# An Analysis of Preference for the Rural Residential environment and Landscape Improvements

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# An Analysis of Preference for Rural Residential environment and Landscape Improvement Activities[1]

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## Abstract

The residential environments and landscapes in rural areas, which are major components of rural amenities, are deteriorating due to changes in demographic conditions such as population decline and aging. To improve rural amenities, the South Korean government has been implementing several policies, such as rural waste management, rural public facility management, and abandoned house management. This study measured the willingness to pay for improving rural residential environments and landscapes by using elicited choice probability model and provided policy implications. The total willingness to pay for abandoned house management ranged from approximately 243 billion to 326 billion KRW, and the total willingness to pay for rural public facility management ranged from approximately 144 billion to 233 billion KRW. For rural waste management, the total willingness to pay was approximately 172 billion KRW. In particular, the total willingness to pay for managing illegally dumped waste was approximately 138 billion KRW. To sum up, the total willingness to pay for improving residential environment and landscapes in rural areas ranged from approximately 525 billion to 732 billion KRW. This indicates that social demand on improving residential environment and landscapes in rural areas would be much larger than the budget of current government policies focusing on the residential environment and landscape improvements in rural areas.

**Keywords**: elicited choice probability model, rural residential environments and landscapes, willingness to pay

**JEL codes:** Q18, Q58

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# 1. Introduction

The promotion of return-to-farming and return-to-village is a key policy tool aimed at addressing demographic challenges in rural areas, including rural depopulation. Returning to farming and living rural villages can mitigate the risk of population decline in rural areas by fostering rural employment, and enhancing human, physical, and social capital in rural areas.

In particular, the attractiveness of rural amenities plays a crucial role as a motivator for returning to farming and living rural villages. According to the '2022 Survey on the Status of Return-to-Farming and Return-to-Village' conducted by the Ministry of Agriculture, Food and Rural Affairs (MAFRA) in Korea, natural landscapes and emotionally relaxed lifestyle were identified as the primary motivators for the return-to-farming and return-to-village.

However, the key elements of rural amenities, such as residential environment and landscapes, are gradually deteriorating due to population decline and aging in rural areas. Firstly, the increasing trend of abandoned houses in rural areas is evident due to population decline (Related Ministries Collaboration, 2023). These abandoned structures in rural areas not only adversely affect the residential environment and landscapes of rural villages but can also be used as crime-prone locations. Secondly, farm waste and trash illegally dumped in rural areas are significant factors degrading the residential environment and aesthetic value of landscapes. Lastly, the reduced frequency of using public facilities in villages due to the decline in rural population and aging has led to inadequate management of these facilities. The growing number of unmanaged public facilities is becoming a factor that undermines the residential environment and the landscapes of rural areas.

Research on the values of residential environment and landscapes, as well as studies on agricultural environmental policies incorporating landscapes, have been continuously conducted (Duke 2008; Bergstrom & Ready 2009; Sayadi et al. 2009; Zanten et al. 2016; OECD 2022). Nevertheless, most studies have primarily analyzed the aesthetic or recreational value associated with agricultural activities, and

literature on the value of improving residential environment in rural areas is limited (Zhang et al. 2023). Moreover, many studies incorporated the Random Utility Model (RUM) for valuation. The RUM assumes that decision-makers accurately know the utility they can obtain from their choices. However, such assumptions would not be suitable for scenarios involving decision-makers unfamiliar with aspects like landscape and living condition improvement, as well as evaluating scenarios related to future changes, as in this study (Herriges et al. 2011; Provencher et al. 2012).

The purpose of this study is to measure the willingness to pay for each element constituting the residential environment and landscapes in rural areas by using a more accurate method, and to provide implications for valuation of residential environment and landscapes in rural areas. To do this, we identified the main activities managing waste, abandoned houses, public facilities in rural areas, and conducted national wide online survey to collect data. We also incorporated the elicited choice probability model to address the uncertainty from incomplete scenarios. Our findings show that the value of improving residential environment and landscapes resulting from selected activities would be between 525 billion KRW and 732 billion KRW. However, the results show that estimates of willingness to pay are more sensitive to near-epistemic uncertainty than bias resulting from strategic behaviors and inconsequential scenarios.

The remainder of the paper is organized as follows. The next section of the article explains survey design and the way of constructing data. Section 3 shows our model specification and related assumptions. Section 4 describes our results, and Section 5 tests the robustness of our estimates. Lastly, section 6 discusses our conclusions and policy implications.

## 2. Experimental design and data

We used stated-preference method based on a survey to measure the willingness to pay for improving the residential environment and landscape in rural areas. Attributes are selected based on main

factors of residential environments and landscapes in rural areas, as well as activities included in policies actually implemented in rural areas. Specifically, attributes that selected in this study include 'rural waste management,' 'rural public facility management,' and 'abandoned house management.' In particular, the waste from rural areas is divided into farm waste and illegally dumped waste. We assumed that illegally dumped waste has a greater impact on the residential environments and landscapes in rural areas than waste disposed by farms, so that this study set different level for waste from farms and illegally dumped waste in rural areas. Lastly, we imposed tax as the attribute to estimate willingness to pay for attributes. The attributes and levels set for constructing choice are represented in Table 1.

We constituted three alternatives including status quo based on attributes and their levels[4]. Based on attributes and levels we selected 15 optimal combinations by using D-efficiency among the feasible alternative combinations (Hole, 2017). The choice questions were divided into three blocks, with each respondent presented with 5 questions per block. To control order effects, we randomly presented questions to each respondent. Respondents were asked about the degree of policy reflection in the survey results to check for consequentiality. To prevent strategic behavior, respondents were further surveyed on whether they modified their responses considering the anticipated survey results of other respondents and their previous responses during the response to questions. Lastly, to apply the elicited choice probability model, respondents were asked to indicate their subjective probabilities of choosing for each alternative with description picture (see Figure 1).

The online survey was conducted for 501 adults aged 20 to 69 nationwide who are part of the economically active population in Korea. Respondents were proportionally allocated based on demographic

[4] We present the following policy scenarios to measure willingness to pay. "The policy to improve rural residential environments and landscapes is based on the social demand for them. If the government expands and promotes the policy of the residential environment and landscape improvement in rural areas, it would be necessary to secure additional budget. This means that it is necessary to impose additional tax on the people once policy is implemented. On the other hands, if there is no social demand for them, there would be no additional tax."

characteristics according to the population census in Korea[5]. The summary statistics for respondents who participated in the survey are presented in Table 2.

## 3. Estimation

To evaluate the economic value of enhancing the residential environments and landscapes in rural areas, we incorporated the elicited choice probability model. While the mixed logit model, which commonly used to estimate willingness to pay based on the most preferred alternative, elicited choice probability model allows reflecting the potential preferences for each alternative by providing the probability of selecting each alternative (Kosar et al., 2022). In particular, while choice questions can differentiate alternatives based on their attributes, it is hard to encapsulate all features of alternatives within the scenarios presented in choice questions. This would be able to lead to the omission of important features in scenarios, potentially resulting in potential biases such as endogeneity bias when answering questions. In contrast, elicited choice probability model could deal the uncertainty resulting from in complete scenarios by allowing respondents to present a choice probability for each alternative.

This study estimates the economic value based on willingness to pay for attributes related to improvements of residential environments and landscapes, where the willingness to pay for a particular attribute is derived from individual preferences. These personal preferences can be expressed as the random utility model.

$$U_{nj} = V_{nj} + \varepsilon_{nj} = \beta'_n X_{nj} + \varepsilon_{nj} \quad (1)$$

[5] The survey was conducted from October to November in 2022, and the composition of question is as follows: 1) Demographic characteristics, such as gender, age, and region, 2) Pre-knowledge about rural residential environment and landscape, 3) Explanation of activities and policies for improving rural residential environment and landscape, 4) Presentation of policy scenarios and choice question, 5) Evaluation question for the survey.

The utility ($U_{nj}$) is the $n$th respondent's utility when choosing the $j$th alternative, and consists of the deterministic ($V_{nj}$) component and the random ($\varepsilon_{nj}$) component. The deterministic component comprises various variables ($X_{nj}$) influencing the respondent's utility, with the coefficients ($\beta'_n$) representing the respondent's preferences. The random component includes intangible information to researchers, and it is assumed an extreme value of independent and identically distribution. Based on these assumptions, the probability ($q_{nj}$) that the $n$th respondent select the $j$th alternative out of J alternatives follows a logit model, where $f(\beta)$ represents a continuous probability distribution of $\beta$ (Equation 2).

$$q_{nj} = \int \left( \frac{\exp\left(V_{nj}(\beta_n)\right)}{\sum_{k=1}^{J} \exp\left(V_{nk}(\beta_n)\right)} \right) f(\beta) d\beta, \ \forall\, j \neq k \tag{2}$$

Equation 2 means that the probability of selecting a particular alternative $j$ can be derived by taking the weighted average of the probability density functions ($f(\beta)$) of each variable's impact ($\beta$) on the respondent's utility (Train 2009: 139). By transforming Equation 2 to the log-odds form, marginal effects for attributes on selecting alternatives can be derived.

$$\ln\left(\frac{q_{nj}}{q_{nk}}\right) = \left(X_j - X_k\right)\beta_n + \eta_{njk}, \ \forall\, j \neq k \tag{3}$$

In the conventional stated-preference method, respondents are asked to typically choose a specific alternative or not. However, in this study, respondents were asked to indicate the probability of choosing each given alternative rather than selecting their most preferred alternative. In particular, respondents are asked to indicate their subjective probabilities rounded to the nearest 5% or 10%, rather than being exact probabilities. For example, although a respondent might indicate a 1% probability of choosing a specific alternative, they might respond with 0% in the actual survey, or they might indicate a 98% probability of choosing an alternative but respond with 100% in the survey (Kosar et al., 2022).

However, this approach can introduce convenience bias (Blass et al. 2008). To resolve the bias caused by rounding of choice probability, this study incorporated Least Absolute Deviation (LAD)[6]. To apply LAD, we assumed that respondents' preferences for a specific alternative are distributed symmetrically around the coefficient ($\beta_n$), and $\beta_n$ follows the normal distribution. From the symmetry assumption, the conditional median ($M[\eta_{njk}|X_j]$) of the error term ($\eta_{njk}$) with respect to the attributes ($X_j$) of the alternative is represented as 0.

$$M\left[ln\left(\frac{q_{nj}}{q_{nk}}\right)|X\right] = (X_j - X_k)\beta_n,\ \forall\, j \neq k \tag{4}$$

In this study, there are three alternatives including the status quo and alternatives in each choice questions. We, thus, normalized them based on the status quo for estimation. In particular, the normalization process not only normalized the probabilities of choosing each alternative with respect to the status quo, but also normalized the features or values of the alternatives with respect to the status quo. The normalization process derives two normalized probability ratios, alternative A ($ln\left(\frac{q_{nA}}{q_{nC}}\right)$) and alternative B ($ln\left(\frac{q_{nB}}{q_{nC}}\right)$) are derived. Correspondingly, two differenced covariates are derived by differentiating features of status quo from the features of each alternative respectively. Since five choice questions were presented per respondent, the two probability ratios are merged into one column, so that 10 observations per respondent are used for estimation.

## 4. Results

[6] LAD is an analysis technique used to estimate coefficient values that minimize the sum of the absolute deviations of residuals. Unlike Ordinary Least Squares (OLS) that minimize the sum of squared residuals, LAD aims to minimize the sum of absolute deviations of residuals. In cases where outliers are present, such as in this study, using OLS can lead to the problem of residual amplification (Mebrarki et al., 2016).

Table 3 shows the result for elicited choice probability model[7]. Model 1 comprises activities managing household waste and illegally dumped waste at different levels, while Model 2 considers them by using separate dummy variables. The results based on Model 1 show that estimates of three variables representing activities for enhancing residential environments and landscapes in rural areas were statistically significant. This implies that three activities have positive impacts on choosing alternatives instead of status quo. Also, the results show that taxes would have negative effects on choosing alternatives. In particular, we found that when the tax amount of the particular alternative increases by one unit, then the probability of choosing that alternative decreases by 0.004%.

The results based on Model 2 show that only illegal dumped waste management was found to be statistically significant at the 5% level, whereas farm waste management was not statistically significant. This means that the public in Korea may not have significant interest in waste generated from farms, but they show relatively higher interest in activities aimed at reducing illegally dumped waste for residential condition and landscape improvements in rural areas.

Table 4 shows the estimated willingness to pay for improving residential environments and landscapes in rural areas[8]. The results show that the willingness to pay for rural public facility management and abandoned house management were statistically significant at the 5% level across all models. The willingness to pay for rural waste management was also statistically significant, except for the willingness

[7] Furthermore, this study derived the willingness to pay from the mixed logit model which is commonly used to estimate willingness to pay (see Appendix A Table A1). Mixed logit model allows respondents to choose the best alternative in survey. Thus, the alternative choice probabilities that collected through the survey are rounded and used as analysis data. The results are shown in Table 6. There is no difference in the statistical significance of the willingness to pay for both elicited choice probability model and mixed logit model. For all activities related to improving residential environment and landscapes in rural areas, the willingness to pay derived from mixed logit model is greater than the willingness to pay derived from elicited choice probability model. For example, the total willingness to pay estimated from mixed logit model is 32,766 KRW, which is 1.66 times the total willingness to pay from the elicited choice probability model.

[8] Based on estimated coefficients in Table 3, the willingness to pay for residential environment and landscape improvements in rural areas was measured. To test the statistical significance of each willingness to pay, parametric bootstrapping was incorporated (Krinsky and Robb 1986). The willingness to pay for each management activity can be derived by the ratio of the estimated average coefficient of each activity to the coefficient of taxes (Kim et al., 2018).

to pay for managing farm waste estimated by Model 2. In particular, the willingness to pay amounts for abandoned house management ranged from 6,540 to 8,790 KRW, showing the highest willingness to pay compared to other activities. This was followed by rural public facility management with a willingness to pay ranging from 3,878 KRW to 6,286 KRW per person. For rural waste management activities, the willingness to pay estimated in Model 1 was 4,632 KRW per person, while the willingness to pay for managing illegally dumped waste in Model 2 was about 3,716 KRW per person. As a result, the total estimated willingness to pay for residential environment and landscape improvement in rural areas ranged from 14,134 KRW to 19,708 KRW per person.

## 5. Robustness Test

To check the robustness of willingness to pay estimates, respondents were asked to answer to questions testing consequentiality of their answers and strategic behaviors. The consequentiality question assesses whether the survey results were appropriately reflected in policy-making. Also, strategic behaviors refer to whether respondents adjust their answers based on their anticipation of other respondents' answers or their own previous responses when answering choice questions. Furthermore, since the elicited choice probability model surveys respondents' subjective probabilities for each alternative, there would be the uncertainty when the probability of choosing a particular alternative is close to 50%, known as near-epistemic uncertainty (Scarpa et al., 2021). This study, thus, tests the effects of the uncertainty on the willingness to pay estimates by removing observations having the probabilities of choosing alternatives are similar.

The result for the robustness of willingness to pay are represented in Table 5[9]. The results show that estimates of the willingness to pay for improving residential environments and landscapes in rural areas

[9] To focus on the robustness of the estimates, the analysis is conducted using the baseline model (Model 1). For the results for robustness test based on Model 2, please see the Appendix of this study.

were statistically significant even when excluding observations considered as strategic behaviors and inconsequentiality. However, after excluding respondents who the survey results would not be incorporated when related policy making, the willingness to pay per person increased ranging 578 to 1,225 KRW. This suggests that as the respondents' belief in the reflection of survey results in related policies increases, their willingness to pay also increases. Also, when removing respondents doing strategic behaviors, the estimated willingness to pay was increased compared to the original estimates, indicating that respondents' strategic behavior would be negatively related to the willingness to pay for residential environments and landscapes improvements.

After conducting the survey, we found that there were 161 observations where the choice probability was between 48-52%, indicating a high level of choice uncertainty among activities related to residential environment and landscape improvements. Thus, we conduct tests for the near-epistemic uncertainty by removing observation with alternative choice probabilities of 48-52% and 45-55%. The results show that, after addressing the near-epistemic uncertainty, the willingness to pay corresponding to rural waste management and abandoned house management retained their statistical significance. However, the results show that the willingness to pay for rural public facility management would not be statistically significant. These results imply that rural public facility management has relatively higher choice uncertainty compared to other activities. Lastly, the willingness to pay for rural waste management under choice uncertainty is higher compared to other activities. The estimated willingness to pay per capita for rural waste management increased by at least 229 KRW compared to the original model, while management of abandoned houses management was estimated to be at least 156 KRW lower than the original model.

## 6. Conclusion

The objective of this study is to measure the economic value of residential environment and landscape improvements. The results show that the estimated willingness to pay per capita was to be 6,540

to 8,790 KRW for abandoned house management and 3,878 to 6,286 KRW for rural public facility management. The estimated willingness to pay per capita for rural waste management was 4,632 KRW. Lastly, the willingness to pay for reducing illegally dumped waste was estimated at 3,716 KRW when it was estimated separately.

Based on the estimated willingness to pay per capita, we calculate the total value of improving residential environment and landscapes in rural areas could be estimated by multiplying the population who aged 20 to 69 in Korea. The total willingness to pay for abandoned house management ranged from approximately 243 billion to 326 billion KRW, and the total willingness to pay for rural public facility management ranged from approximately 144 billion to 233 billion KRW. For rural waste management, the total willingness to pay was approximately 172 billion KRW in Model 1. On the other hand, the total willingness to pay for managing illegally dumped waste estimated by Model 2 was approximately 138 billion KRW. To sum up, the total willingness to pay for improving residential environment and landscapes in rural areas ranged from approximately 525 billion to 732 billion KRW.

The robustness tests show that most willingness to pay estimates were changed modestly after controlling for respondents' strategic behavior and policy consequentiality. However, when controlling for the near-epistemic uncertainty, the willingness to pay for rural public facility management became statistical insignificant[10]. This suggests that the willingness to pay for rural public facility management would be more sensitive to the near-epistemic uncertainty compared to other activities.

[10] When we incorporated Model 2 for the robustness test, we found that all estimates of the willingness to pay would be insignificant (See Appendix B Table B1).

## References


Bergstrom, J. C., and Ready, R. C. (2009). “What have we learned from over 20 years of farmland amenity valuation research in North America?” Applied Economic Perspectives and Policy, 31(1), 21-49.

Blass, A. A., Lach, S., and Manski, C. F. (2010). “Using elicited choice probabilities to estimate random utility models: Preferences for electricity reliability.” International Economic Review, 51(2), 421-440.

Duke, J. M. (2008). “Estimating amenity values: will it improve farmland preservation policy?” Choices, 23(4), 11-15.

Herriges, J., Bhattacharjee, S., and Kling, C. (2011). “Capturing preferences under incomplete scenarios using elicited choice probabilities.” Working Papers 11003, Iowa State University.

Hole, A. (2017). DCREATE: Stata module to create efficient designs for discrete choice experiments.

Kim, S. S., Sung, J. H., Cho, W. J., Lee, M. G., and Lee, S. M. (2018). The Evaluation of Agricultural Multifunctionality - Focused on Sustainable Livestock Production. Korea Rural Economic Institute. R251.

Koşar, G., Ransom, T., and Van der Klaauw, W. (2022). “Understanding migration aversion using elicited counterfactual choice probabilities.” Journal of Econometrics, 231(1), 123-147.

Krinsky, I., and Robb, A. L. (1986). “On approximating the statistical properties of elasticities.” The review of economics and statistics, 715-719.

Manski, C. F. (1999). “Analysis of choice expectations in incomplete scenarios.” Journal of Risk and Uncertainty, 19, 49-66.

Ministry of Agriculture, Food and Rural Affairs (MAFRA) (2022). 2022 Survey on the Status of Return-to-Farming and Return-to-Village.

OECD (2022). Making Agri-Environmental Payments More Cost Effective. OECD Publishing Press.

Pedersen, L. B., Mørkbak, M. R., and Scarpa, R. (2020). “Handling resolvable uncertainty from incomplete scenarios in future doctors' job choice–Probabilities vs discrete choices.” Journal of choice modelling, 34, 100199.

Provencher, B., Lewis, D. J., and Anderson, K. (2012). “Disentangling preferences and expectations in stated preference analysis with respondent uncertainty: The case of invasive species prevention.” Journal of Environmental Economics and Management, 64(2), 169-182.

Related Ministries Collaboration (2023). It becomes possible to accurately determine the status of vacant homes across the country, Press Release.

Sayadi, S., González-Roa, M. C., and Calatrava-Requena, J. (2009). “Public preferences for landscape features: The case of agricultural landscape in mountainous Mediterranean areas.” Land Use Policy, 26(2), 334-344.

Scarpa, R., Bazzani, C., Begalli, D., and Capitello, R. (2021). “Resolvable and Near-epistemic Uncertainty in Stated Preference for Olive Oil: An Empirical Exploration.” Journal of Agricultural Economics, 72(2), 335-369.

Shoyama, K., Managi, S., and Yamagata, Y. (2013). “Public preferences for biodiversity conservation and climate-change mitigation: A choice experiment using ecosystem services indicators.” Land use policy, 34, 282-293.

Train, K. E. (2009). Discrete choice methods with simulation. Cambridge university press.

Zanten, B. T. V., Zasada, I., Koetse, M. J., Ungaro, F., Häfner, K., and Verburg, P. H. (2016). “A comparative approach to assess the contribution of landscape features to aesthetic and recreational values in agricultural landscapes.” Ecosystem Services, 17, 87-98.

Zhang, Z., Paudel, K. P., and Upadhyaya, K. (2023). “Preference for rural residential environment improvement initiatives in China.” American Journal of Economics and Sociology, 82(1), 61-78.

# Appendix A.

Table A1. Comparison of willingness to pay between mixed logit model and elicited choice probability model (Model 1)

(Unit: KRW)

| Variables | Elicited choice probability model | Mixed logit model |
|---|---|---|
| Rural waste management | 4,632<br>(2,710~8,402) | 10,845<br>(7,257~23,499) |
| Rural public facility management | 6,286<br>(3,013~12,040) | 7,555<br>(6,106~17,705) |
| Abandoned house management | 8,790<br>(5,004~16,345) | 14,366<br>(8,848~32,221) |
| Total WTP | 19,708 | 32,766 |

Note 1) ( ) means 95% confidence interval.

2) Mixed logit model allows respondents to choose the best alternative in survey. Thus, the alternative choice probabilities collected through survey are rounded and used as analysis data.

4) Total WTP is derived by adding up the statistically significant willingness to pay within the 95% confidence.

Source: author's own work.

# Appendix B.

Table B1. Robustness test results for willingness to pay per capita based on Model 2

(Unit: KRW)

| Variables | Consequentiality | Strategic behavior | Choice uncertainty | |
|---|---|---|---|---|
| | | | Removed (48~52%) | Removed (45~55%) |
| Improving landscapes from reducing farm waste | -137 (-4,709~3,676) | -1,846 (-9,657~3514) | -313 (-6,630~4,896) | 136 (-5,997~5,392) |
| Improving landscapes from reducing illegally dumped waste | 3,915 (211~9,015) | 5,220 (89~14,152) | 3,876 (-990~11,142) | 3,688 (-1,178~10,834) |
| Rural public facility management | 3,455 (292~8,079) | 5,085 (694~14,547) | 2,754 (-1,463~9,219) | 2,884 (-1,298~9,419) |
| Abandoned house management | 6,755 (3,523~12,376) | 7,747 (3,255~18,376) | 3,701 (-378~10,010) | 3,538 (-529~9,768) |

Note 1) ( ) means 95% confidence interval.

2) Total WTP is derived by adding up the statistically significant willingness to pay within the 95% confidence.

Source: author's own work.

Table 1. Attributes and levels for setting choice question

| Attributes | Levels |
|---|---|
| Rural waste management | ⓐ Not improving |
| | ⓑ Improving landscapes from reducing farm waste |
| | ⓒ Improving landscapes from reducing illegally dumped waste |
| | ⓓ Improving landscapes from reducing both farm waste and illegally dumped waste |
| Rural public facility management | ⓐ Not improving |
| | ⓑ Improving landscapes from managing and cleaning public facilities |
| Abandoned house management | ⓐ Not improving |
| | ⓑ Improving landscapes from managing and cleaning abandoned house |
| Tax | ⓐ 0 KRW |
| | ⓑ 3,000 KRW |
| | ⓒ 5,000 KRW |
| | ⓓ 7,000 KRW |
| | ⓔ 10,000 KRW |
| | ⓕ 15,000 KRW |

Note: KRW is Korean currency.
Source: author's own work.

Table 2. Demographic characteristics

| Characteristics | | Observation | Ratio (%) |
|---|---|---|---|
| Gender | Male | 255 | 50.9 |
| | Female | 246 | 49.1 |
| Region | Rural | 454 | 90.6 |
| | Urban | 47 | 9.4 |
| Age | 20~29 | 84 | 16.8 |
| | 30~39 | 84 | 16.8 |
| | 40~49 | 114 | 22.8 |
| | 50~59 | 114 | 22.8 |
| | 60~69 | 105 | 21.0 |
| Monthly income per household | Under 2,000,000 KRW | 70 | 14.0 |
| | 2,000,000 ~ 2,990,000 KRW | 85 | 17.0 |
| | 3,000,000 ~ 3,990,000 KRW | 80 | 16.0 |
| | 4,000,000 ~ 4,990,000 KRW | 78 | 15.6 |
| | 5,000,000 ~ 5,990,000 KRW | 65 | 13.0 |
| | 6,000,000 ~ 6,990,000 KRW | 39 | 7.8 |
| | 7,000,000 ~ 7,990,000 KRW | 26 | 5.2 |
| | 8,000,000 ~ 8,990,000 KRW | 17 | 3.4 |
| | 9,000,000 ~ 9,990,000 KRW | 9 | 1.8 |
| | Over 10,000,000 KRW | 32 | 6.4 |
| Education | Elementary school graduate or less | 3 | 0.6 |
| | Middle school graduate | 2 | 0.4 |
| | High school graduate | 110 | 22.0 |
| | Currently enrolled or graduated from university or college | 338 | 67.5 |
| | Graduate school or higher | 48 | 9.6 |

Source: author's own work.

Table 3. Elicited choice probability model result for rural residential environment and landscape improvement

| Variables | Model 1 | Model 2 |
|---|---|---|
| Tax | -0.00004***<br>(0.0000) | -0.0004***<br>(0.0000) |
| Rural waste management | 0.1724***<br>(0.0290) | - |
| ① Improving landscapes from reducing farm waste | - | -0.0555<br>(0.0717) |
| ② Improving landscapes from reducing illegally dumped waste | - | 0.1460**<br>(0.0713) |
| ③ Improving landscapes from reducing both farm waste and illegally dumped waste | - | - |
| Rural public facility management | 0.2339***<br>(0.0626) | 0.1523***<br>(0.0586) |
| Abandoned house management | 0.3271***<br>(0.0631) | 0.2569***<br>(0.0588) |
| Gender | 0.0258<br>(0.0631) | 0.0053<br>(0.0592) |
| Age | 0.0017<br>(0.0024) | 0.0022<br>(0.0022) |
| Income | 0.0343***<br>(0.0129) | 0.0331***<br>(0.0121) |
| Education | 0.0588<br>(0.0546) | 0.0673<br>(0.0512) |
| Observation | 501 | |

Note 1) ( ) means standard error.

2) Model 1 is a model that sets waste from farm and illegally dumped waste at different levels.

3) Model 2 is a model that sets waste from farm and illegally dumped waste as dummy variable respectively.

4) *** p<0.01, ** p<0.05, * p<0.1

Source: author's own work.

Table 4. Willingness to pay per capita for activities to improve living conditions and landscapes in rural areas

(Unit: KRW)

| Variables | Model 1 | Model 2 |
|---|---|---|
| Rural waste management | 4,632<br>(2,710~8,402) | - |
| ① Improving landscapes from reducing farm waste | - | -1,413<br>(-5,709~2,036) |
| ② Improving landscapes from reducing illegally dumped waste | - | 3,716<br>(339~8,205) |
| ③ Improving landscapes from reducing both farm waste and illegally dumped waste | - | - |
| Rural public facility management | 6,286<br>(3,013~12,040) | 3,878<br>(989~8,111) |
| Abandoned house management | 8,790<br>(5,004~16,345) | 6,540<br>(3,579~11,363) |
| Total WTP | 19,708 | 14,134 |

Note 1) ( ) means 95% confidence interval.

2) Model 1 is a model that sets waste from farm and illegally dumped waste at different levels.

3) Model 2 is a model that sets waste from farm and illegally dumped waste as dummy variable respectively.

4) Total WTP is derived by adding up the statistically significant willingness to pay within the 95% confidence.

Source: author's own work.

Table 5. Robustness test results for willingness to pay per capita (Model 1)

(Unit: KRW)

| Variables | Consequentiality | Strategic behavior | Choice uncertainty | |
|---|---|---|---|---|
| | | | Removed (48~52%) | Removed (45~55%) |
| Rural waste management | 5,210 (2,990~10,061) | 5,781 (3,125~13,092) | 4,861 (2,061~15,149) | 4,869 (1,839~17,604) |
| Rural public facility management | 7,495 (3,830~14,850) | 6,968 (2,734~16,234) | 3,806 (-1,298~14,026) | 4,198 (-1,429~16,913) |
| Abandoned house management | 10,015 (5,693~19,464) | 10,194 (5,223~23,129) | 8,194 (2,750~25,991) | 8,634 (2,669~31,389) |
| Total WTP | 22,720 | 22,943 | 13,055 | 13,503 |
| Observations | 438 | 392 | 340 | 336 |

Note 1) ( ) means 95% confidence interval.

2) Total WTP is derived by adding up the statistically significant willingness to pay within the 95% confidence.

Source: author's own work.

Figure 1. Sample of choice question

In this survey, we aim to investigate the probability of choosing the three alternatives (A, B, and C) presented below. Please indicate the probabilities of choosing each alternative according to the respondent's preferences. The probabilities of choosing each alternative range from 0 to 100%, and the sum of the probabilities should add up to 100%. If the probability of choosing a particular alternative is very high, it means that the alternative is chosen almost certainly. Conversely, if the probability of choosing a particular alternative is very low, it means that the alternative is hardly chosen.

| Attributes \ Alternatives | A [ ]% | B [ ]% | C [ ]% |
|---|---|---|---|
| Rural waste management |  Improving landscapes from reducing farm waste |  Improving landscapes from reducing farm waste  Improving landscapes from reducing illegally dumped waste |  Not improving |
| Rural public facility management |  Improving landscapes from managing and cleaning public facilities |  Not improving |  Not improving |
| Abandoned house management |  Not improving |  Improving landscapes from managing and cleaning abandoned house |  Not improving |
| Tax | 15,000 KRW | 10,000 KRW | 0 KRW |

Source: author's own work.