth hormones also had a relatively low preference share.

When standardized to the ratio scale, the sampled consumers reported that farm size is seven times more important in a sustainable agricultural system than animal health and safety. Respondents in the beef survey ranked the financial well-being of farmers and ranchers and affordable consumer food prices in the bottom third on the underlying scale of importance, the same result found in the apple survey.

To better qualify distinct consumer segments, the data were also analyzed under a latent-class clustering framework. The ten best-worst attributes formed the dependent variables over the underlying probability distribution of latent-class inclusion. The analysis reveals that consumer clusters of similar perceptions about the ten sustainability attributes are located close to one another in the n-dimensional utility space. Identifying groups of consumers with similar perceptions is useful for advertising, pricing, and product development.

The optimal number of latent classes is determined by minimizing the Bayesian Information Criterion. This resulted in four latent classes of apple consumers and five latent classes of beef consumers. Table 6 (apples) and Table 7 (beef) outline the latent class structures. In each column, the parameter reported identifies the probability of an item response corresponding to a participant's endorsement of each attribute as most important.

For apples, the first cluster, representing 14 percent of the sample, consists of consumers who believe that local production is a highly important aspect of sustainable production. This group also strongly values preventative pest management and limited use of chemical herbicides. It is possible that the use of chemicals in production is undesirable for this cluster due to potential effects on local ecosystems and water resources.

The second cluster, representing 30 percent of the sample, perceives limited corporate involvement as important in a sustainable production system as indicated by their preference for small farm sizes and financial stability of farmers relative to other clusters. This group also emphasizes the importance of other farming attributes that are in line with current organic land use standards, such as ground cover and limited application of chemical inputs. This group probably places a higher value on organically labeled products and would like for farms in sustainable systems to be less consolidated.

Table 6. LCA Parameter Estimates: Probability of Apple Production Attribute Chosen as Most Important by Cluster

Attribute	Localvores (14 percent)	Small Business Enthusiasts (30 percent)	Price Savvy Shoppers (10 percent)	Sustainably Indifferent (46 percent)
Ground cover	0.0000	0.1852	0.0	0.0976
Fertilizer	0.0000	0.1852	0.0	0.0976
Pesticides	0.0000	0.1852	0.0	0.0976
Herbicides	0.3077	0.0000	0.0	0.1219
Pollinators	0.0000	0.1481	0.0	0.0976
Pest management	0.3846	0.0000	0.0	0.1220
Farm size	0.0000	0.1481	0.0	0.1219
Local	0.3077	0.0000	0.0	0.1220
Food prices	0.0000	0.0000	1.0	0.0000
Farmer stability	0.0000	0.1481	0.0	0.1220

Table 7. LCA Parameter Estimates: Probability of Beef Production Attribute Chosen as Most Important by Cluster

Attribute	Animal Rights Activists (15 percent)	Nutrition Buffs (24 percent)	Price Savvy Shoppers (10 percent)	Sustainably Indifferent (41 percent)	Say No to GMOs (10 percent)
Antibiotics	0.0000	0.1818	0.0	0.1351	0.0
Growth hormones	0.0000	0.2273	0.0	0.1081	0.0
Genetically modified organisms (GMOs)	0.0000	0.0000	0.0	0.0000	1.0
Animal safety	0.3077	0.0000	0.0	0.1351	0.0
Pest management	0.0000	0.0000	0.0	0.1081	0.0
Pasture-based feed	0.3846	0.2273	0.0	0.1081	0.0
Local	0.3077	0.0000	0.0	0.1351	0.0
Food prices	0.0000	0.0000	1.0	0.0000	0.0
Farm size	0.0000	0.1818	0.0	0.1351	0.0
Farmer stability	0.0000	0.1818	0.0	0.1351	0.0

The third cluster, representing 10 percent of the sample, is motivated primarily by consumer food prices. The fourth cluster, representing the largest portion of the sample at 46 percent, is made up of consumers who are indifferent across these particular attributes, may be confused about how the attributes relate to one another in a sustainable system, or perceive sustainability as a bundle of these attributes. Support for this assertion comes from their roughly equal ranking of all attributes. From this latent class assessment, we find that 56 percent of the evaluated respondents in the apple survey are either driven primarily by price or largely indifferent to the value of the studied aspects of sustainability.

For beef, the first cluster, representing 15 percent of the sample, values ethical treatment of animals in meat production as evidenced by the high probability of their choosing preservation of animal health and safety and pasture-based feed as most important in a sustainable system. Additionally, this cluster perceives local production and limited corporate involvement as desirable contributions.

The second cluster, comprising 24 percent of the sample, is primarily concerned with the safety and nutritional aspects of their food decisions. This cluster of respondents most often chose prohibition of subtherapeutic antibiotics and bovine growth hormone along with pastured feed as the most important attributes of sustainable production systems. Additionally, they value small farms and the financial stability of farmers. Since small-scale farmers may be inclined to maintain a more direct connection with their consumer base, better food safety and traceability standards may be attainable, explaining the correlation.

The third and fourth clusters share the same two characteristics—price savvy shoppers (10 percent) and sustainability-indifferent consumers (41 percent)—with the apple survey. Together, the two clusters comprise 51 percent of the beef sample. However, a distinct fifth cluster emerges in the beef survey. It is comprised of consumers who chose the prohibition of genetically modified livestock as most important in every choice set in which it appeared. While this segment of the market is small, it may offer significant opportunities for producers who do not use genetically modified products and for marketing firms that could emphasize this attribute in a labeling scheme.

Conclusions

Best-worst analysis was applied in this research to investigate the degree of importance consumers give to ten sustainable farming production attributes and to determine behavioral differences across clustered subgroups of the population sample. The advantages of this methodology over more traditional stated-preference analyses are evident in its greater discriminatory power for measuring tradeoff decisions and its wider applicability and interpretation outside of the survey's context. Best-worst analysis results avoid common rating bias and can be used in cross-national and cross-regional comparison studies of diverse populations and their judgments regarding similar attributes. This study gives credence to the strong ability of the best-worst method to yield clear, simple interpretations. The simplicity of this analysis allows it to be applied by marketing managers to gain insight into the evaluation behavior of different consumer segments for targeted food labeling.

The information gleaned from consumers' perceptions of sustainable farming practices offers valuable guidance for marketing managers. The unique best-worst framework provides greater insight into determinants of market behavior than more commonly used Likert-scale ranking approaches. In both the beef and the apple survey, consumers indicated a strong perceptive correlation between sustainability and the size and locality of the farm of origin. This analysis suggests, along with Onozaka and Thilmany McFadden (2011), that consumers associate quality differences with locally grown and distributed products. Supporting studies, such as that of Bond, Thilmany, and Keeling-Bond (2008), have demonstrated that a preference for local food products is related to farmer viability, sustaining local farm land, and contributing to smaller local economies. Our work supports those findings, providing evidence that scale and geographic range factor heavily into consumers' perceptions of food labeled as sustainably produced.

Increasing attention to smaller local farms is one response to widening awareness of the conduct of global food-system businesses. Distrust of imported foods, especially meat products, has grown in response to publicity related to country-of-origin labeling requirements and other high-profile food contamination cases. Sustainability claims on food labels target many dimensions of consumer utility—from concerns about quality and safety to intrinsic valuations connected to underlying values such as fairness and environmental impacts. In effect, consumers may see some sustainability claims as substitutable and others as complementary, another point emphasized by Onozaka and Thilmany McFadden (2011). Sustainable certification may contribute only marginally to the value of localness of a food product in some situations; in others, it may enhance consumers' commitments to a more well-rounded sustainable-farming viewpoint.

While consumers are generally familiar with organic standards that proscribe land use and environmental impact variables of production, this study indicates that environmental indicators of sustainability are less important to consumers than economic dimensions. Based on our initial results, size, scale, and geographic scope capture the attributes of sustainability that are most important to consumers, which is supported by the growing literature on the local food movement. Therefore, differentiating food claims on level of locality is a marketing avenue worth exploring further.

Our study also provides evidence that the term "sustainable" may be more apt to cause confusion than to add value to labeling schemes. The latent class assessments for both beef and apple consumers indicate that 50–55 percent of the evaluated population was either primarily driven by price or significantly indifferent to the value of various sustainability attributes. Given the extent of heterogeneous economic welfare impacts that would come from across-the-board market adjustments such as mandatory sustainability labeling and bans on select farming practices, this is an important result. Extensions of this work could concentrate on estimating willingness to pay for food labeled as sustainably produced relative to competing niche markets such as organic and local.

References

Batte, M.T. 2010. "Consumer-driven Changes in Food Marketing Channels: Organics and Sustainable Food Systems in the United States: Discussion." *American Journal of Agricultural Economics* 93(2): 604–605.

Bond, C.A., D. Thilmany, and J. Keeling-Bond. 2008. "Understanding Consumer Interest in Product and Process Based Attributes for Fresh Produce." *Agribusiness* 24: 231–252.

Callens, I., and D. Tyteca. 1999. "Towards Indicators of Sustainable Development for Firms: A Productive Efficiency Perspective." *Ecological Economics* 28: 41–53.

Casini, L., and A.M. Corsi. 2009. "Consumer Preferences of Wine in Italy Applying Best-worst Scaling." *International Journal of Wine Business Research* 21(1): 64–78.

Clonan, A., M. Holdsworth, J. Swift, and P. Wilson. 2010. "UK Consumers' Priorities for Sustainable Food Purchases." Proceedings of the 84th Annual Conference of the Agricultural Economics Society, 2010, Edinburgh, Scotland. Available at http://purl.umn.edu/91948.

Cohen, E. 2009. "Applying Best-worst Scaling to Wine Marketing." *International Journal of Wine Business Research* 21: 8–23.

Flynn, A., and J.J. Louviere. 1992. "Determining the Appropriate Response to Evidence of Public Concern: The Case of Food Safety." *Journal of Public Policy and Marketing* 11:12–25.

Flynn, T.N., J.J. Louviere, T.J. Peters, and J. Coast. 2007. "Best-worst Scaling: What It Can Do for Health Care Research and How to Do It." *Journal of Health Economics* 26:171–189.

Lusk, J.L., and B. Briggeman. 2009. "Food Values." *American Journal of Agricultural Economics* 91: 1–13.

Lusk, J., and N. Parker. 2009. "Consumer Preferences for Amount and Type of Fat in Ground Beef." *Journal of Agricultural and Applied Economics* 41(1):75–90.

Marley, A.A.J., and J.J. Louviere. 2005. "Some Probabilistic Models of Best, Worst, and Best-worst Choices." *Journal of Mathematical Psychology* 49: 464–480.

Mueller, S., and C. Rungie. 2009. "Is There More Information in Best-worst Choice Data? Using Attitude Heterogeneity Structure to Identify Consumer Segments." *International Journal of Wine Business Research* 21: 21–40.

National Agricultural Library, USDA. 2009. "Sustainable Agriculture: Information Access Tools." NAL, USDA, Washington, DC. Available at www.nal.usda.gov/afsic/pubs/agnic/susag.shtml (accessed July 2013).

National Agricultural Library, USDA. 2007. "Sustainable Agriculture: Definitions and Terms." NAL, USDA, Washington, DC. Available at www.nal.usda.gov/afsic/pubs/terms/srb9902.shtml#toc2 (accessed July 2013).

Onozaka, Y., and D. Thilmany McFadden. 2010. "Defining Sustainable Food Market Segments: Do Motivations and Values Vary by Shopping Locale?" *American Journal of Agricultural Economics* 93(2): 583–589.

———. 2011. "Does Local Labeled Complement or Compete with Other Sustainable Labels? A Conjoint Analysis of Direct and Joint Values for Fresh Produce Claims." *American Journal of Agricultural Economics* 93(3): 693–706.

Saunders, C., M. Guenther, W. Kaye-Blake, S. Miller, and P. Tait. 2010. "Consumer Attitudes toward Sustainability Attributes on Food Labels." Proceedings of the 2010 New Zealand Agricultural and Resource Economics Society Conference, Nelson, New Zealand. Available at http://purl.umn.edu/96944.

Scarpa, R., S. Notaro, J. Louviere, and R. Raffaelli. 2011. "Exploring Scale Effects of Best/Worst Rank Ordered Choice Data to Estimate Benefits of Tourism in Alpine Grazing Commons." *American Journal of Agricultural Economics* 93(3): 813–828.

Thurstone, L.L. 1927. "The Method of Paired Comparisons for Social Values." *Journal of Abnormal and Social Psychology* 21(1927): 384–400.

Umberger, W.J., R. Stringer, and S.C. Mueller. 2010. "Using Best-Worst Scaling to Determine Market Channel Choice by Small Farmers in Indonesia." Presentation at the 2010 Annual Meeting of the Agricultural and Applied Economics Association, Denver, Colorado.