An effect of CO2 information labeling for the pork produced with feed made from food residuals

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Abstract In this study, we attempts to evaluate customer reaction to the labeling of food residuals recycling and CO2 reduction for the pork using web marketing survey and in-store survey. The results are shown as below: (1)The amount of willingness to pay (WTP) for the pork produced with feed from food residuals was approximately additional more than dozen yen / 100g-pork in comparison with that of ordinary Japanese pork. (2)The amount of WTP for LC-CO2 reduction was also approximately additional 0.4 yen / g-CO2. From the above results, many consumers have positive feelings and added value toward the pork produced with feed made from food residuals. Moreover, it is suggested that actively labeling the information for resource recycling and LC-CO2 reduction would lead consumers to purchase the pork produced with feed from food residuals.

1 Introduction

In Japan, every year approximately 21 million tons of food residuals are generated. Since most of food residual is high-moisture, it is not suitable for incineration disposal. Moreover, landfill sites for incineration residue are shortage. In recent years, food residual from urban areas has come to be regarded as a renewable biomass resource, and its recycling is expected to lessen the environmental burden. Food waste recycling system has been at the center of attention and “Law for the Promotion of the Utilization of Recyclable Food Resources (Food Recycling Law)” has established in 2000. The law cited composting, bio-gasification, and feeding as ways of recycling food waste. Currently, more than half of food waste discarded from food-related industries is recycled while hardly any waste from households is recycled. In particular, the Food Recycling Law specifies the use of

food residuals in livestock feed as a preferred way of utilizing its components and calorie content. Furthermore, in our study, it is cleared that the pork produced with liquid feed made from food residuals emits less amount of lifecycle CO2 (LC-CO2) in comparison with ordinary Japanese pork [1].
On the other hand, for dissemination of feed from food residuals, it is essential for consumers to actively evaluate in respect to the resource recycling and the reduction of LC-CO2, and purchase such pork. Therefore, it is important to analyze social dimension such as consumers' acceptance and displaying information for promoting purchase.
In this study, we attempts to evaluate customer reaction to the labeling of food residuals recycling and CO2 reduction for the pork using web marketing survey and in-store survey.

2 Methodology

2.1 Internet marketing survey

2.1.1 Conjoint analysis

First, we quantified the customer reaction to the information of food residuals recycling and CO2 reduction for the pork with conjoint analysis. The analysis is one of the econometric methods often adopted to evaluate goods such as the environment which are not treated on the market [2]. In this analysis, several question methods such as ranking type, pair wise, and choice experiment (CE) can be applied. In this study, CE was adopted which is close to the actual purchase behavior. Items in which we wish to measure utilities are called as "attributions" and their levels as "standards." Four alternative plans composed of the four attributes were provided in the questionnaire. Respondents were asked to select one of the most preferred choices. Figure 1 shows an example of a questionnaire used in this study.
The collected data are then analyzed econometrically using the following conditional logit model in the background of the CE. CE is based on the random utility function. That is, the random utility function is shown as follows:

$$U_{in} = V_{in} + \varepsilon_{in} = \left(\beta_1 X_1\right)_{in} + \left(\beta_2 X_2\right)_{in} + \cdots + \varepsilon_{in} \qquad (1)$$

where U is the total utility, V is the observable component of the total utility, ε is the unobservable component, X is the vector of the attributes, β is the parameters of attributes, the i is the number of alternatives, generally called profiles, and n is the number of respondents. Parameters of the observable utility function V are estimated using the conditional logit model.

Q. Please select your preferred pork, considering the balance between each attribute.
Then, pleasecheck the plan you selected at the bottom column.

	Pork 1	Pork 2	Pork 3	Pork 4
Feeding of feed from food residuals	Used	Used	Not used	Not used
CO2 fractuatuation	50g increase	50g decrease	50g decrease	Not influctuation
Production area	Domestic	Homegrown	Foreign Countries	Domestic
Added expense	100 JPY	50 JPY	50 JPY	0 JPY
	↓	↓		↓
Check the prefered pork				

Figure 1: An example of questionaire sheets

When ε is assumed to be independently and identically distributed with a Gumbel distribution (a type 1 extreme value distribution), the probability Pni that alternative i is selected in the set of all possible alternatives C = {1, 2, … ,J}is as follows;

$$P_{ni} = \frac{\exp(V_{ni})}{\sum_{j=1}^{J} \exp(V_{nj})} \tag{2}$$

The log likelihood function for the maximum likelihood estimate is,

$$\ln L = \sum_{n=1}^{N} \sum_{j=1}^{J} d_{ni} \ln P_{ni} \tag{3}$$

where N is the number of respondents, dni is the dummy variable, dni = 1 when individual n selects alternative i, and dni = 0 when individual n selects any other alternative, except for alternative i. The utility parameters that maximize Eq. (3) are then calculated.

If conjoint analysis examines attributes including the payment, it can estimate the utility of product as monetary value. By comparing each marginal utility of attributes with that of payment, the monetary values per unit change in each attribute (Marginal Willingness to Pay: MWTP) can be calculated by the following equation.

$$MWTP_{x1} = -\frac{\beta_{x1}}{\beta_{payment}} \tag{4}$$

2.1.2 Survey design

Table 1 shows the attributes and standards of the conjoint analysis in this study. Attribution 1 was "with or without feeding of feed from food residuals." Attribution 2 was "fluctuation of CO2 generation." As there was a possibility of CO2 generation by drying process applied to feeding stuff production, standard of CO2 increase was set with providing such information. Attribution 3 was "production region," and "homegrown" exhibiting circulation within regions. Finally, attribution 4 was "added expense" that was employed for estimating MWTP. From these attributes and standards, we identified alternative plans using the orthoplanning of SPSS Conjoint. The selection sets composed of these alternatives were provided to each respondent seven times as shown in Figure 1. Plan 4 is ordinary Japanese pork.

Table 1: Attributes and standards of conjoint analysis

	Feeding of feed from food residuals	CO2 fractuation	Production area	Added expense
Level 1	Not use	100g increases	Domestic (not homegrown)	0 JPY
Level 2	use	50g increases	Homegrown	10 JPY
Level 3	-	Not fluctuation	Foreign countries	50 JPY
Level 4	-	50g decreases	-	100 JPY
Level 5	-	100g decreases	-	-

Internet survey is implemented to 3,946 residents of Tokyo metropolitan area on December 2009.

2.2 In-store survey

In addition to the above mentioned internet survey, a survey was conducted at shops that actually deal in pork produced with feed made from food residuals. First, a point-of-purchase (POP) advertising tool was prepared that contained information regarding recycling and CO2 emission (Figure 2). Our study has revealed that pork produced with liquefied feed made from food residuals can

reduce CO2 emission by about 31g-CO2 / 100g-pork compared with ordinary Japanese pork [1]. Second, with the POP advertising displayed at the meat sales counter, we observed the buying behavior of the customers and conducted a questionnaire of their views when they finished their payment. In the survey, while being shown the same image as the POP advertising, the customers were asked questions regarding the following items:

1) Awareness with pork produced with liquefied feed made from food residuals;
2) Experience of having bought such pork;
3) Recognition rate of the POP advertising displayed in the survey;
4) Understandability of the display of environmental information;
5) Necessity to display environmental information;
6) Influence of such information on buying intention;
7) Reasons to buy/not to buy such pork; and
8) Willingness to pay of such pork (compared with ordinary Japanese pork).

The survey was conducted at two shops for one day in February, 2011, and 210 sample data sets were collected.

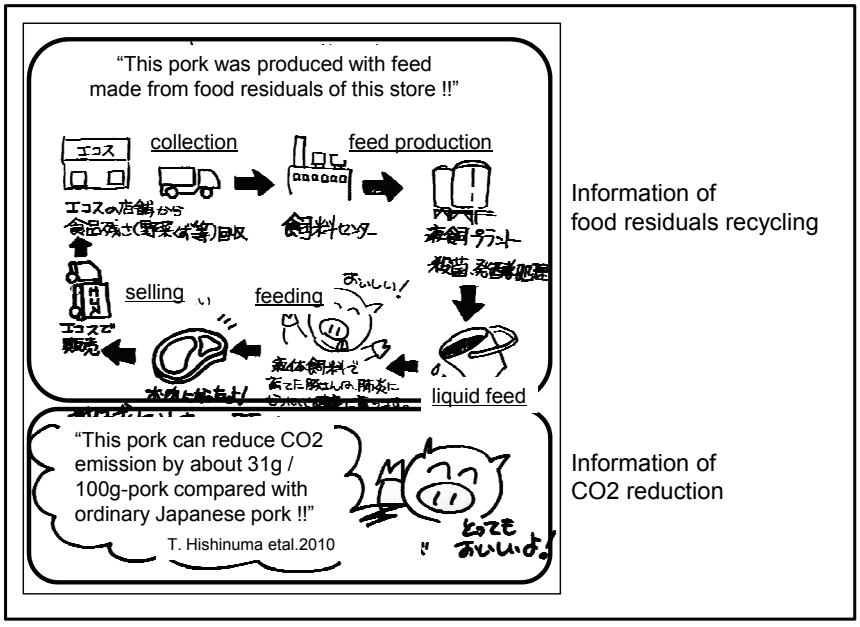

Figure 2: Point-of-purchase (POP) advertising tool

3 Results and discussion

3.1 Internet marketing survey

We assumed the following linear model, and analyzed the responses of the questionnaires. Then we presumed the parameter β. The linear model used in this study is:

$$V = \sum_{d=1}^{1} \beta_{EF} EF_d + \beta_{cf} CF_d + \sum_{d=1}^{2} \beta_{AP} AP_d + \beta_{\cos t} COST \quad (5)$$

where EF is a dummy variable that shows the with/without feeding of feed from food residuals, AP is a dummy variable that shows the production region, CF is the amount of fluctuation of CO2 generation, and COST is the amount of added expense. Analysis outcome is exhibited in Table 2.

Table 2: Estimation result of conjoint analysis

		β	MWTP(JPY)	
Feeding of feed from food residuals		4.38E-01	19.3	***
CO2 fractuation		-8.13E-03	-0.4	***
Production area		-	-	-
	Foreign country	-1.65E+00	-72.7	***
	Homegrown	3.79E-01	16.7	***
Added expense		-2.27E-02	-	***
Likelihood ratio index (LRI)		0.223		

Per 100g pork, ***:Significant at < 1%, 1 EURO= about 110 yen

The utility of the pork produced with feed from food residuals (attribution 1) is positive; and The amount of MWTP was approximately 19.3 yen / 100g-meat in comparison with that of ordinary Japanese pork. This means that consumers sensing something extra to food residuals recycling. The high acceptance was suggested by providing information of food residuals recycling. About fluctuaion of CO2 generation in second attribution, utility to emission increase became negative (cost to reduction was positive). The amount of WTP for LC-CO2 reduction was also approximately additional 0.4 yen / g-CO2. According to our research, it is cleared that the pork produced with liquid feed made from food residuals reduces approximately 31g-CO2/100g-pork in comparison with ordinary Japanese pork (Hishinuma etal. 2010). Therefore, it is expected that the additional payment of approximately 12.4 yen/100g-pork. In addition, when a previous food

residuals recycling is included, additional payment is approximately 31.7 yen/100g-pork.
From the above results, it is suggested that actively labeling the information for resource recycling and LC-CO2 reduction would lead consumers to purchase the pork produced with feed from food residuals.
（In second attribution set for concerning regional rotation, foreign made MWTP became significantly negative by approximately minus 73 yen in a case utilities of domestic aside of homegrown products are set at 0 under postulation. Meantime, MWTP of homegrown product became approximately 17 yen positive.）

3.2 In-store survey

The in-store survey results are as follows.
Combinations of responses as “knows very well” and “do not know much but heard about it” were turned out to be 44.1% of all subjects. Of those, 76.3% had bought such pork at least once. This indicates that promoting familiarity can increase the demand.
In this survey, however, only 21.0% of all subjects noticed the displayed POP advertising. In particular, a mere 14% of those who had not even heard of such pork took note of the display. Therefore, the influence on buying behavior of having been provided with information beforehand could not be observed in the survey. After being shown the same image as the POP advertising, however, about 60% answered that it was easy to understand and 95% answered that it could increase their buying intention. In addition, 82.6% replied that such information was useful. Thus, it can be concluded that the contents of the provided information was highly appreciated.
Moreover, as shown in Figure 3, about half of the subjects showed their willingness to pay 20 yen / 100g-pork over the price of ordinary Japanese pork. The result was almost the same as that via the Internet survey.

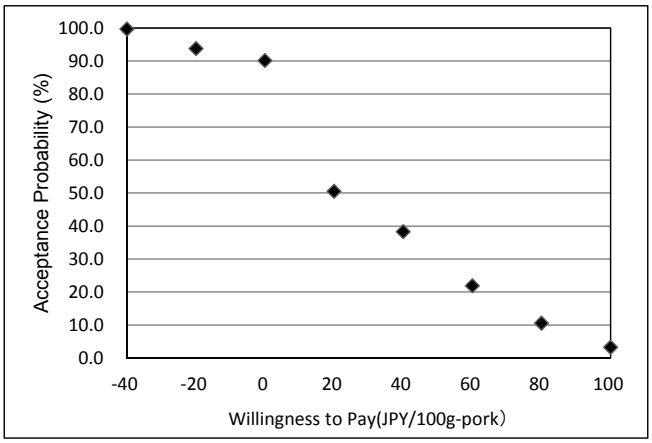

Figure 3: Willingness to pay for the pork produced with feed made from food residuals

4 Conclusions

In this study, we attempts to evaluate customer reaction to the labeling of food residuals recycling and CO2 reduction for the pork using web marketing survey and in-store survey. As a result, many consumers have positive feelings and added value toward the pork produced with feed made from food residuals. Providing information regarding such food residuals recycling and CO2 reduction for the pork will increase the receptivity of consumers, and thus added value will also be increased. However, because the actual changes in buying behavior could not be examined in this survey, our next task is to review the method by which and duration for which the information is provided so that we are able to analyze whether it will affect buying behavior.

5 References

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