Paddy Water Environ (2008) 6:229–236
DOI 10.1007/s10333-008-0110-5

ARTICLE

Environmental multifunctionality of paddy fields in Taiwan: an application of contingent valuation method

Ya-Wen Chiueh · Ming-chien Chen

Received: 27 April 2007 / Accepted: 3 January 2008 / Published online: 8 March 2008

Abstract This paper aims to evaluate the social value of the environmental multifunctionality of paddy fields in Taiwan; through individual consumers' direct expressions of their perceived benefit and to provide the empirical data thus collected for the reference of the decision makers in the government. This study use contingent valuation method (CVM) to evaluates the value of environmental multifunctionality of paddy fields from the purposefully selected pool of samples in Taiwan. The result shows if judged by the threat that free trade poses to the retention of arable land, most respondents give a value of 114 NT/household/month to 115 NT/household/month for 1% reduction of arable land to be restored to the existing level; and168 NT/household/month to 181 NT/household/month for a reduction rate of 4%. There are 7,394,758 households in Taiwan. The aggregating result is 10,116,028,944 NT/year to 10,204,766,040 NT/year for 1% reduction of arable land to be restored to the existing level; and 14,907,832,128 NT/year to 16,061,414,376 NT/year for a reduction rate of 4%.

Keywords Environmental multifunctionality · Willingness to pay · Contingent valuation method

Y.-W. Chiueh (✉)
Department of Regional Studies in Humanity and Social Sciences, National HsinChu University of Education, No.521, Nanda Rd, Hsinchu 300, Taiwan
e-mail: yawen@mail.nhcue.edu.tw; Yawen.chiueh@gmail.com

M. Chen
Department of Finance, Hsuan Chuang University, Hsinchu, Taiwan, R.O.C

Introduction

The World Trade Organization (WTO) was established, first and foremost, to eliminate various trade barriers, with an aim to promote free trade and optimal use of resources. In its effort to bid for WTO membership, Taiwan is bound to provide an encumbered trade regime by abolishing its own trade restrictions in the agricultural sector, which is expected to lead to a sharp rise in imports with but limited export growth due to the higher prices of Taiwan's agricultural products. In turn, this will threaten the very survival of the agricultural industry in Taiwan, and thus an urgent issue to be addressed. The value of agriculture should not be reduced to its production output, nor should a simplified international price be equally applied to the calculation of the output value. Besides, other than its economic value, agricultural production serves several other important functions. This is why the policy goals for the agricultural development in Taiwan also highlight the important roles of agriculture in production, living, and the ecosystem. In short, agriculture should not be given up just because its products are no longer competitive in the world market in the foreseeable future.

During the WTO technical meeting on Multilateral Environmental Agreements, the possible conflict between WTO rules and various international protocols and conventions on environmental protection was fiercely debated. Through marathon discussions in the trade and environment committee meeting representative of both agricultural net exporting and importing countries in June 1999, the participants concluded that the improvement on the techniques and methods of evaluating the environmental benefit of agriculture in fact contributes to the measurement of the benefit of other public goods characteristic of

externalities, which recognizes, though indirectly, that agriculture is indeed multifunctional.

Countries in the Keynesian bloc may hold firmly that market mechanism should be respected and that agricultural subsidies of any kind are to the detriment of the optimal use of world resources. Still, it is no reason for the discussion of a free agricultural trade to ignore the multifunctional features and the environmental services of agriculture. Kim et al. (2006) indicated that the Asian monsoon regions should evaluate the characteristics of multi-functionality of paddy farming correctly and transmit them to the people of Western countries. This is especially true for Taiwan because the agricultural sector is so tied in with the conservation of the local ecosystem, and any damage on the natural environment is not likely to be rectified by bin creasing imports. Considering the small and densely populated land that Taiwan is based upon, the environmental value of agriculture should never be dismissed in such a careless manner. To evaluate the multifunctionality of paddy farming is very impartment. Chang and Ying (2005) estimated the willingness to pay (WTP) of the water preservation and land protection function for rice fields in Taiwan by the assumption that the water preservation and land protection function would completely disappear without government payment. Aizaki et al. (2006) used a realistic assumption to measure the multifunctionality of agriculture and rural areas in Japan. In this study, we use a realistic assumption to evaluate a selected pool of samples' willingness to pay (WTP) for the environmental multifunctionality of paddy fields. We hope the result could provide the empirical data thus collected for the reference of the decision makers in the government.

Research method

Survey sampling

The study collects consumer data directly from a purposefully selected pool of samples. Bateman and Turner (1992) and Hutchinson et al. (1995) indicated that the more knowledge for the evaluated good for respondents will enhances the accurate in CVM evaluation. The survey aims to investigate consumers' appreciation of the environmental multifunctionality of paddy fields and their willingness to pay for such benefit by creating a hypothetical context that draws the respondents' special attention to the role that paddy fields' environmental multifunctionality. The sample selected by this study comes in two groups: (1) Professionals of the agricultural sector comprised of full-time instructors currently teaching at the Department of Agriculture of the National Taiwan University. A pre-test questionnaire was distributed to each member of the first group. (2) General public with some knowledge of agriculture or those well informed of daily life subjects selected particularly for the purpose of the survey. This second group consists of two different subgroups: (1) parents of students currently enrolled in the agriculture department of various universities, and (2) parents of pupils attending the Taipei Municipal Kung-Fu Elementary School. Questionnaires were then sent to both groups of subjects by postal mail, with the time of survey, number of sample households, and the return rate provided in Table 1. The contingent valuation method is employed during analysis. Finally, an evaluation on the environmental services of paddy fields enjoyed by the respondents is conducted through simulation.

Questionnaire design and sample characteristics

The CVM approach starts out by describing the environmental multifunctionality of paddy fields to help the respondents formulate a hypothetical market in their mind. A vast amount of literatures (Kim et al.2006; Agus 2006; Matsuno et al. 2006; Huang 2006; Aizaki et al. 2006) has already indicated that paddy fields provides space, green land, and natural habitats, and helps retain excessive rainwater and supply for groundwater, all of which are commonly termed "the environmental multifunctionality of paddy fields." However, the fact that such services is beneficial to the entire society but of which the value is undetermined because of the lack of available market transaction data shows that it is in fact a non-market, public good. To study the subject, this paper has categorized the benefit of environmental multifunctionality of paddy fields into the value of use, the value of option, the value of inheritance, and the value of existence. The total economic value of environmental multifunctionality of paddy fields is the sum of the value of use, the value of option, the value of inheritance, and the value of existence. Table 2 summarizes values of environmental multifunctionality of paddy fields.

Table 1 Survey sample and return rate

Respondents' grouping	Agriculture professionals	Parents of college students	Parents of Taipei elementary school pupils
Survey period	April 1–30, 1999	May 15–June 15, 1999	May 15–June 15, 1999
Household samples	200	400	200
Valid samples	77	108	118
Return rate	38.5%	27%	59%

Source: This study

Table 2 Total economic value of environmental multifunctionality of paddy fields

Category	Use value	Option value	Inheritance value	Existence value
Descriptions	Direct or indirect values of using the services	Willingness to pay for the protection of the environmental multifunctionality of paddy fields to ensure future benefit for oneself	Willingness to pay for the sustaining of the environmental multifunctionality of paddy fields to serve future generations	Recognizing the value of the environmental multifunctionality of paddy fields and satisfied with it; thus willingness to pay for its sustaining to maintain the satisfaction

Source: This study

If we evaluate the value of option, the value of inheritance, and the value of existence for environmental multifunctionality one by one, it may occur embedding bias (Dupont 2003; Carson et al. 1992; Hanemann 1994). To avoid the embedding bias, this paper evaluates the total economic value of environmental multifunctionality of paddy fields. For the purposes of price inquiry, this study employs hypothetical questions where the international rice prices are provided to probe the consumer's willingness to pay for the environmental multifunctionality of paddy fields, using monthly rice consumption as a payment vehicle. This is a reality question for rice consumers. The questionnaire also requests the respondents to consider two scenarios. In Scenario A, the total paddy fields area will decrease from 864,000 to 828,000 ha given the average agriculture land area drop rate of recent years, or a decrease from 24 to 23% in its share of the total land area of Taiwan. The setting of scenario A is base on the average paddy fields area decrease rate in Taiwan. In the meantime, the benefit of environmental multifunctionality benefit of paddy fields diminishes from 100 to 95.80%, corresponding to the drop in the paddy fields area. In Scenario B, the policy target of deregulating paddy fields ownership and usage set forth by the Council of Agriculture to maintain at least 720,000 ha of paddy fields will allow the environmental multifunctionality benefit of paddy fields to drop further to a level of 83.31%. A detailed calculation/assumption of the two scenarios is provided in Table 3. The precise description of the critical question for the willingness to pay is in the Appendix.

This study first employs open questions to inquire prices from agriculture professionals for pre-test, and then selects four price quotations from the survey data as the basis for the single-bounded dichotomous-choice questions for the general public. The general public respondents are required to decide whether to accept or reject the cutoff points of the WTP (5, 10, 20, 50 NT/kg). The final part of the questionnaire is designed to obtain the socio-economic characteristics of the respondents. The definitions of the variables and the sample statistics of the general public are summarized in Table 4.

Table 3 Scenarios

Scenarios	Paddy fields area (ha)	Paddy fields area/total land area (%)	Environmental multifunctionality benefit (%)
Current state	864,000	24	100.00
Scenario A	828,000	23	95.80
Scenario B	720,000	20	83.31

Source: This study

Benefit evaluation

Evaluation model

The household production model was employed when Freeman (1993) established his theory on benefit evaluation for non-market goods. The same model is used here.

The price of general goods P_X, the price of domestic rice products P, and the income of M under the given level of agriculture protection Q are all independent variables that have an influence on the demand of the household. By Freeman (1993) the indirect utility function U^0 of the household shown below.

$$U^0 = V(P_X, P, Q, M). \quad (1)$$

In light of the fact that utility function is immeasurable while expenditure functions can be easily observed through the household behaviors, the correlation between the functions of indirect utility and expenditure can help convert Eq. (1) into the expenditure function below:

$$E = E(PX, P, Q, U^0). \quad (2)$$

Under the assumptions of a fixed utility level (U^0) and a constant price for X (P_X), the interaction between P and Q can be reflected through the expenditure function. As proposed by Bradford (1970) in his individual bid curve theory, a certain trade-off exists between the rise in the prices of domestic rice products and the environmental multifunctionality values of paddy fields and thus creates the bid curve E^0, as shown in Fig. 1. In other words, putting up with high prices of domestically produced rice products is necessary if paddy fields are to be maintained, as well as

Table 4 Sample statistics of general public

Variable name	Definition	Mean	Standard
THK	The respondent's views toward free agricultural trade and agricultural protection. The higher the score, the greater the degree in favor of protection. The answer "entirely in favor of free trade" scores no point, while that of "entirely agree with protection" obtains 20 points.	12.59	2.68
Year	The respondent's age.	45.94	8.07
EDU	The respondent's education attainment.	11.29	2.88
OC	The respondent's occupation.	5.00	2.84
INC	Regular monthly income of the responding household.	7.58	2.71
TYPE	The respondent's sub-grouping. Parents of college students are 1, those of school pupils is 0.	0.60	0.49
ASK	The cutoff points of the WTP (5, 10, 20, 50 NT/kg).	6.85	2.43

Source: This study

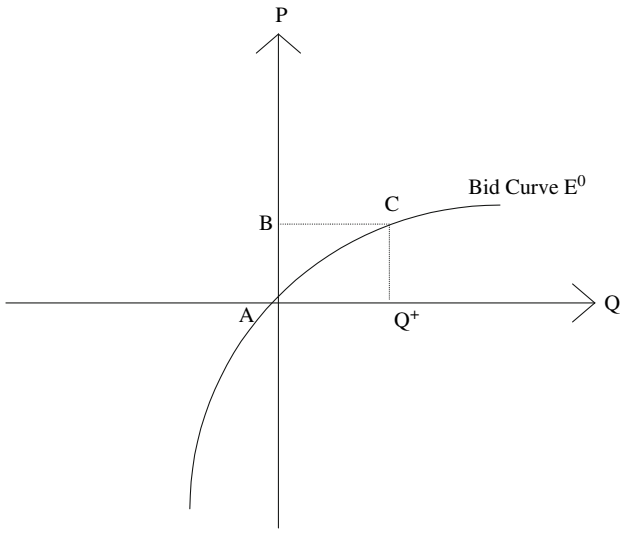


Fig. 1 Bid curve

the environmental multifunctionality benefit of paddy fields is to be enjoyed. As a result, the bid curve will stretch from the third quadrant to the first on the coordinate plane. The origin A (Q^0, P^0) in the diagram below denotes the current levels of rice price and environmental multifunctionality benefit of paddy fields face consumers.

The environmental multifunctionality benefit of paddy fields increases as the axis of abscissa extends to the right and decreases as it moves to the left; the price of domestic agricultural products rises as the axis of ordinate stretches upward and drops as it goes down. Therefore, any given point along the Bid Curve E^0 will generate the same level of utility, making the bid curve the consumer's indifference curve between the environmental benefit and the agricultural prices. When the environmental function improves and reaches a higher level of Q^+, consumers' willingness-to-pay (WTP) equals the difference between the later price and the original price, or the result of P^1 minus P^0, or CQ^+ in the diagram. This is also called the compensating surplus (CS) for consumers. CS denotes consumers' WTP to maintain the original bid level of E^0 if they are to enjoy a better environmental benefit level of Q^+ as the environmental benefit changes, expressed in the function of expenditure below.

$$E(Q^0, P^0) = E^0 = E(Q^+, P^0 - \mathrm{CS}) = E(Q^+, P^0 - \mathrm{WTP}) \quad (3)$$

The questionnaire of this study is designed to estimate the respondents' bid function B (Q^0, Q^1, U^0, W) in response to the restored environmental benefit of agriculture in the hypothetical market as the economic benefit of environmental protection improves as shown below.

$$B(Q^0, Q^1, U^0, W) = E(Q^0, U^0, W) - E(Q^1, U^0, W) \quad (4)$$

In other words, the bid function is the difference between two expenditure functions,

$$W = W(P, \mathrm{PX}, V) \quad (5)$$

where the independent variable V is the vector of the individual socio-economic characteristics. The bid function can be approached in two ways: One, according to Cameron and James (1987) and assuming u takes the form of normal distribution with the mean of 0 and variation of σ, the bid function may be approached by the probit model. Two, according to Cameron (1988) and assuming u takes the form of logistic distribution, the bid function can be approached by the logistic model. The two methods generate similar coefficients, but different scaling (Greene 2000).

Empirical results

Under the postulate of a linear bid function and with the help of the LIMDEP software package, the environmental multifunctionality benefit of paddy fields as perceived by the respondents under various scenarios can be easily obtained. The results of the environmental multifunctionality benefit

Table 5 Evaluation of the environmental multifunctionality benefit of paddy fields-logit model

Scenario	A			B		
	Coeff.	*t*-ratio	*P* value	Coeff.	*t*-ratio	*P* value
Intercept	−1.7705	−1.80837	0.070549	−2.67106	−2.44002	0.014686
ASK	−0.01337	−1.35946	0.174	−0.01029	−0.98064	0.326771
THK	0.201846	3.30893	0.000937	0.298067	4.28022	1.87E-05
INC	0.078398	1.18283	0.236876	0.072347	0.990177	0.322088
TYPE	0.382327	1.15631	0.247555	0.550873	1.4983	0.134057
Log likelihood	−123.0960			−98.68429		
Restricted log likelihood	−123.0960			−111.4073		
Chi-squared (4)	16.47431			25.44613		
Correct prediction (%)	76.991			82.743		
WTP	114.803			181.727		

Source: Questionnaire survey of this study

of paddy fields given by the general public applying a different function are summarized in Tables 5 and 6. Among various individual variables, most of the t-ratio reaches 80% of significance. All of the empirical models have a predictability of 75%. On the whole, the Restricted Log Likelihood and Chi-square test also confirms that all the models reach a level of significance.

The factors in the bidding function include the views toward free agricultural trade and agriculture protection (THK), household monthly income (INC),[1] and sample grouping (TYPE).[2] This echoes to the conclusion that both information and cognition variables of the respondents are variables of significance made by most previous literature on CVM evaluation. Moreover, the respondent's income level also plays an important role in his price bid, which is also consistent with the assumptions of the model.

In terms of the values of the variables, it is found that the respondents' views toward free trade and agriculture protection (THK) are positive, showing that the higher the degree in favor of protection, the higher the prices they are willingness to pay, which also agrees with commonsense reasoning. The household monthly income (INC) also demonstrates a positive correlation with the WTP of the respondents. Namely, the higher the income level, the higher the prices the respondents are willingness to pay, which is also in agreement with the assumptions of the CVM theory.

Table 7 compares the WTP prices obtained from the empirical data of this study. Under Scenario A and B, with the respective arable land decrease rate of 1 and 4% and all to be restored later, the respondents demonstrate great sensitivity about their willingness to pay as the reduction rate of 1% under Scenario A rises to 4% under Scenario B, evidenced by the fact that the benefit of Scenario B has a far greater value than that of Scenario A. Generally, the change in the arable land area does exert an influence on consumers' willingness to pay.

For the evaluation of the environmental multifunctionality of paddy fields, if judged by the threat that free trade poses to the retention of arable land, most respondents give a value of 114 NT/household/month to 115 NT/household/month for 1% reduction of arable land to be restored to the existing level; and168 NT/household/month to 181 NT/household/month for a reduction rate of 4%. There are 7,394,758 households in Taiwan. The aggregating result is 10,116,028,944–10,204,766,040 NT/year for 1% reduction of arable land to be restored to the existing level; and 14,907,832,128–16,061,414,376 NT/year for a reduction rate of 4%. It is larger than Change and Ying (2005) who had only evaluate the value of rice fields' water preservation and land protection function, and we had consider the total economic value of the environmental multifunctionality of paddy fields. The result is larger than Kim et al. (2006) and Aizaki et al. (2006) had done in Korea and Japan. We think the main reason is the payment vehicle is monthly rice consumption, and it is a realistic and suitable payment vehicle. We suggest that the further study could use the monthly rice consumption as a payment vehicle to evaluate the environmental multifunctionality of paddy fields.

Conclusion and recommendation

Environmental functions of paddy fields such as the provision of space, green land, natural habitats, and ground water are usually called the environmental multifunctionality of paddy fields, of which the value is determined by

[1] The variable INC is expected to be significantly affecting the willingness to pay of the respondent. But the result in Table 5 and Table 6 it cannot reach 80% significance level. We think the reason is our study collects consumer data directly from a purposefully selected pool of samples. The INC in our sample is standing stable.

[2] The variables YEAR, EDU and OC are not significance. Maybe those variables are highly correlated with the variable TYPE. Finally we kept the variable TYPE and deleted the variables YEAR, EDU and OC.

Table 6 Evaluation of the environmental multifunctionality benefit of paddy fields-Probit model

Scenario	A			B		
	Coeff.	*t*-ratio	*P* value	Coeff.	*t*-ratio	*P* value
Intercept	−0.94478	−1.6772	0.093503	−1.27271	−2.1308	0.033106
ASK	−0.00795	−1.37029	0.170596	−0.00645	−1.06478	0.286975
THK	0.112683	3.28801	0.001009	0.155731	4.21948	2.45E-05
INC	0.045411	1.17829	0.238682	0.036217	0.869718	0.384454
TYPE	0.217466	1.13858	0.254876	0.284448	1.39002	0.164522
Log likelihood	−115.0541			−99.43820		
Restricted log likelihood	−123.0960			−111.4073		
Chi-squared(4)	16.08386			23.93830		
Correct prediction (%)	77.434			81.858		
WTP	115.017			168.369		

Source: Questionnaire survey of this study

Table 7 Empirical findings on different scenarios

Scenario	A		B	
	LOGIT	PROBIT	LOGIT	PROBIT
WTP	114.803	115.017	181.727	168.369
Predictability (%)	76.991	77.434	82.743	81.858

Source: Questionnaire survey of this study

the economic demand for nature and beauty in the mind of the human. The evaluation of such values thus belongs to the field of non-market or public goods. This study evaluates the purposefully selected pool of samples' willingness to pay, for environmental multifunctionality of paddy fields. The CVM was employed to find out the value of environmental multifunctionality of paddy fields.

Despite the attempt of this study to express the environmental benefit in monetary terms and the data somewhat controversial and arbitrary, the research has helped to conduct a critical review on the practical implications of current agriculture policies. It is recommended that to reach the goal for sustainable development, agriculture policies aim not only to the production of agricultural products or the enhancement of farmer's well being, but the important contributions of the sector to the conservation of ecosystem as well. Also, with the provision of specific data, agriculture policies may be promoted more effectively; after all, both the formulation and implementation of policies should be based upon a sound cost-and-benefit analysis. In sum, the evaluation of the environmental benefit of agriculture is in itself a good opportunity for the development of agriculture.

Appendix: Questions for the willingness to pay

At present there are 864,000 ha of paddy fields in Taiwan that occupies approximately 24% of the entire land area of Taiwan. The paddy fields serve as a recreation area for the people as well as maintaining environmental conservation efficiencies such as conservation of water and soil resources and atmospheric cleansing. The paddy fields provide space, green land, and natural habitats, and helps retain excessive rainwater and supply for groundwater, all of which are commonly termed "the environmental multifunctionality of paddy fields.

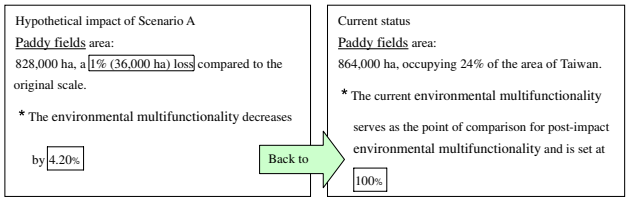
However, if Taiwan joins the WTO free trade it will become cheaper for us to import major foods (such as rice) from foreign countries rather than producing them locally in Taiwan as the agricultural production cost in foreign countries are lower than that in Taiwan. The local rice industry will not be able to compete with foreign agricultural produce and the volume of the agricultural produce will also decrease followed by the decrease in the area of paddy fields. Rice will no longer grow on the original paddy fields as the original paddy fields will often be filled with concrete where houses are built. The environmental conservation provided by paddy fields will also diminish with the loss of the paddy fields

- Please answer the following questions based on the different hypothetical impact upon joining the WTO, and the descriptions on the scale of the loss of paddy fields areas caused by such impact.
- You will not pay for the increase in food cost that is mentioned in the questions. This question only helps us to understand the economic values of the paddy fields.
- Please note that the different impact resulted in joining the WTO should cause different types of losses in efficiency.

Scenario A

If we were to join the WTO to bring the rice industry in Taiwan to recession, a 1% decrease in total paddy fields

area will drag the environmental functionalities down by 4.20%. However, the paddy fields in Taiwan will be able to maintain the original environmental multifunctionality if the people in Taiwan were willing to pay a little bit more for the rice that are produced locally in Taiwan.



A.1 If rice were considered a key agricultural produce of Taiwan, based on the environmental multifunctionality of the paddy fields, will you be willing to continue to purchase locally produced rice from Taiwan if the local rice were NT$5(or10, 20, 50)[3] more expensive per kg than imported rice of the same quality, in order to help bringing the area of paddy fields up by 1% and to bring the environmental multifunctionality up by 4.20% to the current standards?

☐ Yes ☐ No

References

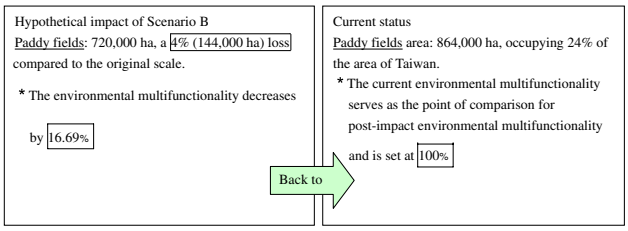
Rice type	Price (NT$)
Wholesale Price for Thai white rice	6–10/kg
Wholesale Price for American long grain white rice	8–11/kg
Wholesale Price for American medium grain white rice	7–10/kg
Rice Farm Price for Taiwan Penglai Rice	14–22/kg
Retail price for Taiwan Penglai rice	25–38/kg

Taiwan White Rice (Taiwan Penglai Rice)—Small bag (5 Kg): about NT$ 125–160 per bag

Scenario B

If we were to join the WTO to bring the rice industry in Taiwan to recession, a 4% decrease in total paddy fields area will drag the environmental functionalities down by 16.69%. However, the paddy fields in Taiwan will be able to maintain the original environmental multifunctionality if the people in Taiwan were willing to pay a little bit more for the rice that are produced locally in Taiwan.

[3] There are four cutoff points of the WTP (5, 10, 20, 50NT/kg). We have four difference cutoff points in four forms of questionnaire.



B.1 If rice were considered a key agricultural produce of Taiwan, based on the environmental multifunctionality of the paddy fields, will you be willing to continue to purchase locally produced rice from Taiwan if the local rice were NT$5(or10, 20, 50)[4] more expensive per kg than imported rice of the same quality, in order to help bringing the area of paddy fields up by 4% and to bring the environmental multifunctionality up by 16.69% to the current standards?

☐ Yes ☐ No

References

Rice Type	Price (NT$)
Wholesale Price for Thai white rice	6–10/kg
Wholesale Price for American long grain white rice	8–11/kg
Wholesale Price for American medium grain white rice	7–10/kg
Rice Farm Price for Taiwan Penglai Rice	14–22/kg
Retail price for Taiwan Penglai rice	25–38/kg

Taiwan White Rice (Taiwan Penglai Rice)—Small bag (5 Kg): about NT$ 125–160 per bag

References

Agus F, Irawan I, Suganda H, Wahyunto W, Setiyanto A, Kundarto M (2006) Environmental multifunctionality of Indonesian agriculture. Paddy Water Environ 4:181–188

Aizaki H, Sato K, Osari H (2006) Contingent valuation approach in measuring the multifunctionality of agriculture and rural areas in Japan. Paddy Water Environ 4:217–222

Bateman LJ, Turner RK (1992) Evaluation of the environment: the contingent valuation method. CSERGE Working Paper GEC 92-18

Bradford DF (1970) Constraints on public action and rules for social decision. The Am Econ Rev 60(4):642–654

Cameron TA, James MD (1987) Efficient estimation methods for "Closed-Ended" contingent valuation surveys. Rev Econ Stat 69:269–276

Cameron TA (1988) A new paradigm for valuing non-market goods using referendum data: maximum likelihood estimation by

[4] There are four cutoff points of the WTP (5, 10, 20, 50 NT/kg). We have four difference cutoff points in four forms of questionnaire.

censored logistic regression. J Environ Econ Manage 15:355–379

Carson RT, Flores NE, Hanemann WM (1992) On the creation and destruction of public goods: the matter of sequencing. Paper presented at the European Association of Environmental and Resource Economists Meeting, Cracow, Poland. Working paper 690, Agricultural and Resource Economics, University of Berkeley, California

Chang K, Ying Y-h (2005) External benefits of preserving agricultural land: Taiwan's Rice Fields. Soc Sci J 42:285–293

Dupont PD (2003) CVM embedding effects when there are active, potentially active and passive users of environmental goods. Environ Resour Econ 25:319–341

Freeman AM (1993) The measurement of environmental and resource values—theory and methods. Resources for the Future, Washington

Greene WH (2000) Econometric analysis, 4 th edn. Prentice Hall International, Inc., New Jersey

Hanemann WM (1994) Valuing the environment through contingent valuation. J Econ Perspect 8(4):19–43

Huang CC, Tsai MH, Lin WT, Ho YF, Tan CH (2006) Multifunctionality of paddy fields in Taiwan. Paddy Water Environ 4:199–204

Hutchinson WG, Chilton SM, Davis J (1995) Mearsuring non-use value of environmental goods using the contingent valuation method: problems of information and cognition and the application of cognitive questionnaire design methods. J Agricult Econ 46(1):97–112

Kim T-C, Gim U-S, Kim JS, Kim D-S (2006) The multi-functionality of paddy farming in Korea. Paddy Water Environ 4:169–179

Matsnuo Y, Nakamura K, Masumoto T, Matsui H, Kato T, Sato Y (2006) Prospects for multifunctionality of paddy rice cultivation in Japan and other countries in Monsoon Asia. Paddy Water Environ 4:189–197