Consumer behaviour on low-carbon agri-food purchase: a carbon labelling experimental study in China

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Abstract: By adopting the scenario experimental methodology of carbon labelling on agri-food products, coupled with 873 questionnaires collected from six cities in China, we made a statistical analysis of different types of consumers' behaviour on the low-carbon agri-food purchase by using the SPSS software. The results indicate that: (1) there are great differences of the low-carbon purchasing behaviour between different types of consumers: male groups at young and middle-aged, especially those who are highly educated and better paid in economically developed areas, have strong low-carbon product purchasing powers; (2) consumers' low-carbon purchasing behaviour is highly correlated with their preference for low-carbon products; (3) young consumers and some of the high-income consumers have a weak environmental consciousness and; (4) consumer's perception on government policies and the implementing efficiency shows a positive moderating effect on the consumers' low-carbon purchasing behaviour. Finally, we proposed policy recommendations accordingly based on the findings of this study for further facilitating low-carbon consumption in China.

Key words: carbon labelling, low-carbon awareness, potential consumption power, scenario experiment, SNK test

With the world economic development and the dramatic increase of the global greenhouse gas (GHG) emissions, the issue of sustainable development that is largely related with the environmental deterioration has aroused a world-wide concern. Low-carbon economy, therefore, has gradually shifted from the ideology and advocacy to theoretical researches and practical policy actions throughout the world. As a revolutionary new mode of economic development, a new model of energy consumption and a new way of life for mankind, the low-carbon economy is rooted in the low-carbon consumption (He et al. 2011a). It is an important issue to achieve sustainable development and sustainable consumption by changing the consumption ideology and readjusting consumption patterns of the people's livelihood. The existing research findings demonstrate that the change of consumer behaviour has a more obvious and a far-reaching impact on the emissions reduction than improving the energy efficiency of machines and facilities such as automobiles and buildings (Wang et al. 2010). Unlike industrialized countries such as Europe and the USA, China is still at the post-industrialization stage and the rising well-off consumers tend to consume more goods with energy intensity; the studies show that the consumption activities contribute 30–40% to the environmental degradation (Wang and Jing 2012), the high-carbon consumption tendency, the scarcity of low-carbon awareness and deficiency of social norms are the main obstacles of low-carbon consumption behaviour (Chen and Li 2012). Therefore, it is of great significance to conduct an experimental study on consumers' potential behaviour on purchasing low-carbon agri-food products in China.

Literature review

The research on the impact of carbon labelling on low-carbon consumption began only a few years ago. Edwards-Jones et al. (2009) claimed that if it is unclear both how consumers currently trade off between the

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different aspects of labelled food, it could be suggested that the introduction of a carbon label would have little impact on consumer behaviour as they are already confused by the profusion of labelling schemes relating to food. By and large, current research literature focuses on the following three aspects:

(1) *Research on the extent to which carbon labelling is acknowledged and accepted.* Gadema and Oglethorpe (2011) surveyed 428 consumers in British shopping malls and found that 72% consumers show interest in the introduction of carbon labels while as many as 89% of them have doubts or problems in understanding carbon footprint information because of ineffective promotion. Based on the questionnaire survey on 6 foreign-invested supermarkets in Beijing, Ying (2011) shows that 64.8% respondents are now well-informed of the term – low-carbon – and 83.8% of them only accept a premium of 20% on the average counterparts. According to the experiment of Kimura et al. (2010) on 151 graduate students, the degree of carbon emissions is more influential on participants' willingness-to-pay in the active-search condition than in the read-only condition.

(2) *Research on the conventional factors influencing low-carbon consumption.* Qin (2012) finds that Chinese consumers' acceptable prices of carbon-labelled products are decided by age, knowledge on environmental protection and the promotion of low-carbon brands. The younger the consumers, the more willing they are to pay higher prices for carbon labelled products. The older the consumers, the more willing to pay lower prices for carbon labelled products. Consumers with better knowledge of the environmental protection are more willing to pay higher prices for carbon labelled products. The more effective of the promotion activities for low-carbon brands by the manufacturers, the more likely of the consumers be influenced to buy low-carbon products. Cohen and Vandenbergh (2012) point out that without information about the greenhouse gas implications of product choices, consumers are unable to make informed choices about which products to purchase and how to use them. Consumer segments that care about carbon emissions are likely to grow as more information is disclosed and life-cycle analyses uncover more ways to reduce carbon emissions without increasing – or even decreasing – the cost to consumers. Zhou and Wu (2012) discover that Nanjing consumers' average payment on low-carbon pork is 18.95 yuan but the average payment willingness is 3.95 yuan. Payment willingness is affected by factors such as low-carbon pork price, the awareness of low-carbon farm products, household income, family size and educational background. The higher the price of low-carbon pork, the lower the probability it is to be purchased. With the improvement of their awareness, the probability of consumers' purchase will become higher. The higher the family income, the higher probability of the purchase. The bigger the household population, the lower the willingness of the purchase. The higher the education level of consumers, the higher the willingness of the purchase. However, Yin et al. (2012) find that for Beijing consumers there is a positive relationship between the low-carbon expenditure and age, monthly spending on daily necessities, and the number of children under the age of 12 in a family, and there is no significant effect of gender, educational background, family size, and the number of people over 60 in a family on the low-carbon expenditure. Upham et al. (2011) point out that only a percentage of shoppers can be expected to make a substantial use of carbon labels. If carbon labelling is to play a significant role in the transition to the low carbon economy, it will need to be widely applied on the basis of a carbon reduction label, not simply an emissions reporting label.

(3) *Research on the psychological and emotional factors affecting low-carbon consumption.* Chen and Li (2012) find that there is no common understanding yet about the impact of demographic variables on the green consumption behaviour, and that psychological factors such as values, and the situational factors have more obvious effects on the green consumption behaviour. Hirsh (2010) indicates that the consumers' concern over the benefits of the low-carbon lifestyle, to some extent, affects the low-carbon consumption. Yamamoto (2008) and Sauer and Fischer (2010) find that consumers' awareness of low-carbon products has a positive impact on the purchasing behaviour on low-carbon products. Taciano and Duckitt (2010) research results indicate that the low-carbon product preference would influence the low-carbon consumption. Chen (2007), in his empirical study on organic food in the Taiwan market, reveals that the low-carbon behaviour tendency, to some degree, is related to the purchasing behaviour on the low-carbon products. Barr et al. (2005) find that the household energy use habits and the traditional energy disposal behaviour are included in the low-carbon consumption concept. Brandon and Lewis (1997) make a study on reducing the household energy consumption and find that income and demographic characteristics do not affect the household energy consumption and that environmental attitudes and feedback exert

an impact on the household energy consumption. Meng Aihong (2011) makes a regression analysis of many other factors such as demographic variables, psychological characteristics and cognitive factors taking samples from the residents of Hangzhou in China. He et al. (2011b), Chen and Li (2012), Ren and Zhang (2012), Zhang (2012) conduct studies by using different samples on the low-carbon consumption behaviour from different perspectives.

The literature review suggests that: (i) there is quite a lot of literature on the low-carbon consumption; yet, as an important aspect of low-carbon consumption, the low-carbon *purchasing behaviour* still requires further study; (ii) there are researches on the low-carbon consumption and its impact factors. However, there has been no experimental study so far on low-carbon purchasing behaviour of different types of consumers. Therefore, we attempt to conduct a scenario experimental study on Chinese consumers' potential behaviour on purchasing low-carbon agri-food products, by adopting the methodologies of questionnaires and statistical methods from the perspective of different types of consumers.

METHODOLOGY AND DATA

Research methodology

We adopt the research methodologies of the questionnaire survey, scenario experiment, and various statistical analyses.

Table 1. The 15 indicators in the questionnaire with the Likert five-point scale

Dimensions	Measurement indicators	Degrees of measurement
1. Environmental Consciousness	1) degree of consciousness for the demerits of a high-carbon lifestyle	1 = never heard of; 2 = occasionally heard of; 3 = basic understanding; 4 = better understanding; 5 = full knowledge
	2) degree of concern for low-carbon environmental policies	
	3) degree of awareness for living a low-carbon life	(multiple choice, scores are given based on the No. of right answers)
2. Evaluation on Low-carbon Education	4) evaluation on the effectiveness of low-carbon publicity	1 = totally ineffective; 2 = almost ineffective; 3 = just so-so; 4 = effective; 5 = completely effective
	5) willingness to participate in low-carbon publicity activities	1 = extremely unwilling; 2 = unwilling; 3 = probably willing; 4 = quite willing; 5 = definitely willing
	6) willingness to advertise ideas of low-carbon lifestyle	
3. Consumer Awareness	7) degree of awareness for carbon labelling	1 = never heard of; 2 = occasionally heard of; 3 = basic understanding; 4 = better understanding; 5 = full knowledge
	8) degree of awareness for the difference between low-carbon and high-carbon agri-food products	
	9) degree of awareness for low-carbon lifestyle	
4. Consumer Preference	10) rank of low-carbon in all the factors that impact purchase decision-making	score values are determined based on the rank given
	11) willingness to purchase low-carbon agri-food products.	score values are determined based on the degree of willingness (same as other above willingness questions)
	12) preference for prices of low-carbon agri-food products	score values are determined based on % of overpayment for buying low-carbon agri-food products
5. Purchasing Behaviour	13) percentage of money spent on low-carbon gri-food products	score values are determined based on the percentage interval
	14) percentage of overpayment for buying low-carbon agri-food products	
	15) amount of carbon emissions from the agri-food products purchased	score values are determined based on carbon emissions amount

Source: Designed and edited by the research group

(1) Questionnaire survey

The questionnaire is centred on four dimensions: i.e. the consumers' "Environmental Consciousness", consumers' "Evaluation on Low-carbon Education", "Consumer Awareness" and "Consumer Preference" for low-carbon agri-food products. People are randomly sampled in the selected cities throughout China; and the respondents fill out questionnaires at the specific locations, and then enter the phase of the scenario experiment, which is carried out on the spot.

Table 2. The distribution of samples

Features		Frequency	Ratio (%)
1. Region	Shenzhen	169	19.36
	Wuhan	114	13.06
	Daqing	142	16.27
	Xiangyang	147	16.84
	Xuchang	154	17.64
	Gucheng	147	16.84
2. Gender	male	366	41.90
	female	507	58.10
3. Age	under 19	32	3.70
	20–29	340	38.90
	30–39	197	22.60
	40–49	173	19.80
	above 50	131	15.00
4. Educational background	– secondary school	122	14.00
	vocational school/high school	217	24.90
	professional training/ college	146	16.70
	university	289	33.10
	graduate school	99	11.30
5. Monthly income	–999 Yuan	167	19.10
	1000–2999 Yuan	399	45.70
	3000–4999 Yuan	189	21.60
	5000–6999 Yuan	73	8.40
	7000 Yuan–	45	5.20
6. Monthly spending on agri-food products	–499 Yuan	49	5.60
	500–999 Yuan	388	44.40
	1000–1999 Yuan	303	34.70
	2000–2999 Yuan	79	9.00
	3000– Yuan	54	6.20

Source: Derived from the sample data by the authors using SPSS 20.0

(2) Scenario experiment

After finishing the questionnaire, the respondents subsequently enter the phase of the scenario experiment that includes the following steps:

– **Step one:** In compliance with the international formula, we designed 3 kinds of labels: low-carbon label (green), middle-carbon label (yellow) and high-carbon label (red). We assume that: the green label refers to carbon emissions of 0.2 g CO_2 per 1 kilogram of product, the yellow label 0.4 g and the red label 0.6 g. The prices of low-carbon, middle-carbon and high-carbon agri-food products are RMB 4.00 yuan, RMB 4.50 yuan and RMB 5.00 yuan each, respectively.

– **Step two:** In the experiment, every participant is given 20 yuan for buying agri-food products such as packs of milk, bananas, eggs and instant noodles etc., which are provided by the research group. Then, the participants should hand their shopping orders to the staff of the research group for the check-out and record keeping. They could take all of the shopped products after the experiment as incentives offered by the research group. The questionnaire and the experiment records are matched one on one. Both the questionnaire and the scenario experiment were conducted anonymously.

(3) Statistical analyses

In this study, we adopted the SPSS 20.0 software for the independent sample *t*-test, one-way ANOVA and SNK test, for quantitatively analyzing the differences in "Environmental Consciousness", "Evaluation on Low-carbon Education", "Consumer Awareness" and "Consumer Preference" for the low-carbon agri-food products, and the low-carbon product "Purchasing Behaviour" of the 873 consumers collected from 6 cities in China. A regression model was also applied to verify the moderating effect of the policy variable on the low-carbon "Purchasing Behaviour", in an attempt to disclose the inherent law of the consumer behaviour on buying low-carbon agri-food products.

Sample data

(1) Questionnaire desing

A structured interview questionnaire is used in this study, with 15 structured questions (indicators) including 5 dimensions, i.e., the consumer "Environmental Consciousness", the consumer "Evaluation on Low-

Table 3. The descriptive statistics of fifteen indicators

	N	Minimum	Maximum	Mean	Standard deviation
Degree of consciousness for the demerits of a high-carbon lifestyle	873	1	5	2.68	1.085
Degree of concern for low-carbon environmental policies	873	1	5	2.74	0.869
Degree of awareness for living a low-carbon life	873	1	5	2.68	1.188
Evaluation on the effectiveness of low-carbon publicity	873	1	5	3.73	0.853
Willingness to participate in low- carbon publicity activities	873	1	5	3.57	0.847
Willingness to advertise ideas of low-carbon lifestyle	873	1	5	3.70	0.815
Degree of awareness for carbon labelling	873	1	5	2.12	0.905
Degree of awareness for the difference between low and high-carbon agri-food products	873	1	5	2.45	0.837
Degree of awareness for low-carbon lifestyle	873	1	5	2.38	0.922
Rank of low-carbon in all the factors that impact purchase decision-making	873	1	5	2.74	1.195
Willingness to purchase low-carbon agri-food products	873	1	5	2.98	0.807
Preference for prices of low-carbon agri-food products	873	1	5	1.83	0.850
Percentage of money spent on low-carbon agri-food products	873	1	5	1.92	0.800
Percentage of overpayment for buying low-carbon agri-food products	873	1	5	1.98	0.798
Amount of carbon emissions from the agri-food purchased	873	1	5	1.92	0.802

carbon Education", "Consumer Awareness" and "Consumer Preference" for low-carbon products and the consumer low-carbon product "Purchasing Behaviour". Referring to the measurements of the "Purchasing Behaviour" dimension, we obtained specific values of the three variables through the scenario experiment, namely, each respondent's percentage of money spent on the low-carbon agri-food products, the percentage of overpayment for buying the low-carbon agri-food products and the amount of carbon emissions from the agri-food products that he or she purchased. Then, we determined the score values based on the percentage intervals to make them a five-point scale variable. The way of questioning varies with the specific feature of the question, including a single option, multiple choices, ranking, matching and filling in blanks; and continuous variables are designed with the Five-Point Likert Scale (Table 1).

Table 4. The KMO test and the Bartlett's test of sphericity of 15 variables

Test indicators		Test results
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.833
Bartlett's Test of Sphericity	approx. χ^2	9.450
	Df	105
	Sig.	0.000

Source: Derived from the sample data by the authors using SPSS 20.0

(2) Sample properties

Considering the diversity of geography and disparity of economic development in China, we chose 6 different cities (i.e. Shenzhen, Wuhan, Daqing, Xiangyang, Xuchang and Gucheng) throughout the country to conduct the experiment. A total of 950 questionnaires were handed out on a face-to-face basis and 876 received, providing a response rate of 92.21%, among which 873 are valid, accounting for 99.66%.

Further, the features of responses are identified by their regions, gender, educational background, monthly income and monthly spending on agri-food products. As shown in Table 2, in the dimension of region, samples are evenly distributed between 13% (Wuhan) and 20% (Shenzhen); in the dimension of gender, females outnumber males with 58.10% to 41.9% as females are the main shopping population in China; in the dimension of age, the youths are

Table 5. Rotated component of the matrix of orthogonal rotation of 15 variables

Variables	Consumer preference	Environmental consciousness	Consumer awareness	Evaluation on low-carbon education	Consumer behaviour
(1) Willingness to purchase low-carbon agri-food products	0.782				
(2) Preference for prices of low-carbon agri-food products	0.711				
(3) Rank of low-carbon in all the factors that impact purchase decision-making	0.610				
(4) Degree of concern for low-carbon environmental policies		0.946			
(5) Degree of awareness for living a low-carbon life		0.903			
(6) Degree of consciousness for the demerits of a high-carbon lifestyle		0.897			
(7) Degree of awareness for carbon labelling			0.817		
(8) Degree of awareness for the difference between low and high-carbon agri-food products			0.815		
(9) Degree of awareness for low-carbon lifestyle			0.753		
(10) Willingness to advertise ideas of low-carbon lifestyle				0.828	
(11) Willingness to participate in low- carbon publicity activities				0.793	
(12) Evaluation on the effectiveness of low-carbon publicity				0.731	
(13) Amount of carbon emissions from the agri-food purchased					0.922
(14) Percentage of money spent on low-carbon agri-food products					0.916
(15) Percentage of overpayment for buying low-carbon agri-food products					0.913

Source: Derived from the sample data by the authors using SPSS 20.0

becoming the main power of the agri-food products consumption when those aged between 20 and 49 constitute 81.3%; in the dimension of educational background, vocational college (24.9%) and university (33.1%) make up the largest proportion, which complies with the education reality in China: the young generation has more undergraduate degrees while a vocational college degree is more common among the middle-aged; in the dimension of income, the percentage of those earning less than 5000 yuan per month is 86.4% and that of 1000–1999 per month is 34.7%, which reflects the reality of the China's income structure. All in all, the samples are fairly typical and representative (Table 2). We have made the descriptive statistics table for the fifteen indicators (Table 3).

Table 6. Reliability testing of the sample data

Item	Cronbach's Alpha
Environmental consciousness	0.911
Evaluation on low-carbon education	0.729
Consumer awareness	0.792
Consumer preference	0.746
Purchasing behaviour	0.974

Source: Derived from the sample data by the authors using the SPSS 20.0

(3) Data credibility and validity test

Based on the 873 sample data collected from the questionnaire, we adopted the SPSS 20.0 for the ex-

ploratory factor analysis of the 15 observed variables, and the results show that (i) the KMO value is 0.833, indicating good data validity; (ii) the 15 variables are divided into 5 dimensions (Table 4 and Table 5). Then, we conduct the credibility analysis of the internal consistency of data according to the divided dimensions. The results show that α value of the first dimension – the consumer "Environmental Consciousness" is 0.911, followed by the consumer's "Evaluation on low-carbon education" (0.729), "Consumer Awareness" (0.792), "Consumer Preference" (0.746), and the consumer low-carbon "Purchasing Behaviour" (0.974), all of which indicate a good internal consistency of data (Table 6).

RESULTS AND ANALYSES

Following the sorting and verification of the sample data, we made several analyses by adopting the methodologies of one-Way ANOVA and the SNK test (also known as the "Student's *t*-test") using the SPSS 20.0 software, in an attempt to find out the differences among different groups (region, age, education, income and gender) of consumers in the values of their "Environmental Consciousness", "Evaluation on Low-carbon Education", "Consumer Awareness", "Consumer Preference" and "Purchasing Behaviour" with the following results and findings.

Analysis of different regions

First, we made a SNK test on the consumer low-carbon agri-food "Purchasing Behaviour" and its influencing factors in the four dimensions based on the data of the "region" dimension, i.e. the six cities where our questionnaire and experiment were carried out, with the following findings (Table 7).

(1) *Consumers low-carbon "Purchasing Behaviour" in different regions is far different from one another; and the two major influencing factors of "Consumer Preference" and "Consumer Awareness" show a similar impact.* The SNK test indicates that there are big differences among the evaluation indicators of the 6 cities. According to the mean value of the low-carbon product "Purchasing Behaviour", the cities are ranked in a descending order like this: Wuhan, Daqing, Xuchang, Shenzhen, Xiangyang and Gucheng. Wuhan, the highest of all cities, is 59.27% higher than that of Gucheng (A, B and C represent different regional groups, and their difference has reached the significance level of 0.05). The standard deviation of all cities is 0.378, indicating a huge gap of "Purchasing Behaviour" in different regions. Gucheng is a county town, with relatively more farmers as against urban residents, reflecting the difference of the low-carbon purchasing power between the urban and rural residents. Moreover, consumers in different cities also have differences in "Consumer Awareness" and "Consumer Preference". In terms of "Consumer Awareness", there is 20.91% difference between the highest (Wuhan) and the lowest (Xiangyang), with the standard deviation of 0.175; as for "Consumer Preference", the mean value difference between the highest (Wuhan) and the lowest (Gucheng) reaches 20.06%, with the standard deviation of 0.177. Wuhan ranks first of all cities in terms of "Consumer Awareness" and "Consumer Preference", which may be due to the fact that Wuhan is one of the two experimental cities in China for developing resource-saving and the environmentally-friendly society.

(2) *As an economically developed city, Shenzhen consumers' "Evaluation on Low-carbon Education" ranks*

Table 7. SNK Test results and groups for samples from different regions

Dimensions	Daqing	Xuchang	Wuhan	Gucheng	Xiangyang	Shenzhen	Standard deviation	Relative percentage (%)
	level							
Environmental consciousness	A_5(2.62)	A_3(2.75)	A_2(2.80)	A_1(2.81)	A_4(2.70)	A_6(2.55)	0.081	10.18
Evaluation on low-carbon education	A_1(3.77)	A_4(3.67)	A_2(3.76)	A_5(3.67)	A_3(3.70)	B(3.48)	0.048	8.37
Consumer awareness	B_1(2.39)	B_3(2.26)	A(2.60)	B_4(2.23)	C (2.15)	B_2(2.34)	0.175	20.91
Consumer preference	A_2(2.68)	B_1(2.43)	A_1(2.68)	B_3(2.29)	B_2(2.40)	A_3(2.65)	0.177	20.06
Purchasing behaviour	A_2(2.19)	B_1(2.11)	A_1(2.30)	D(1.45)	C(1.62)	B_2(2.04)	0.378	59.27

Source: The results from statistical analyses based on the sample data by the authors

last, and their "Environmental Consciousness" is the lowest. Unlike the "Purchasing Behaviour", "Consumer Awareness" and "Consumer Preference", Shenzhen's mean value of "Evaluation on Low-carbon Education" is the lowest and far different from other cities. We believe that as a rapidly growing immigrant city since China's reform and opening-up in the 1980s, Shenzhen has paid a great attention to the development of the real economy and neglected the low-carbon related publicity and education. Interestingly, Shenzhen consumers' "Environmental Consciousness" ranks at the bottom of the list, lagging far behind Gucheng, which is a county representing the relatively underdeveloped areas. This deserves our attention and profound introspection.

Note: A, B, C and D are groupings of the samples conducted by the student *t*-test; A is the best grouping and D is the worst; subscript 1, 2, 3, 4, 5, 6 are orders of intra-group. 1 is the best and 6 is the worst within the same group.

Analysis of different age groups

Next, we made a similar SNK test based on data of the "age" dimension, with the following findings (Table 8):

(1) *The differences in low-carbon product "Purchasing Behaviour" of consumers at different age groups are smaller than that of the regional groups.* From Table 8, we find that the mean values for "Purchasing Behaviour" have a difference of 21.04% between the highest group (aged 40–49) and the lowest group (aged ≤ 19), showing a smaller difference in different age groups. There is, however, a significant difference between these two groups: 20–49 group and the rest age group (sig. level reaches 0.05), and the mean values of "Purchasing Behaviour" are arranged in the order of age, indicating that the young and middle-aged consumers (20–49) have a strong behaviour for the low-carbon product consumption. In terms of 40–49 age group, "Consumer Preference", "Consumer Awareness" and "Evaluation on Low-carbon Education" all rank at the top of the list in addition to "Purchasing Behaviour".

(2) *Young consumers generally have a low "Consumer Preference", "Consumer Awareness" and "Evaluation on Low-carbon Education".* What worries us is that the young consumer group (< 29) is lower than the middle-aged and the elderly consumers in China for the above three dimensions. This implies that the young consumers who are post 1980s are care less about the national policy and that the blundering socio-cultural environment has a far-reaching influence on the teen-agers and the young people in China. This is a social problem that deserves a profound introspection of the Chinese government and departments concerned.

(3) *The youth group (20–29) has the lowest "Environmental Consciousness".* To our dismay, the SNK test reveals that the 20–29 consumers group has a crisis of the environmental consciousness. Normally, consumers at this age group should be receiving or have already received higher education, having a high cultural quality and noble ideals, and they should have a high level of the environmental consciousness. This is an issue deserving attention and action of the government and the society.

Analysis of different educational background

Then, we made a similar SNK test based on data of the "educational" dimension, with the following findings (Table 9):

Table 8. SNK test results and orders of different age groups

Dimensions	≤ 19 years	20–29 years	30–39 years	40–49 years	≥ 50 years	Standard deviation	Relative percentage (%)
	level						
Environmental consciousness	A_3 (2.66)	A_5 (2.63)	A_1 (2.81)	A_2 (2.76)	A_4 (2.65)	0.081	7.14
Evaluation on low-carbon education	B_3 (3.51)	B_2 (3.58)	A_2 (3.73)	A_1 (3.79)	B_1 (3.67)	0.112	7.94
Consumer awareness	C_1 (2.18)	B (2.31)	A_2 (2.40)	A_1 (2.47)	C_2 (2.04)	0.171	20.86
Consumer preference	A_5 (2.32)	A_3 (2.52)	A_4 (2.56)	A_1 (2.63)	A_4 (2.35)	0.134	13.17
Purchasing behaviour	B_2 (1.67)	A_3 (1.98)	A_2 (2.00)	A_1 (2.02)	B_1 (1.70)	0.173	21.04

Source: The results from statistical analyses based on the sample data by the authors

Table 9. SNK test results and group orders for samples at different educational levels

Dimensions	Middle school or below	Technical secondary or high school	Community college	Bachelor	Master or above	Standard deviation	Relative percentage (%)
	level						
Environmental consciousness	B (2.40)	A_4 (2.67)	A_3 (2.76)	A_2 (2.76)	A_1 (2.95)	0.199	22.81
Evaluation on low-carbon education	B_3 (3.58)	B_2 (3.61)	B_4 (3.53)	B_1 (3.71)	A (3.98)	0.179	12.61
Consumer awareness	D (1.93)	C_1 (2.24)	C_2 (2.16)	B (2.40)	A (2.95)	0.385	53.30
Consumer preference	C (2.20)	B_3 (2.43)	B_2 (2.47)	B_1 (2.60)	A (2.95)	0.275	33.94
Purchasing behaviour	D (1.59)	C_2 (1.74)	C_1 (1.85)	B (2.03)	A (2.71)	0.436	70.16

Source: The results from statistical analyses based on the sample data by the authors

(1) *Consumers at different educational levels show the greatest difference in the low-carbon "Purchasing Behaviour".* As can be seen from Table 9, the mean value of low-carbon product purchasing behaviour of consumers who have the master or higher degrees is by 70.16% higher than that of those who have received only the middle school education or lower, with the standard deviation of 0.436, which is the biggest of all groups. Meanwhile, the education factor has a positive impact on "Purchasing Behaviour", "Consumer Preference", "Consumer Awareness" and "Environmental Consciousness", and its impact on "Evaluation on Low-carbon Education" is varied. Generally, however, the impacts of education on the low-carbon "Purchasing Behaviour" and on other relevant variables tend to be similar.

(2) *Consumers at different educational levels also show a big difference in "Consumer Awareness", but the difference of "Evaluation on Low-carbon Education" is limited.* Our analysis result indicates that the mean value of "Consumer Awareness" of those who have the master or higher degrees is by 53.30% higher than that of those with only the middle school or lower education. And the standard deviation of different education consumers in the dimension of low-carbon awareness is 0.385, indicating that the consumers with higher education pay a great attention to the national low-carbon policies. It is also worth noting that there is a little difference in "Evaluation on Low-carbon Education" of consumers at different educational levels except those who have the master or higher degrees. It implies that the current Chinese education system is not quality-oriented with a lack of guidance for the national policies.

(3) *Large differences also exist among the five dimensions for consumers with different educational background.* Of all the differences for all indicators, educational levels have the largest difference among different demographic variables of indicators within the same dimension, which fully demonstrates that education has the greatest influence on the consumers' low-carbon product "Purchasing Behaviour" and other 4 dimensions than any other factors. Meanwhile, in terms of "Environmental Consciousness", the largest difference among demographic variables also appears with the educational levels, the mean value of which differs by 22.81% between the lowest and the highest with a 0.199 standard deviation, which again confirms the findings of our previous analyses

Analysis of different income levels

A similar SNK test was also conducted based on the data of the "income" dimension, with the following findings (Table 10):

(1) *There is a positive relationship between "Purchasing Behaviour" and the consumer income (except for the lowest income group).* Our test results show that the consumer income has a great impact on the low-carbon "Purchasing Behaviour", whose mean value differs by 53.63% between the highest and lowest income groups. The SNK test results indicate that consumers at different income levels are divided into three groups based on the 0.05 significance level: group 1 for consumers with the monthly income of over 7000 yuan, group 2 for those between 3000 and 6999, and group 3 for those less than 2999. Due to the inflation and the improvement of the living standards, the basic living expenses are now over 1000 yuan per month in China. And most of those consumers, whose monthly income

Table 10. SNK test results and orders for samples at different income levels

Dimensions	≤ 999	1000–2999	3000–4999	5000–6999	≥ 7000	Standard deviation	Relative percentage (%)
	level						
Environmental consciousness	A_5 (2.68)	A_3 (2.69)	A_4 (2.69)	A_1 (2.79)	A_2 (2.70)	0.047	4.25
Evaluation on low-carbon education	A_5 (3.60)	A_4 (3.64)	A_2 (3.74)	A_3 (3.70)	A_1 (3.79)	0.074	5.12
Consumer awareness	B_2 (2.09)	B_1 (2.20)	A_2 (2.57)	A_3 (2.53)	A_1 (2.73)	0.266	30.19
Consumer preference	C_2 (2.27)	C_1 (2.42)	B_2 (2.71)	B_1 (2.79)	A (3.01)	0.294	32.51
Purchasing behaviour	C_1 (1.74)	C_2 (1.73)	B_2 (2.23)	B_1 (2.37)	A (2.66)	0.405	53.63

Source: The results from statistical analyses based on the sample data by the authors

is less than 999 yuan, are college students. It is understandable that their cost of living is less than 1000 for they have no sources of income. Therefore, it is not surprising that the consumer group with the lowest monthly income has a higher level of the low-carbon "Purchasing Behaviour" than those who have a higher income.

(2) *Large differences also exist among consumers at different income levels in "Consumer Preference" and "Consumer Awareness".* The SNK test results show that the monthly income of 3000 yuan is the dividing line, and there are significant differences between the high-income consumers (3000 or more) and low-income consumers (2999 or less) in low-carbon product "Purchasing Behaviour", "Consumer Preference" and "Consumer Awareness". This indicates that only when the consumers' monthly income is over 3000 yuan, will they begin to show an interest in and the preferences for the low-carbon products, and become the potential low-carbon consumers. Considering the national average consumption level, the average monthly income of residents in China was only 1988.27 yuan in 2011, and that implies that it will take some time to popularize the low-carbon consumption in the country. Therefore, it is necessary for the government to take actions to encourage consumers for more low-carbon consumption and to subsidize the low-income consumers, since the China's income disparity is considerably great.

Analysis of different genders

Finally, we made an independent sample *t*-test based on the data of the "gender" dimension, with the following findings (Table 11):

(1*) Significant differences exist between male and female consumers in the low-carbon product "Purchasing Behaviour", "Consumer Preference", "Consumer Awareness" and "Evaluation on Low-carbon Education".* Male consumers have better performances than the female ones in all indicators except "Evaluation on Low-carbon Education". It may be explained by the fact that men have a stronger sense of responsibility than women, and they are more easier to accept new ideas and to try novel products, thus leading better

Table 11. Independent sample *t*-test results of consumers of different genders

Dimensions	Male			Female			*t*	Sig. (2-tailed)
	mean	standard deviation	standard error mean	mean	standard deviation	standard error mean		
Environmental consciousness	2.721	0.976	0.051	2.683	0.954	0.042	0.576	0.565
Evaluation on low-carbon education	3.612	0.696	0.036	3.709	0.656	0.029	–2.089	0.037
Consumer awareness	2.401	0.788	0.041	2.256	0.71	0.032	2.843	0.005
Consumer preference	2.584	0.804	0.042	2.467	0.749	0.033	2.183	0.029
Purchasing behaviour	2.014	0.831	0.043	1.89	0.738	0.033	2.281	0.023

Source: The results from statistical analyses based on the sample data by the authors

low-carbon preferences and a higher value of the low-carbon product "Purchasing Behaviour".

CONSUMERS PERCEPTION TOWARDS GOVERNMENT POLICIES

As rational consumers, the low-carbon product "Purchasing Behaviour" is not only affected by endogenous factors such as "Environmental Consciousness", "Evaluation on Low-carbon Education", "Consumer Awareness", and "Consumer Preference", but it is also influenced, to some extent, by exogenous factors. Since China now lags behind some industrialized countries in the development of the low-carbon economy, the government's policy measures for supporting the low-carbon economy are still inadequate. Therefore, we adopted a regression model in an attempt to find the moderating role of the policy variable on the consumers' behavioural variables based on our questionnaire dataset.

Table 12. Moderating role of the consumer perception of the government low-carbon policy

Variables	Low-carbon product "Purchasing behaviour"		
	*M*1 β1	*M*2 β2	*M*3 β3
First step (control variables)			
Region	−0.215	−0.191	−0.189
Age	−0.092	−0.073	−0.076
Gender	0.005	0.006	0.005
Education	0.215	0.079	0.078
Monthly income	0.321	0.200	0.173
Monthly expenditure on agri-food products	0.012	−0.016	0.003
Regulatory R^2	0.230		
F	44.533		
Second step (main effect)			
preference		0.603	−0.001
policy		0.128	−0.266
Regulatory R^2		0.601	
ΔR^2		0.371	
F		165.143	
Third step (moderating effect)			
preference × policy			0.818
Regulatory R^2			0.617
ΔR^2			0.016
F			156.839

Source: The results from statistical analyses based on the sample data by the authors

Policy variable design in the questionnaire

Three questions are designed in our questionnaire to measure the respondents' perception of and the expectation for the government policy intervention: (1) the role that the government plays in the atmosphere formation of the low-carbon agri-food products; (2) the percentage of subsidies that the government should allocate to low-carbon agri-food products; (3) the obstacles that China faces to promote carbon labelling of agri-food products. As a part of the questionnaire, these three questions were answered by each respondent followed by the scenario experiment mentioned earlier in this paper.

Verification of the moderating role of the policy variable

We made a regression analysis using the calculated values of the above 3 questions (independent variables) and "Purchasing Behaviour" (dependent variable). The result shows that there is a moderating role for the consumers' "perception on the government low-carbon policies and implementing efficiency" in between "Consumer Preference" and "Purchasing Behaviour", i.e. if the government policies exert more impact, the low-carbon product "Purchasing Behaviour" might become higher. (see Table 12).

To illustrate the moderating role of the policy strength more clearly, we adopted the approach put forward by Aiken et al. (1991), i.e. adding and subtracting one standard deviation from the original data respectively based on the mean value of the policy strength, thus turning the original sample into a high policy strength and a low policy strength, and then performing the regression with "Consumer Preference" and "Purchasing Behaviour" respectively. The result shows that under both high and low policy strengths, the correlation coefficients of "Consumer Preference" and "Purchasing Behaviour" are significant: $\beta_{hi} = 0.931$, $p < 0.05$; $\beta_{lo} = 0.518$, $p < 0.05$. The correlation coefficient is much smaller under the low policy strength, indicating that the consumer's perception on the government low-carbon policies and

implementing efficiency might have a positive impact on the low-carbon product "Purchasing Behaviour".

CONCLUSIONS AND POLICY RECOMMENDATIONS

Conclusions

Based on the above analyses, we can draw the following conclusions:

(1) Large differences exist among different types of consumers in "Purchasing Behaviour". The descending order of the relative differences between the highest and lowest values of the low carbon product "Purchasing Behaviour" of different demographic variables is: educational background, regions, monthly income levels, age and gender; the descending order of standard deviations in the demographic variables is: regions, educational background, monthly income levels, age and gender.

(3) Consumers "Environmental Consciousness" deserves great attention. The analysis of different regions found that the Shenzhen residents have the lowest level of "Environmental Consciousness"; analysis of different ages showed that the teen-agers have the lowest "Environmental Consciousness"; the analysis of different educational background illustrated that education has comparatively more obvious impact on promoting the residents' low-carbon product "Purchasing Behaviour".

(4) Consumers' low-carbon product "Purchasing Behaviour" is affected by their perception of the government policies. The empirical analysis found that the stronger the motivation role of the government subsidies on the low-carbon products, the stronger the consumers' low-carbon product "Purchasing Behaviour"; meanwhile, establishing a credible carbon footprint certification authority and increasing the carbon labelling publicity might also have positive effects on the consumers' low-carbon product "Purchasing Behaviour".

Policy recommendations

Based on the conclusions above, we hereby put forward the following recommendations:

(1) Segmenting the low-carbon consumption market, and targeting the critical low-carbon consumer groups. Chinese government authorities should take the young middle-aged male consumers who are highly educated and better paid in the economically developed areas as the breakthrough to promote the low-carbon product consumption strategies. According to the differences shown in low-carbon purchasing behaviour of different regions, the educational background, ages and income levels, a variety of low-carbon promotion strategies should be made to make these consumers with a high purchasing power play a demonstrative role for the nation's low-carbon consumption drive.

(2) Paying attention to the low-carbon consumption guidance, and promoting the consumer awareness and preference for the low-carbon products. Chinese government authorities should promote the low-carbon products through the mass media such as the TV, the Internet, newspapers, community poster, etc, and establish a complete mechanism of leadership, organization and publicity, with the guidance of the low-carbon consumption. The low-carbon consumption behaviour should be promoted through governments, enterprises, and consumers, etc. hence the improvement of the whole nation's awareness and preference for the low-carbon products and the establishment of a public opinion atmosphere for the transformation of the low-carbon consumption model in the society.

(3) Increasing the low-carbon publicity and education, and strengthening the low-carbon environmental consciousness of all consumer groups. The above analysis shows that the better-paid consumers aged at 20–29 and those consumers in the economically developed areas have the lowest level of "Environmental Consciousness". Therefore, the relevant government departments in China should specifically target at these groups for a special knowledge training; at the same time, take the necessary performance appraisal measures, in an attempt to improve the "Environmental Consciousness" of these consumers. This will play a connecting role in the transformation from the high to low-carbon consumption ideology throughout the nation.

(4) Improving the government low-carbon consumption policies, and enhancing the policy implementing efficiency. The government low-carbon consumption policies should include the cost and price subsidies, publicity and promotion measures for low-carbon products, the efforts made for developing the low-carbon certification system, and other specific policies issued by the government to promote the low-carbon consumption. In addition, the implementing efficiency should also be improved. A compensation mechanism for the low-carbon development should

be established and the local governments encouraged to make the low-carbon development plans with local features, enabling consumers to better perceive the government attention and its effective execution efficiency, thus motivating the individuals' participation in the low-carbon consumption.

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