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Chinese consumer quality perception and preference of sustainable milk

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ABSTRACT

A sustainable food consumption and production system is at the center of the global sustainability initiative. With the world's largest population and rapidly growing environmental concerns, it is urgent for China to develop effective ways to motivate sustainable food consumption and production. Understanding consumer perception and preference of sustainable food provides critical information for Chinese policy makers to identify barriers and develop rules and policies to reach this goal. Our paper shows that most Chinese consumers do not clearly understand the meaning of sustainability, and lack knowledge about sustainable food production. The premium that consumers are willing to pay for sustainable milk is about 40%. Consumers who do not perceive the linkage between sustainable production and food quality have a significant lower willingness to pay for sustainable milk. Interestingly, people with children are more willing to pay for sustainable milk, suggesting a potential overgeneration concern about sustainable development.

1. Introduction

With improved understanding of the social and environmental impact of human activities, social, environmental, and economic sustainability development has become accepted and is being promoted globally. For instance, more than 178 governments signed Agenda 21, the Rio Declaration on Environment and Development, and adopted the principles for the Sustainable Management of Forests at the United Nations Conference on Environment and Development (UNCED) held in Brazil in 1992 (UNCED, 1992). The UNCED changed to the United Nations Conference on Sustainable Development (Rio + 20) in 2012, which was one of the largest conferences ever held by the United Nations (UN) (UNDESA, 2015a). Later, participants of the 2015 conference adopted the 2030 Agenda for Sustainable Development (UNDESA, 2015b). Sustainable development is complex and comprehensive and one of the indispensable components of it is sustainable food consumption and production. How food is produced and consumed has a great implication on the conservation of natural ecosystems and environments (Food and Agriculture Organization [FAO], 2015). This is particularly true for China which has limited natural resources to feed the world's largest population. Whether China can develop a sustainable consumption and production system will significantly affect its food security, food safety, environment, and ecosystems (Zhou & Li, 2014).

Sustainable food is food produced by taking into consideration its environmental impact, economic viability, and social justice principles (UNCED, 1992; Yanarella, Levine, & Lancaster, 2009). A sustainable food consumption and production system is

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consumer-driven. Individual lifestyles, diets, consumption habits, and food preferences have an influential impact on the amounts, the types, and the ways that food is produced (FAO, 2015). Before the twentieth century, people had limited knowledge of the effect of food production on the environment, ecosystems, and human health. Take for instance the globally promoted Green Revolution which focused on the use of modern agricultural technology and chemicals to improve food production output (Davies, 2003). With increased understanding of the effects of the heavy use of fossil-based chemicals, the Green Revolution was criticized for its negative impact on biodiversity, human health, income distribution, and sustainability (Byerlee & Siddiq, 1994; Conway & Barbie, 1988). As a result, people became increasingly concerned about the environmental and social impacts of food production, and began changing their food choices (De Pelsmacker, Driesen, & Rayp, 2005; Loureiro & Lotade, 2005; Loureiro, McCluskey, & Mittelhammer, 2002; Xie, Gao, Swisher, & Zhao, 2015). Consumer demand for food that is healthy, environmentally friendly, and produced in a way that bears more social responsibility has significantly changed agriculture and the food industry. More food manufacturers are supplying food carrying labels that indicate the credence attributes of food such as Organic, Fair Trade, and Locally Produced. For instance, the global sales of organic products increased from $15.2 billion in 1999 to $72 billion in 2013 (currency in US dollars), and the land dedicated to organic production increased from 11 million ha in 1999 to 43.1 million ha in 2013 (Willer & Lernoud, 2015). China experienced the same type of changes. Chinese organic market value increased dramatically from $500 million in 2007 to $1.1 billion in 2008. Compared to 2012, the 2013 sales of organic honey and organic cereals in the Chinese market increased by more than 45%, valued about $0.97 billion. Meanwhile, the organic certifications to products also saw a surge of 50% in 2013 (Green Guide, 2014; International Trade Center [ITC], 2011). To meet the increasing but heterogeneous demand for safer and more environmentally friendly food products, the Chinese government adopted a three-tier system that certifies Safe Food, Green Food, and Organic Food (Yu, Gao, & Zeng, 2014). Due to the influential role of consumer food choices, identifying consumer preferences of sustainable foods and the important factors affecting consumer preferences would provide important information to develop and promote a sustainable food consumption and production system.

Most of the current literature on consumer preferences of sustainable foods focuses on food labels, such as organic labels (Hughner, McDonagh, Prothero, Shultz, & Stanton, 2007; Sirieix, Delanchy, Remaud, Zepeda, & Gurviez, 2013; Xie et al., 2015), eco-labels (Grunert, Hieke, & Wills, 2014; Loureiro et al., 2002; Vlaeminck, Jiang, & Vranken, 2014), fair trade labels (Grunert et al., 2014; Sirieix et al., 2013), animal welfare labels (Lagerkvist & Hess, 2011; Liljenstolpe, 2008; Napolitano, Pacelli, Girolami, & Braghieri, 2008), and local food (Darby, Batte, Ernst, & Roe, 2008; Thilmany, Bond, & Bond, 2008). These researches show that consumers generally are willing to pay more for food with certain types of sustainable labels and that heterogeneous preferences exist among consumers. While foods carrying these labels are produced in certain sustainable ways, sustainable food is a more comprehensive and complex concept, with few researches specifically investigating consumer preference of foods carrying the sustainable label. One exception is the Sirieix et al. study (2013) which examined UK consumers' perception of the Sustainable Agriculture label. The definition of the sustainable label in this study is narrowed down to “labels that indicate the products were grown with practices that had a low impact on the environment” (Sirieix et al., 2013, p. 146). Nevertheless, evidence shows that previous research has not examined consumer preference of sustainable labels that reflect the comprehensive economic, social, and environmental responsibilities regarding food production.

The literature on Chinese consumer preferences of different types of sustainable labels is rather limited, mostly focusing on organic, green, and fair trade labels. Yin, Wu, Du, and Chen (2010) conclude that consumers are willing to pay a premium as high as 130% for organic food in some cities of China. Xu, Zeng, Fong, Lone, and Liu (2012) show that Chinese consumer willingness to pay (WTP) for green-labeled and eco-labeled seafood is higher than those for non-certified seafood. In addition, green-labeled seafood receives a higher premium than eco-labeled seafood. Yu et al. (2014) demonstrate that Chinese consumers are willing to pay 47% and 40% more for green vegetables and meat, respectively, than for their conventional counterparts. Yang, Qing, Hu, and Liu (2013) show that Chinese consumers have a positive attitude and WTP for fair trade coffee. The higher WTP for organic or green food may result from the intention to protect both self-interests and social-interests, especially natural food resource sustainability (Xu et al., 2012). The impact of age, income, food expenditure, and education on consumer WTP and purchase intention of these foods is unclear. Research shows that income has a significant positive effect on consumer WTP and purchase intention for some but not for others (Yin et al., 2010; Yu et al., 2014). Xu et al. (2012) demonstrate that education has a significant positive impact on consumer WTP for eco-labeled seafood, while Yin et al. (2010) and Yu et al. (2014) do not find any significant impact of education on Chinese consumer WTP for different types of sustainable labels.

Obvious gaps exist between current knowledge and the need for a better understanding of Chinese consumer preference and demand for sustainable food. More information on consumer preference of sustainable food will help develop policies and programs that can more effectively promote sustainable food consumption, which is an indispensable part of the sustainable development of China's agriculture and food system. The objective of this research is to fill this gap by identifying Chinese consumers' perception of sustainable foods and their WTP for these foods. Perception has a significant impact on consumer preference formulation (Thang & Tan, 2003). Determining consumer perception of sustainable food is important because sustainability is often confused with “good for the environment” green labels and/or eco-labels (Yanarella et al., 2009).

In this study, we determine Chinese consumer perception and preference of sustainable fluid milk, which is produced with less impact on the environment, improved animal welfare, etc. We choose milk because dairy products provide nutrients such as calcium, vitamin D, and potassium that are essential for individual health, and fluid milk accounts for about 95% of Chinese consumers' dairy consumption. Although historically under-consumed by Chinese consumers (Garnaut & Ma, 1993), milk has become an integrated part of Chinese consumers' daily diet, with consumption increasing at an annual rate of 10% from 1990 to 2016 (Bai, Wahl, & McCluskey, 2008; Untied States Department of Agriculture, Foreign Agricultural Service [USDA/FAS],

2016). Increased consumption not only provides market opportunities, but also places great pressure on domestic dairy producers. Mainly due to the mismatch between the fast growing dairy industry and effective regulations and food safety control, the Chinese milk industry experienced several severe food safety incidents (e.g., the 2008 milk scandal) that damaged consumer confidence in domestic milk products (Jia, Huang, Luan, Rozelle, & Swinnen, 2012; Pei et al., 2011). The dramatic increase in the number of dairy cattle also creates some environmental problems because many dairy farms are small and lack the incentives and facilities to produce milk in socially responsible ways that are both environmentally and animal friendly (Shefali & Zhang, 2014). These evidences suggest that promoting sustainable milk consumption may be an important approach to alleviate many of the problems in the dairy industry regarding food safety, animal welfare, the environment, and social responsibility. On the one hand, if the dairy industry can produce milk sustainably, it may recover Chinese consumers' confidence in domestically produced milk products. On the other hand, if consumers are willing to pay more for sustainable milk products, the dairy industry will have more incentives to produce high quality dairy products in an environmental and animal friendly and social responsible way.

2. Methods and data

2.1. Theoretical model

Based on Lancaster's (1966) theory of utility maximization, a consumer will select the product attribute combination that maximizes the consumer's utility. This will result in a utility function (z), where z is a vector of the product attribute (Lancaster, 1966). Without losing generality, we define consumer utility function over a milk product as

$$U(z)_{ij} = \beta_0 \cdot P_{ij} + \beta_1 \cdot \left(S_{ij}, X_i\right) \tag{1}$$

where P_{ij} is the price of the milk j, S_{ij} indicates whether the milk is produced with a sustainable method, and X_i is a vector of the demographic and perception variables. When facing two alternatives, j and k, consumers will select the product that give the maximized utility such that

$$\Pr(y = j) = Pr\left\{U(z)_{ij} > U(z)_{ik}\right\}. \tag{2}$$

Consumer WTP for sustainable food can be defined as the amount of premium for sustainable food that makes the consumer utility indifferent between sustainable food (S_{i1}) and conventional food (S_{i0}), that is,

$$\beta_0 \cdot (P_{i0} + \mathrm{WTP}) + \beta_1 \cdot (S_{i1}, X_i) = \beta_0 \cdot P_{i0} + \beta_1 \cdot (S_{i0}, X_i). \tag{3}$$

This results in $\frac{\beta_1}{\beta_0}((S_1, X_1) - (S_0, X_1))$, where $\frac{\beta_1}{\beta_0}$ is the marginal effect of X on consumer WTP for sustainable food.

2.2. WTP elicitation method

Consumer WTP can be estimated by stated preference or revealed preference methods. Revealed preference methods using consumer real purchase data more truthfully reflect consumer preference and choice in the real world market than do stated preference methods. However, revealed preference methods make it more difficult to observe multiple observations of an individual's choice of products having different characteristics. And when the product being studied is unavailable in the market, the revealed preference data will also be unavailable (Adamowicz, Louviere, & Williams, 1994; Hensher, Rose, & Greene, 2005). In such a situation, we must turn to stated preference methods. Contingent valuation (CV) is a popular stated preference method that is widely used to elicit consumer preferences of market and non-market goods (Hanemann, 1984; Hu, Woods, Bastin, Cox, & You, 2011). CV methods include using open-ended questions or close-ended questions to elicit consumer WTP (Loomis, 1990). Open-ended questions ask consumers to directly state the prices that they are willing to pay for a product or service; while close-ended questions ask whether consumers are willing to pay for a product or service at several proposed prices (Kealy & Turner, 1993; Loomis, 1990). Although open-ended CV is easily understood and provides more flexibility for consumers to state their WTP, sometime it is difficult for consumers to name their own prices so they need reference prices to help them formulate the value (Muller & Ruffieux, 2011; Shi, Gao, & Chen, 2014). In addition, open-ended CV always results in zero bids, which may cause some problems in econometric model estimation (Alvarez-Farizo, 1999; Bateman, Langford, Turner, Willis, & Garrod, 1995). In this paper, we use a double-bounded CV method. This method asks whether consumers are willing to pay a certain price (e.g., A) for a product being evaluated. If consumers are willing to do so, a follow-up question asks whether they are willing to pay a higher price (e.g., AH); if they are not willing to do so, a follow-up question asks whether consumers are willing to pay a lower price (e.g., AL). Compared with other popular CV methods, such as the open-ended CV method, the responses in a double-bounded CV do not show a significant scope effect (Ready, Buzby, & Hu, 1996). In addition, a double-bounded CV method generates more efficient WTP estimates than a single-bounded CV that does not ask for consumers' responses to a follow-up higher or lower price (Hanemann, Loomis, & Kanninen, 1991).

In this study, consumers were asked to answers the following question:

Suppose that a box of 250 ml regular fluid milk is sold in-store at a price of X RMB. Are you willing to pay a premium of A RMB more for milk that is labeled as 'Produced with Sustainable Production Method'?

If consumers answered *No* to price *A*, they were then asked whether they would be willing to pay a lower premium for the sustainable milk (A_L); otherwise, consumers would be asked whether they would be willing to pay a higher premium (A_H) for the sustainable milk. To reduce the starting value bias (Herriges & Shogren, 1996), we included three prices for the regular (conventional) fluid milk: 2.5 RMB, 3.5 RMB, and 4.5 RMB. The premium prices for the sustainable milk were 0.5 RMB, 1.0 RMB, and 1.5 RMB for AL, A, and AH, respectively. We purposely did not provide the definition of *Sustainable Production Method* to avoid biasing consumers' perception of sustainable food.[1] This is different from previous studies that narrowed sustainable food to specific food characteristics or functions (e.g., Sirieix et al. (2013) defines sustainable food as foods that only carry an environmental benefit). In this way, we can better capture the impact of consumer perception of sustainable food on their WTP.

2.3. Econometric model

Following Hanemann et al. (1991), we denote consumer responses to price *A* as *Y1*, and their responses to follow-up price *AL* or *AH* as *Y2*; thus there are four outcomes based on the responses in a double-bounded CV method.

$$Y_1 = No, Y_2 = No, if\ -\infty < \mathrm{WTP} < A_L \tag{4}$$

$$Y_1 = No, Y_2 = Yes, if\ \ A_L \le \mathrm{WTP} < A \tag{5}$$

$$Y_1 = Yes, Y_2 = No, if\ \ A \le \mathrm{WTP} < A_H \tag{6}$$

$$Y_1 = Yes, Y_2 = Yes, if\ \ A_H \le \mathrm{WTP} < \infty. \tag{7}$$

Assuming that the WTP can be modeled as a linear function,

$$\mathrm{WTP}_i = X_i' \cdot \beta + \varepsilon_i \tag{8}$$

where X_i is a vector of demographic and preference variables and ε_i is the random error following normal distribution, $\varepsilon_i \sim N(0,\sigma^2)$. Accordingly, the probability that a consumer gives the answer $Y_1 = No$, $Y_2 = No$ is

$\Pr(Y_1 = No, Y_2 = No) = \Pr(X_i' \cdot \beta + \varepsilon_i < A_L) = \Phi\left(\frac{A_L - X_i' \cdot \beta}{\sigma}\right) = 1 - \Phi\left(X_i' \cdot \frac{\beta}{\sigma} - \frac{A_L}{\sigma}\right)$, where Φ is a cumulative distribution function of the standard normal distribution.

The probability for Eqs. (5) to (7) can be calculated in a similar way. The associated log likelihood function is

$$LogL = \sum_{i=1}^{N}\left[I_i^{nn}\ \ln\left(1-\Phi\left(X_i' \cdot \frac{\beta}{\sigma} - \frac{A_L}{\sigma}\right)\right) + I_i^{ny}\ \ln\left(\Phi\left(X_i' \cdot \frac{\beta}{\sigma} - \frac{A_L}{\sigma}\right) - \Phi\left(X_i' \cdot \frac{\beta}{\sigma} - \frac{A}{\sigma}\right)\right) + I_i^{yn}\ \ln\left(\Phi\left(X_i' \cdot \frac{\beta}{\sigma} - \frac{A}{\sigma}\right) - \Phi\left(X_i' \cdot \frac{\beta}{\sigma} - \frac{A_H}{\sigma}\right)\right) + I_i^{yy}\ \ln\left(\Phi\left(X_i' \cdot \frac{\beta}{\sigma} - \frac{A_H}{\sigma}\right)\right)\right] \tag{9}$$

where I_i^{nn} is an indicator variable indicating consumers' answers to the two WTP questions in the double-bounded CV method. Eq. (9) can be estimated with the maximum likelihood method, and the expected value of the WTP can be calculated as $E(\mathrm{WTP}_i) = X_i' \cdot \beta$ (Hanemann et al., 1991; Lopez-Feldman, 2012).

3. Data collection and results

A survey designed to understand Chinese consumers' perception and WTP for sustainable milk was conducted in May 2015. The survey was conducted in three districts (Xicheng, Haidian, and Changping) of the greater metropolitan areas in Beijing. Two supermarkets in each district were selected by considering geographic representativeness for the survey.[2] The trained enumerators interviewed every second shopper exiting the grocery stores at each location. Each selected respondent was randomly

[1] Rather than directly providing a definition of "Sustainable Milk" we asked respondents' perceptions of sustainable milk. There are two main reasons for us to do this. First, not providing the definition creates a situation that is more similar to the real world scenario, where a definition of such concept is rarely provided during consumers' everyday shopping exercise. Second, providing any definition will bias respondents' perceptions, which may bias the estimation of consumer WTP because perception is one of the most important factors that affects consumer behavior (Zeithaml, 1988).

[2] There are several reasons for the choice of the supermarkets in selecting our sample. First, the specific product used to estimate consumer WTP is boxed milk which is most likely sold in supermarkets and hypermarkets. Second, supermarkets and hypermarkets have become very popular in the urban areas of China. In 2014, there are a total 42,683 supermarkets and hypermarkets in China, accounting for 71% of the retail stores that sell groceries (e.g., excluding department stores that do not sell food, and specialty stores that mainly target high-end consumers and may not sell food). Almost all urban households shop at supermarkets or hypermarkets for groceries.

given one of three versions of the survey, each with different prices for regular/conventional fluid milk. A bottle of shampoo valued at about $3 was provided upon survey completion as a participation incentive. Altogether, 307 responses were collected and retained for analysis, which resulted in 99, 92, and 116 respondents for the surveys, with prices for regular milk listed as 2.5 RMB, 3.5 RMB, and 4.5 RMB, respectively.

Table 1 reports the sample demographic statistics. About 59% of the survey respondents were female, which was consistent with the fact that females shop more frequently than males and they contribute more than half of the purchasing power in China (Rein, 2009; Shi et al., 2014). The median monthly household income was between 7001 and 10,000 RMB, consistent with that of household monthly income in Beijing. About 49% of the respondents had college or postgraduate degrees, and 54% were aged 34 years old or younger. In addition, more that 50% of our samples had children at home.

3.1. Perception of sustainable milk

Fig. 1 reports the statistics of respondents' perception of fluid milk labeled as produced using a sustainable production method. Sustainable food is food produced using methods that can promote sustainability in the environment, society, and economics. This is in contrast with the perception of many people who think that sustainable food only provides environmental benefits (Yanarella et al., 2009). This misunderstanding may significantly affect consumers' preferences and choices of sustainable food. Therefore, determining consumer perception of sustainable food is important to identify the barriers to consuming sustainable food. To do this, respondents were asked whether they perceived several product qualities when they saw the label "Produced with Sustainable Production Method" on fluid milk. These product qualities include Better Milk Quality, Safer, More Trustable, Good for the Environment, Good for Animal Welfare, More Socially Responsible, and Better Taste. These cover most of the intrinsic and extrinsic qualities of fluid milk that may influence consumer choice (Olynk, Tonsor, & Wolf, 2010; Tonsor & Wolf, 2012; Wang, Mao, & Gale, 2008). Respondents could also select "Do Not Know" if they did not have any idea what sustainably produced milk means regarding product quality.

Results in Fig. 1 show that most respondents (44%) thought milk labeled "Produced with Sustainable Production Method" was produced in a more environmentally friendly way. The percentage of respondents who thought sustainable milk was better quality, safer, more trustable, and produced in a more socially responsible way ranged from 21% to 26%. Respondents were least likely to perceive sustainable milk as having better taste and produced in a more animal friendly way. In addition, 21% respondents stated that they did not know what "Produced with Sustainable Production Method" meant regarding milk quality. These results are consistent with Yanarella et al. (2009) who argue that most consumers confuse sustainability with "greenness" and simply consider sustainability as environmentally friendly.

3.2. Answer to double bounded CV question and WTP for sustainable milk

Table 2 reports the statistics of respondents' answers to the CV question in the three versions of the survey, each with different prices for regular/conventional fluid milk. Results show that the percentages of respondents who answered "Yes, Yes" to the CV

Table 1
Demographic statistics of survey respondents (n = 307).

	Sample	Population (Beijing, 2014)[a]
Variables	Percentage (%)	
Female	58.89	49.44
Age		
Age (≤25)	18.75	90.48%
Age (26–34)	35.53	
Age (35–44)	19.41	
Age (45–64)	18.42	
Age (>64)	7.89	9.52%
Income (RMB/month)		Average monthly household income
Income (<7000)	26.64	8088.50
Income (7001–10,000)	27.30	
Income (10,001–16,000)	24.34	
Income (16,001–25,000)	13.49	
Income (>25,001)	8.22	
Education level		
Middle school or less	13.49	
High school degree	14.14	
Associate degree	23.36	
Bachelor's degree	32.89	
Post-graduate degree (MS or doctoral)	16.12	
Has children		
Yes	52.63	
No	46.25	

[a] The data are from the National Bureau of Statistics of China and are based on the total population of urban residents in those four cities.

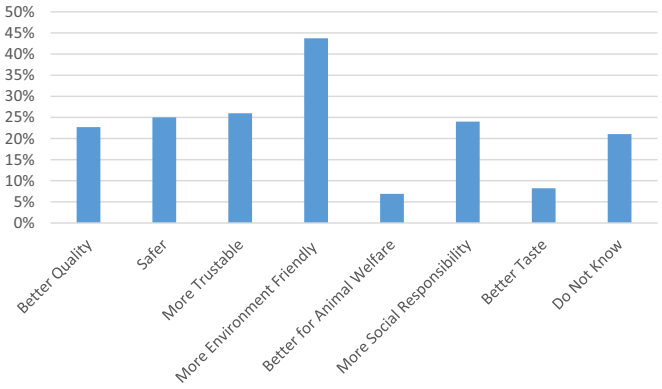

Fig. 1. Perception of sustainable milk.

Table 2
Statistics of respondents' answers to CV questions.

Base price	Premium	Percentage of respondents across three base price	Total WTP	Percentage of respondents			
				Yes, Yes	Yes, No	No, Yes	No, No
2.5	<0.5		<3.0				21%
2.5	0.5		3.0			10%	
2.5	1.0		3.5		22%		
2.5	1.5		≥4.0	47%			
3.5	<0.5	19%	<4.0				16%
3.5	0.5	16%	4.0			15%	
3.5	1.0	19%	4.5		18%		
3.5	1.5	45%	≥5.0	50%			
4.5	<0.5		<5.0				20%
4.5	0.5		5.0			22%	
4.5	1.0		5.5		18%		
4.5	1.5		≥6.0	41%			

question were 47%, 50%, and 41% when the prices of conventional milk were 2.5 RMB, 3.5 RMB, and 4.5 RMB, respectively. This generally reflects a downward sloping demand curve where the number of respondents decreased when the total price of sustainable milk increased from 4.0 RMB to 6.0 RMB.[3] The percentages of respondents who answered "No" to the CV question were 21%, 16%, and 20% when the prices of conventional milk were 2.5 RMB, 3.5 RMB, and 4.5 RMB, respectively. These results demonstrate the impact of starting values on respondents' answers to the CV question, implying the importance of using multiple prices of conventional milk as the base product. Summarizing the results from all three versions of the survey, more than 80% of the respondents were willing to pay a premium of 0.5 RMB or higher for sustainable milk over conventional milk. The percentages of respondents who were willing to pay 1.5 RMB, 1.0 RMB, 0.5 RBM, and less than 0.5 RBM more for sustainable milk than for conventional milk were 45%, 19%, 16%, and 19%, respectively.

The maximum likelihood method estimation in Eq. (9) used the interval regression procedure in SAS 9.4 (SAS, 2008). The dependent variables were the right and left censored total WTP for sustainable milk; the independent variables were demographic variables (such as age, gender, income, education level, and whether or not the respondents had children), and the perception variables presented in Fig. 1. Other than income, all other variables were included in the model as categorical variables.[4] Male, middle school or less, do not have children, and do not perceive that sustainable milk has certain attributes were used as the benchmark categories for gender, education level, having children, and perception of sustainable milk, respectively. To control the starting value bias, we also included two variables, Base Price 2.5 RMB and Base Price 3.5 RMB, where Base Price 4.5 RMB for conventional milk was used as the benchmark category.

To get the most efficient estimates of the parameters in the regression model, we used the forward, backward, and stepwise selection methods to determine the variables that should be kept in the final models. Both Akaike's information criterion (AIC) and log-likelihood ratio test are used for model comparison and selection. Table 3 reports the regression results for Eq. (9)

[3] The base prices are 2.5 RMB, 3.5 RMB, and 4.5 RMB, respectively, in the three versions of the surveys. When respondents answered "Yes, Yes" to both CV questions, the premium for sustainable milk is 1.5 RMB. This indicates that the total WTPs for sustainable milk are 4.0 RMB (2.5 + 1.5), 5.0 RMB (3.5 + 1.5), and 6.0 RMB (4.5 + 1.5), respectively, in the three versions of the survey.

[4] Income was treated as both a continuous and a categorical variable. Because results did not show that income had a non-linear effect on consumer WTP, income was included as a continuous variable in the final model.

Table 3
Regression results with stepwise, backward, and forward selection.

	Model 1			Model 2 (controlling starting price)		
Parameter	Estimate	95% confidence limits		Estimate	95% confidence limits	
Intercept	5.62***	(4.79	6.46)	6.35***	(5.86	6.83)
	(0.43)			(0.25)		
Better quality	0.59***	(0.07	1.10	0.30**	(0.02	0.59)
	(0.26)			(0.14)		
More trustable	0.41*	(−0.07	0.89)			
	(0.25)					
More social responsibility	0.57***	(0.08	1.07)			
	(0.25)					
Do not know	−1.43***	(−2.00	−0.87)	−1.04***	(−1.33	−0.75)
	(0.29)			(0.15)		
High school degree	0.11	(−0.61	0.84)	0.003	(−0.40	0.41)
	(0.37)			(0.21)		
Associate degree	0.14	(−0.52	0.80)	−0.004	(−0.38	0.37)
	(0.34)			(0.19)		
Bachelor's degree	−0.25	(−0.86	0.36)	−0.22	(−0.56	0.13)
	(0.31)			(0.18)		
Post-graduate degree	−0.67	(−1.37	0.04)	−0.47**	(−0.85	−0.08)
	(0.36)			(0.20)		
Has children	0.15	(−0.10	0.68)	0.21*	(−0.01	0.42)
	(0.20)			(0.11)		
Base price 3.5 RMB				−0.81***	(−1.08	−0.55)
				(0.13)		
Base Price 2.5 RMB				−1.81***	(−2.06	−1.55)
				(0.13)		
Scale	1.43***	(1.24	1.65)	0.82***	(0.70	0.96)
	(0.10)			(0.07)		
−2 Log likelihood	782.95			698.46		
AIC (smaller is better)	804.95			720.46		

Notes: All the three selection methods give the same results, therefore, only a set of results is reported. * indicates that the coefficient is statistically significant at 10% significance level. ** indicates that the coefficient is statistically significant at 5% significance level. *** indicates that the coefficient is statistically significant at 1% significance level.

with (model 2) and without (model 1) controlling the starting prices of conventional milk.[5] However, the log likelihood value and Akaike's information criterion (AIC) indicate that model 2 which controls the price of conventional milk provides more efficient estimates. Therefore, the rest of the paper focuses on the results of model 2.

Results show that the coefficient of Base Price 2.5 RMB and Base Price 3.5 RMB were all significantly negative at the 1% significance level. The survey that used 2.5 RMB and 3.5 RMB as the prices of conventional milk resulted in significantly lower WTP estimates for sustainable milk, implying the importance of controlling the starting value bias in a double-bounded CV method (Herriges & Shogren, 1996; Yang et al., 2013). The coefficients of most of the demographic variables were not significant, which is consistent with the previous research that shows attitudinal and behavioral variables are more important in explaining consumer preferences (Dimech, Caputo, & Canavari, 2011; Gao et al., 2011; Gao, Wong, House, & Spreen, 2014). Education level and whether or not respondents had children are the only two variables that have a significant effect on consumer WTP for sustainable milk. Compared to respondents with middle school or less, those with post-graduate degrees were willing to pay less for sustainable milk, while there was no significant difference between the WTP of respondents with other degrees. The negative effect of education on WTP for sustainable milk is not consistent with most previous studies that find that education has either a positive or no effect on consumer preference of sustainable food. We propose two possible explanations for these interesting results. First, some of the research has shown that Chinese consumers with low educational levels are more likely to accept new products such as genetically modified food (Ho, Vermeer, & Zhao, 2006). Thus the higher WTP for sustainable milk of the respondents with lower educational levels (less than post-graduate degree) in our study may be due to its novelty in the Chinese markets. Second, lower-educated respondents in our sample were more likely to perceive sustainable milk to have better quality or taste. These are two intrinsic attributes that have more influential impact on consumer preference than extrinsic attributes such as better for environment and more socially responsible (Fotopoulos, Krystallis, & Ness, 2003; Grunert, 2005). The insignificant effect of income on consumer WTP is consistent with some previous research that has shown a negative, positive, or insignificant impact of income on consumer demand for organic food or pesticide-free food (e.g., Thompson, 1998; Smith, Huang, & Lin, 2009; Zepeda & Li, 2007).[6] In addition, respondents who had children were willing to pay more for sustainable milk, suggesting a potential over-generational concern about sustainable development.

[5] Regression results of models including all independent variables are provided in the Appendix A.

[6] Further analysis shows that income has a significantly positive relationship with education. Removing education from the regression model shows that income has a significant negative impact on consumer WTP at the 10% significance level. All evidence put together, it seems that the multicollinearity between income and education may make the coefficient of income insignificant.

Table 4
WTP for sustainable milk by respondents in the surveys.

	Mean	Median	Std. Dev.	Lower 95% CL for mean	Upper 95% CL for mean
All samples	4.91	4.90	0.93	(4.81	5.02)
Base price					
3.5 RMB	3.90	4.11	0.53	(3.79	4.00)
2.5 RMB	4.96	5.11	0.52	(4.86	5.07)
4.5 RMB	5.73	5.92	0.54	(5.64	5.83)

Among seven perception variables, only the coefficient of Better Quality was significantly positive at the 5% significance level, implying that respondents who thought sustainable milk had better quality were willing to pay more for it. The variable that had the largest impact on consumer WTP was "Do Not Know". The respondents who had no idea what sustainable milk means regarding milk quality were willing to pay significantly less (1.04 RMB) than those who could link sustainable production with other milk qualities. This result suggests that improving consumers' knowledge about sustainable milk is likely to be effective for market promotion, but any promotion emphasizing a specific attribute other than Better Quality of sustainable food may not be beneficial.

Table 4 reports the statistics of the estimated WTP for each respondent in our sample. Normality tests (i.e., Anderson–Darling test, Cramer–von Mises test, and Kolmogorov–Smirnov test) rejected the null hypothesis that distributions of WTP followed normal distribution for all respondents and for individual respondents in the three surveys. The mean and median WTP were 4.91 RMB and 4.90 RMB, respectively, for all respondents. And the median WTPs were 4.11 RMB, 5.11 RMB, and 5.92 RMB, respectively, when the prices of conventional milk were 2.5 RMB, 3.5 RMB, and 4.5 RMB. This indicated that, overall, respondents were willing to pay 40% more for sustainable milk than for conventional milk, which was consistent with previous research that found that the premium for organic and green foods was between 40% and 130% for Chinese consumers (Xu et al., 2012; Yin et al., 2010; Yu et al., 2014).

4. Conclusions and discussion

A sustainable food consumption and production system is particularly important to China because it has limited natural resources to feed the world's largest population (Godfray et al., 2010). Motivating growers and food industries to pursue sustainability demands the identification of Chinese consumers' perceptions and preferences of sustainable food and the important factors affecting consumer WTP. This paper, which examines Chinese consumers' perception and preference of sustainable milk, shows that Chinese consumers' knowledge of sustainable food is limited. About 20% of the respondents in our sample do not know anything about sustainable milk, and among the respondents who have some knowledge, a majority of them think sustainable means environmentally friendly, ignoring other important aspects of sustainability. This result is consistent with the argument by Yanarella et al. (2009) that the general public tends to equalize sustainability with "greenness" which only emphasizes environmental improvement. Therefore, to promote sustainable consumption and production in China, the first important action is improving consumer knowledge and understanding of sustainable food through public education. Despite their limited knowledge, Chinese consumers on average are willing to pay a 40% premium for sustainable milk over conventional milk. This result is more consistent with the 40% and 47% premiums for green food that is identified by Yu et al. (2014), and is much lower than the 130% premiums for organic food (Yin et al., 2010). The reason may be that consumers confuse sustainable food and green food, thinking sustainable food means "green" which can only provide an environmental benefit.

The results from regression analysis further show the importance of improved knowledge on increasing consumers' sustainable food consumption. Consumers who can link sustainable production with other product attributes have a significantly higher WTP for sustainable milk. However, only those who think sustainable milk has better quality are significantly willing to pay more for sustainable food. These results are consistent with past research that demonstrates that food quality is one of the most important factors affecting consumer food choice (Grunert, 2005). Consumers expect improved quality of intrinsic attributes (e.g., produce quality) when there is improvement in some of the credence attributes (e.g., better for environment, more socially responsible) (Gao & Schroeder, 2009; Gao, Schroeder, & Yu, 2010). This indicates that encouraging the consumption of sustainable food should not only emphasize the environmental and social benefits, but also the potential improved food quality of a sustainable food production system.

This paper provides important information for government and policy makers to promote the demand for sustainable food. However, several important questions are still unanswered. Because the current certification system in China only certifies Safe Food, Green Food, and Organic Food, should a system of sustainable food be established to promote food production that meets the standards of sustainability for economics, the environment, and social justice principles? How difficult is it to develop the rules for sustainable food? What would be the cost of producing sustainable food? If consumers know the true meaning of sustainability in food production, are they willing to pay more for sustainable food than what is currently revealed? All these questions need to be answered so that China can find effective ways to encourage a sustainable food consumption and production system in China.

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Appendix A

Table 5
Regression results from double-bounded CV method with all variables included.

	Model 1			Model 2		
Parameter	Estimate	95% confidence limits		Estimate	95% confidence limits	
Intercept	6.09***	(4.86	7.31)	6.50***	(5.80	7.20)
	(0.63)			(0.36)		
Better quality	0.60**	(0.08	1.13)	0.33**	(0.03	0.62)
	(0.27)			(0.15)		
Safer	0.002	(−0.49	0.49)	0.04	(−0.24	0.31)
	(0.25)			(0.14)		
More trustable	0.38	(−0.13	0.89)	0.15	(−0.14	0.44)
	(0.26)			(0.15)		
More environment friendly	0.0004	(−0.49	0.49)	−0.07	(−0.34	0.21)
	(0.25)			(0.14)		
Better for animal welfare	−0.42	(−1.17	0.33)	−0.08	(−0.50	0.35)
	(0.38)			(0.22)		
More social responsibility	0.50*	(−0.01	1.01)	0.18	(−0.10	0.47)
	(0.26)			(0.15)		
Better taste	−0.25	(−0.95	0.45)	−0.09	(−0.48	0.30)
	(0.36)			(0.20)		
Do not know	−1.54***	(−2.25	−0.83)	−0.99***	(−1.38	−0.59)
	(0.36)			(0.20)		
Female	−0.19	(−0.60	0.22)	−0.15	(−0.37	0.08)
	(0.21)			(0.12)		
Age	−0.001	(−0.13	0.13)	0.02	(−0.06	0.09)
	(0.06)			(0.04)		
Income	−0.08	(−0.25	0.09)	−0.06	(−0.15	0.04)
	(0.09)			(0.05)		
Middle school or less	0.15	(−0.60	0.90)	0.03	(−0.38	0.45)
	(0.38)			(0.21)		
High school degree	0.07	(−0.62	0.77)	−0.02	(−0.40	0.37)
	(0.35)			(0.20)		
Associate degree	−0.21	(−0.88	0.45)	−0.18	(−0.55	0.19)
	(0.34)			(0.19)		
Bachelor's degree	−0.61	(−1.40	0.18)	−0.44**	(−0.87	0.00)
	(0.40)			(0.22)		
Has children	−0.34*	(−0.73	0.06)	−0.25**	(−0.47	−0.03)
	(0.20)			(0.11)		
Base price 3.5 RMB				−0.80***	(−1.06	−0.53)
				(0.14)		
Base price 2.5 RMB				−1.79***	(−2.05	−1.53)
				(0.13)		
Scale	1.43***	(1.24	1.64)	0.81***	(0.69	0.95)
	(0.10)			(0.07)		
−2 Log likelihood	779.90			691.75		
AIC (smaller is better)	815.90			731.75		

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