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Research Report

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Title of Research: Consumers' willingness to pay for conserving floating rice's multifunctional values in the Mekong Delta of Vietnam

Purpose of Research:

Floating rice, which is a unique farming in the Vietnamese Mekong Delta, is cultivated only one crop per year during flooding season. Floating rice consumes no pesticide and very little amount of fertilizer. Thus, floating rice is good for not only producers and consumers but also our natural environment. In fact, floating rice fields are home to 43 fish species and 54 plant species. Moreover, floating rice also play an important role in preserving valuable genetic resources. However, these roles of floating rice to environment and conservation of genetic resources was not fully recognized by farmers. Therefore, the majority of rice farmers in the Mekong Delta have shifted from floating rice cultivation to high-yielding rice production, leading to the significant reduction of total cultivated area of floating rice, from about 0.5 million ha in 1974 to only 50 ha in 2015. This reduction has affected adversely on agro-environment (biodiversity losses, disappearance of valuable genetic resources,...). The most important reason for such noticeable reduction is probably due to the underestimation of multifunctional values (home to species, alive genetic resources, non-chemical products, ...) of floating rice.

Therefore, to conserve floating rice, the multifunctional values of floating rice need to be correctly estimated. The economic values of multifunctional floating rice will be estimated by using discrete choice modeling. This method will consider some hypothetical scenarios about the attributes of floating rice (lower use of agro-chemicals, increase of biodiversity,…) then these scenarios are presented to ask for urban residents' willingness to pay.

For a long-lasting history, urban rice consumers have been consuming a lot of rice but their responsibility on agro-environment is quite limited. For this reason, the objective of this study is also to investigate urban rice consumers' preferences on floating rice conservation and consumption behavior, from which we can estimate the multifunctional values of floating rice.

In addition, under the increasingly serious impacts of climate change, floating rice is considered as one of the valuable genetic resources that help scientists to cross-breed some new rice varieties that can tolerate to new environmental conditions. Therefore, conserving floating rice (consumer-based conservation) is one of the crucial ways to adapt to climate change.

Content/Methodology of Research

Conceptual framework on latent class choice modelling

The latent class model utilized to deal with choice experiment data has been developed by Swait (1994) . Latent class model (sometimes referred as finite mixture model) is considered as one of the most preferable alternatives as the assumption of the IIA property is violated. In the other words, the latent class model can capture or identify the sources of the heterogeneous preferences among respondents by revealing a number of classes/segment that share relatively common tastes. Reviews from literature show that in the analysis of discrete choice data it is important to consider the latent individual characteristics in the decision-making processes (Kontoleon and Yabe 2006; Ben-Akiva et al. 2002; McFadden et al. 1999; McFadden 1986). Previous studies also show that the heterogeneity is often found in market analysis, especially in developing countries (Dillon 1994; Wedel and Kamakura 2012; Kontoleon and Yabe 2006). The latent class model assumes that the sampled respondents can be classified into two or more groups based on their associated attitudinal and and socio-demographic characteristics.

According to Boxall and Adamowicz (2002); Louviere et al. (2000); and Swait (1994), the latent class model representing the composite utility function is expressed as below

$$U_{ij/s} = \beta_s X'_{ji} + e_{ij/s} \quad (4)$$

The equation (4) indicates the utility of the i^{th} respondent in a particular class or segment s selects the alternative j in a choice set C. Please note that in the latent class model the vector X'_{ji} consists of both choice-specific attributes and individual socio-demographic characteristics. The probability that a respondent chooses alternative j on the segment s in a choice set is expressed as

$$P_{ij/s} = \exp(\beta_s X'_{ji}) \Big/ \sum_{k \epsilon C} \exp(\beta_s X'_{ki}) \quad (5)$$

The probability of segment membership can be determined by following the approach developed by Ben-Akiva et al. (1997); and Swait (1994). These authors suggested using a separate logit model to determine the membership probabilities for individual respondents. The process to identify the segment membership is specified as

$$P_{js} = \exp(\delta_s Z'_i) \Big/ \sum_{J \epsilon C} \exp(\delta_k Z'_i) \quad (6)$$

Where, Z'_i are socio-demographic, attitudinal and perceptual variables of the i^{th} respondent; δ_k is the parameters to be estimated.

The latent class model accounting for choice and latent segment membership can be derived simultaneously as joint probabilities of equations (5) and (6). Let P_{ijs} be the joint probability that respondent i belongs to segment s and choose alternative j, we get

$$P_{ijs} = (P_{ij/s}).(P_{js}) = \left[\exp(\beta_s X'_{ji}) \Big/ \sum_{k \epsilon C} \exp(\beta_s X'_{ki})\right].\left[\exp(\delta_s Z'_i) \Big/ \sum_{J \epsilon C} \exp(\delta_k Z'_i)\right] \quad (7)$$

According to Andrews and Currim (2003); Wedel and Kamakura (2012); and Louviere et al. (2000), there have been various indicators suggested to determine the appropriate number of segment S ($S \leq N$). The current study employs three main criteria: the minimum Bayesian Information Criterion (BIC), the minimum Bozdogan Akaike Information Criterion (AIC3) and the maximum Akaike Likelihood Ratio Index ($\bar{\rho}^2$).

Study design and implementation

The data collection process for the current study is summarized within three main stages: attribute selection and questionnaire design, pre-test survey and main survey.

First, attributes and questionnaire design is considered as the most important stage that determines the feasibility and validity of collected data. To determine the attributes of eco-friendly rice (particularly floating rice) and its levels, the study has conducted a focus group discussion with environmental, agricultural economics and agronomy experts and intensive literature reviews from reports and scientific papers relating to eco-friendly rice production in the Mekong Delta. Most importantly, the current study is considered as a follow-up research in a series of work relating sustainable production in the Mekong Delta of Vietnam. Some attributes and its levels (water and ago-chemicals) were determined based on our previous findings. The previous findings were derived from statistical analyses of a dataset of 202 rice farmers collected in 2016 (59 conventional rice and 143 eco-friendly rice). The levels of selling price attribute were determined based on two sources of information: the farmer survey and the observations of five rice selling stores and one supermarket.

The study conducted two interviews with consumers: one with 450 Vietnamese consumers and the other one with 400 UK consumers (using our other budgets). However, this current report focuses mainly on the dataset from Vietnamese consumers. The valid sample of Vietnamese consumers for data analysis is 360 because some consumers are not familiar with the survey and choice experiment.

For the questionnaire design, based on these attributes and its levels, the study constructed a series of profiles or alternatives for one kilogram of eco-friendly rice. The current study employed orthogonal design to create 25 choice sets. For simplicity, 25 choice sets were randomly blocked into five versions of questionnaire. It means that every respondent was asked to answer five choice sets. Each version of questionnaire was used randomly to interview respondents.

Second, the pre-test survey is also considered as "must-do" stage in choice experiment. The study has conducted a pre-test survey with ten researchers and lecturers who are working in Can Tho University to check the appropriateness and understandability of the questionnaires.

Third, the main survey was conducted via face-to-face interviews with 450 Vietnamese rice consumers in 2017. The current study employed multi-stage sampling procedure developed by Lynn and Lievesley (1991) for drawing samples. The study selected two most popular cities (i.e. Long Xuyen city of An Giang province and Ninh Kieu, Binh Thuy, Cai Rang urban districts of Can Tho city) in the Mekong Delta of Vietnam. Can Tho city was selected as the representative study site because it is considered as the "capital" of the Mekong Delta with the total population of 1.4 million people

and the highest per capita income of 5.8 million VND/month. An Giang province being known as one of the major rice producers in the Mekong Delta contributes more than 4 million tons of rice in 2016.

Conclusion/Observation (400 words)

Findings

The study found that the two-segment model is best fit to the data. Based on the estimated coefficients, the consumers who belong to segment 1 are characterized with significantly higher income, less number of family members, higher educational level, higher environmental concerns and particularly they had known and bought eco-friendly rice. Therefore, this segment is labeled as eco-friendly "*potential consumers*". For those who belong to segment 2 are price-sensitive and mistrust the labeling information, suggesting that these consumers pay much attention on selling price and do not trust on eco-friendly labeled rice or floating rice. Accordingly, we labeled this segment as eco-friendly "*unwilling consumers*". The study also found that 205 (57% of total sample size) and 155 respondents (43% of total) belong to segment 1 and segment 2, respectively.

The study showed that potential consumers are willing to pay for both private and public characteristics of eco-friendly rice, particularly floating rice. The most interesting finding is that the potential consumers' willingness to pay for the private characteristics (reduction of agro-chemicals) is 12,760 and 17,027 VND/kg for reductions of 75% and 100% of total agro-chemical use, respectively. The consumers' willingness to pay for public characteristics is 2,477 VND/kg for 100% increase of biodiversity, 5,785 VND/kg for 150% increase of biodiversity and 4,991 VND/kg for reduction of water use, which is much lower as compared to that for the private characteristics. These values reflect not only the multifunctional values of floating rice but also the market demands of eco-friendly rice products. It could be easily explained that rice is a major staple food for Vietnamese. The Vietnamese still consumes a lot of rice per day, total payment for rice, thus, also shares a significant proportion in total expenditure. Health risk aversion seems to be the best choice for them. In addition, the living standard and income of Vietnamese in general are still low, which in part result in their low social and environmental responsibilities. However, their high willingness to pay for reducing agro-chemicals explicitly contributes significantly to biodiversity revitalization. For policy implications, in order to increase the consumption of eco-friendly rice, it is strongly crucial to include and disseminate information of agro-chemicals use rather than biodiversity revitalization.

Conclusions

The study employed latent class choice modeling which allows capturing simultaneously both market segment analysis and product choice. Based on the analysis of socio-demographic and psychometric factors, the study found that there are two distinct consumer segments (i.e. potential and unwilling consumers). The market shares of potential and unwilling segments are 57% and 43%, respectively. The study also found that the rice consumers are willing to pay higher for private characteristics (reduction in agro-chemicals) than public characteristics (biodiversity revitalization) of eco-friendly rice, particularly floating rice. The consumers in segment 1 are willing to pay a premium of 17,027 VND/kg for non-use of agro-chemicals, 170% over the price of normal rice. These consumers are also willing to pay a premium of 2,477 VND/kg and 5,785 VND/kg for 100% and 150% increase of biodiversity, respectively. The consumers in the segment are high price sensitive and mistrust the eco-friendly labeled rice; they are, thus, unwilling to buy eco-friendly rice.