INTRODUCTION

Analysing soil value to encapsulate its true economic contributions has grown immensely in recent years. At the stakeholder level, soil valuation promotes sustainability, explicitly linking economic decision-making with soil’s direct and indirect benefits (Keesstra et al., 2016). For instance, a farmer may become more inclined to adopt sustainable...
agronomic practices upon learning the long-term costs and potential risks from unsustainable farming methods. On the governance side, community leaders may become better informed of the economic consequences of potential changes in soil quality, including their impact on different stakeholders (Jollands, 2006). Successful implementation of soil policy relies heavily on high stakeholder participation, which could be fostered and strengthened by revealing the true economic value of soil.

Different approaches have been developed to estimate soil value since soil was first valued as a component of a broader ecosystem (Jonsson & Davidsdottir, 2016). Stated preference methods, one of the major valuation approaches, use direct solicitation of the respondents’ perceived value of economic contributions. But unlike other environmental public goods, soil value cannot be directly estimated partially due to its dualistic nature of having both private and public benefits (Dimal, 2015). The recognition of net benefits of soil conservation is often missing due partly to the misperception of the conceptual links between soil health and pedologic amenities (Bennett, Mele, Annett, & Kasel, 2010). Moreover, many of the benefits provided by the maintenance and protection of soil functions appear in the long term, which are often perceived as secondary to more immediate concerns. It is therefore imperative that economic approaches to understanding soil value be developed, particularly those that would promote the participation of the various stakeholder groups.

In order to grasp soil’s actual worth, credible approaches are required to explicitly provide economic values in soil amenities based on their contributions to human well-being (see Dimal, 2015). One of the dominant approaches used in valuing the environment is the contingent valuation method (CVM), which is a direct and flexible technique that has been widely used in environmental cost–benefit analysis, impact assessment and infrastructure development. In CVM studies, respondents are commonly asked of their willingness to pay (WTP) for the use (or access) of a particular environmental service or their willingness to accept (WTA) for the loss of access to a particular amenity. WTP (or WTA) values can then be used as proxy indicators for stated value. And although CVM has a number of methodological limitations due mainly to its heavy reliance on respondents’ comprehension and capacity to understand environmental amenities (Carson, Flores, & Meade, 2001), a well-executed CVM study can offer welfare information useful in economic and environmental decision-making (Venkatachalam, 2004).

Aside from providing soil value estimates, CVM can also be used to understand the effect of respondent attributes and other parameters on stakeholder preference, which could then be used in formulating soil use policies and conservation strategies. Previous valuation studies on environmental goods and ecosystem services have found particular socio-economic characteristics to have significant influence on WTP, such as income (Wang, Shi, Kim, & Kamata, 2013), age (Hamed et al., 2016), gender (Zabala, Dolores de Miguel, Martínez-Paz, & Alcon, 2019), education levels (Khan & Damalas, 2015), environmental awareness (Tienhaara, Ahtiainen, & Pouta, 2015), type of land tenure (Kidane, Wei, & Sibhatu, 2019), farm acreage (Ayiinde, Daramola, Adenuga, & Abdulaye, 2019) and family size (Tussupova, Berndtsson, Bramryd, & Beisenova, 2015). In other studies, socio-economic parameters had marginal impact on WTP estimates. For instance, when assessing the WTP for palm tree conservation, Vieira et al. (2016) found the respondents’ socio-economic profile did not have significant effect on preference. These studies suggest, that while the respondents’ socio-economic attributes may have substantial effect in preference formation, other parameters could have significant influence on stated preference.

Economic value and environmental attributes often demonstrate relationships of spatial dependency (Bateman, Day, Georgiou, & Lake, 2006). However, many stated preference studies fail to assimilate spatial components despite their explicit role in value aggregation (Schafaßma, Brouwer, & Rose, 2012). In recent years, numerous valuation studies have shown the benefits of incorporating spatial data and physical models in econometric studies, demonstrating the contributions of spatial features and environmental risk attributes in the formation of stakeholder cognition (Dimal & Jetten, 2018). Yao et al. (2014) found socio-demographics and spatial attributes to have significantly affect the WTP for biodiversity enhancement. Zabala et al. (2019) found that, aside from several demographic determinants, the proximity to rivers affected perceived welfare assessment of water reuse. In investigating WTP for reforestation, Mueller, Springer, and Lima (2018) found that both proximity to the proposed restoration site and viewshed (i.e. visibility of a particular area from the observer’s location) affected respondents’ perception.

Research highlights

- This study uses contingent valuation to evaluate stakeholders’ WTP for soil conservation.
- The impact of socio-economic factors, risks and spatial parameters on WTP was also assessed.
- Results show income, education and land ownership are significant WTP determinants.
- Environmental consciousness and proximity to amenities were found to affect perceived value.
- Study presents how econometric modelling and spatial analysis can be integrated into soil valuation.
Building on the growing interest in environmental valuations and the new perspectives in value analysis, this study implemented a contingent valuation survey in Norzagaray, Philippines, using price bid and dichotomous choice formats, to better understand perceived soil value and assess the variable affecting economic worth. The main objectives of this study are as follows: (a) to estimate the farmers’ WTP for soil conservation and compare the estimates from different CV formats; (b) to identify which socio-economic and farm-based attributes affect WTP; (c) to assess the effect of environmental awareness and soil risks (i.e. erodibility and landslides) on WTP; and, (d) to evaluate the impact of spatial attributes (i.e. topographic effects and proximity to amenity) in forming preferences.

2 | MATERIALS AND METHODS

2.1 | Norzagaray as study site

Located in the province of Bulacan and situated 46km North of Metro Manila, Norzagaray is a rural agricultural town comprised partially of three major watersheds in the Philippines, Angat, Ipo and Bustos (see Figure 1). The eastern half of the town falls within the Angat Watershed Forest Reserve, a conservation region that serves the drainage basin supplying 97% of Metro Manila’s water needs. The western half is where the disposable lands are located, with a mix of flat and gently sloping areas on the extreme western portion, and rolling to hilly lands located west of the centre. The concentration of paddy rice fields and built-up areas are found in the western and northern regions, while mining and cement manufacturing plants are situated mainly in the southern region.

Norzagaray is a growing and diversifying municipality producing a variety of products typical of other Philippine towns. In 2013, the number of households (HH) was at 22,401, with 59% employed in the agricultural sector. Open grasslands (57%) have been increasing due to farm abandonment, mainly as a result of the expansion of the quarry operations and diminishing agricultural yield. Abandonment of agricultural lands has exacerbated soil degradation and landslide susceptibility problems, which have already been challenging given Norzagaray’s topography, climate and soil characteristics. Increased river siltation and sedimentation in the main reservoir are major concerns in the management and maintenance of the dam and hydroelectric power plant. Aside
from having extensive historical and up-to-date data sets due to the presence of the Angat Dam, the town (i.e. municipal government, agricultural office, community officials and farm leaders) has openly expressed willingness to actively participate in long-term investigations on their soil resources.

### 2.2 Contingent valuation techniques

The link between welfare economics and CVM is straightforward, which directly elicits the respondents’ willingness to pay to estimate stated value (Carson & Hanemann, 2005). The econometric model used in estimating WTP for CVM studies is based on the utility variation model proposed by Hanemann (1984):

$$y_i^* = \beta x_i + \lambda_i$$  \hspace{1cm} (1)

where $y_i^*$ is the individual’s WTP variable, $x_i$ is a vector of the individual’s attributes and suggested plan, $\beta$ is the coefficient for the attributes, and the $\lambda_i$ is the error term with the mean equal to zero (Alberini, 1995). Two popular CVM formats are the payment card (PC) and dichotomous choice (DC) (Carson, 2011).

The payment card is an open-ended question with multiple bids format, allowing the respondent to select WTP from a range of choices. Generally, it has shown to be more systematically related to explanatory variables (socio-demographic characteristics) and consistent with actual price choices (Cummings, Brookshire, & Schulze, 1986; Loomis, 1990). Increasing the number of bids can theoretically increase the efficiency of the approach since it narrows down the value range but can also result in additional analytical complexity for the stakeholders that may be counter-intuitive to the valuation process. In the PC format, a proposed community fund was to be set up on a voluntary capacity, which would be collected annually for each household. The respondents were asked to choose for their WTP from among nine price bids (₱0.00–₱200 (~$4.50)). The fund would be used to supplement government efforts to reduce erosion rates at the farm level through public financed soil conservation measures, especially targeting poorer agricultural households.

The other CVM format used was the dichotomous choice, where the respondents were asked whether they were amenable to the imposition of a mandatory annual fee per household, ranging from ₱50, ₱100, ₱150 and ₱200. To improve the statistical efficiency of the model, a double-bounded dichotomous choice (DBDC) scheme can be used as proposed by Hanemann, Loomis, and Kanninen (1991). A follow-up second bid was presented to the respondent, with the value of the bids dependent on their previous response. Those who accepted the original bid were then inquired for their willingness on a follow-up bid with a ₱25 increase, while those who rejected were asked with a ₱25 decrease. Statistical analysis is used in calculating the likelihood that the respondent will agree to the proposed amount given in the proposed scheme and the respondents’ characteristics. Assuming the individual $(i)$ knows their valuation distribution, the probability that the individual would agree (yes = 1, no = 0) with the offer given a price bid $(c_i)$ is:

$$\text{Prob} \left( y_i^* \geq (c_i | x_i) \right) = 1 - F \left( (c_i | x_i) + \lambda_i = 1 - \phi \left( \frac{c_i - x_i \beta}{\sigma_i} \right) + \lambda_i \right)$$  \hspace{1cm} (2)

such that $\phi(.)$ is a standard normal distribution probability density function, and $\lambda_i$ is the error term with a zero mean value.

### 2.3 Survey implementation

The contingent valuation was conducted using a door-to-door questionnaire survey from January to March 2015, with support from Norzagaray Municipal Government and its agriculture office. In this approach, a hypothetical scenario is presented to the respondents, followed by the direct solicitation of their WTP for the change in supply or use, which is then used as a proxy indicator for the explicit value. In this study, in order to reduce the influence of methodological biases, we conducted pre-surveys to ensure familiarity with the payment vehicle, performed pilot-testing to guarantee comprehensibility of questionnaires, used two stated preference formats to provide a check and used double-bounded DC to improve statistical efficiency. Before the survey, focus group discussions (FGD) were organized with the local and provincial government representatives and barangay (community) officials, focusing on farming techniques, environmental concerns and local understanding of soil issues, including farm management and conservation. A draft questionnaire was developed and finalized after pre-testing with personnel from the agriculture office. It was then pilot-tested with a small group of local farmers to ensure comprehensibility of questions and estimate time requirements.

A stratified random sampling approach was developed in choosing the 300 heads of agricultural households as the sample population. The respondents were composed of agricultural households, comprised of landholding farmers, farmer-tenants and farmworkers from Norzagaray, Bulacan and Philippines. The respondents were informed that a valuation study was being conducted in support of soil conservation measures that will supplement current land management projects initiated by the local government. From the 300 agricultural families randomly picked to participate in the survey, 24 responses were excluded from the analysis due to incomplete socio-economic data, missing spatial information of farms and multiple marked responses. The questionnaire (see Appendix) utilized a
PC-CVM format soliciting WTP on a voluntary payment, and a DC-CVM format for a mandatory fee. The questionnaire concluded with a self-evaluation test measuring the individual’s propensity for farm-based soil management. The responses were converted to a numerical scale (1–5), which was then averaged and used as the agricultural sustainability consciousness index (ASCI). ASCI was used to score the individual’s environmental awareness, reflecting the farmer’s behaviour and perception towards soil conservation.

### 2.4 Data processing and analysis

In the PC-CVM format, the Pearson product-moment correlation coefficients were computed to determine the relationship between WTP for soil conservation and the different respondent attributes. An additional one-way analysis of variance (ANOVA) was performed to compare the effect of education, income and ownership type on the WTP. A test for multicollinearity was conducted using the variance inflation factor (VIF) analysis, to ensure that the predictors were independent and not correlated with each other. To further examine the effect of the individual predictors, the OLS regression was then generated to model the relationship of WTP with all the explanatory variables.

To provide a robustness check on the WTP estimates, a stepwise log-linear regression model was constructed to minimize the model using only significant regressors. In this alternative approach, the zero bids were excluded in the analysis to eliminate the effect of possible protest bids. In the log-linear model, the natural log of willingness to pay (ln WTP) was used as dependent variable, while the independent variables were kept at their original scale.

In estimating the WTP for the DC-CVM, both non-parametric and parametric welfare estimations were used. For the non-parametric approach, the Turnbull’s estimator was used to find the expected lower bound of the willingness to pay. Being a distribution-free estimator dependent on asymptotic properties, the Turnbull estimator uses the probability of acceptance for each price bid that mimics a survival function. The WTP estimate is then calculated by adding the products of the lower bound bid and the change in density (Hamed et al., 2016). For the parametric analysis, the approach used is based on Hanemann et al. (1991), which considers the mean WTP in the interval from zero to the maximum price bid. To account for the zero WTP responses, the Spike model can be used:

\[
P_i(1) = \Lambda(\Delta V(A)) = \begin{cases} 
1 + \exp(\alpha) & A = 0 \\
1 + \exp(\alpha - \beta A) & A > 0 
\end{cases}
\]

where \(\Delta V(A)\) is utility difference function, \(\alpha\) and \(\beta\) are variables that could be approximated using the maximum likelihood method, and \(A\) denotes the price bid. The Spike model becomes particularly applicable when a significant portion of the population chooses zero price bids (Ramajo-Hernandez & del Saz-Salazar, 2012). The WTP approximation for the spike model is given by the equation (Kristrom, 1997):

\[
E(WTP) = -\frac{1}{\beta} \ln(1 + e^\alpha)
\]

Similarly, a logit regression model, which included the stakeholders’ attributes, was then generated to analyse the determinants of the DC-CVM. The Wald chi-squared test was performed to determine which factors influenced the respondent’s decision-making in valuing for soil conservation and check the robustness of WTP results.

### 2.5 Spatial analysis

The respondents’ geographic coordinates were determined mainly with the use of handheld GPS, which were then entered into the geodatabase. A different set of spatial analyses were then used for the two CVM formats in analysing the effect of the respondent’s spatial location to WTP. For the payment card-derived WTP, soil erodibility and landslide hazard maps were used to assess WTP heterogeneity. The soil erodibility factor (K) was generated using the geologic/soil map of the Angat Watershed, with additional soil texture data from the Bureau of Soil and Water Management (Philippine Bureau of Soil & Water Management, 1971). The erodibility map was generated using the equation (Foster, Mccool, Renard, & Moldenhauer, 1981):

\[
100K = 0.1313 \left[ (2.1m^{1.14} \times 10^{-4} (12 - a) + (3.25 (b - 2)) + (2.5 (c - 3))] \right.
\]

where \(m\) is (silt (%) + very fine sand (%)) (100-clay (%)); \(a\) is organic matter (%); \(b\) is structure code; and, \(c\) is soil permeability class. The landslide susceptibility map was based on data provided by the Provincial Disaster Risk Reduction and Management Council (Philippine Mines & Geosciences Bureau, 2014). After incorporating the spatial coordinates of the respondents into the geodatabase, the landslide classification index (Figure 2a) and soil erodibility values (Figure 2b) were analysed to check whether these variables are related to WTP. A one-way ANOVA was conducted to test the impact of landslide classes on WTP values, while the Pearson correlation analysis was performed to examine the correlation of soil erodibility and WTP.

For the dichotomous choice format, the influence of topographic effects and proximity to amenity were
The socio-demographic breakdown is shown in Table 1. The mean WTP/HH from the PC-CVM was estimated to be ₱79.98 ($1.80)/year, with 77% of the respondents’ selected price bid of ₱100 or less. When the zero bids were excluded, the mean WTP increased to ₱87.95 ($1.98). For context, the size was five. The sampled demographics were proportional to the town’s demographic composition.

3 | RESULTS

The socio-demographic breakdown is shown in Table 1. The respondents’ average age was 54, and the average household size was five. The sampled demographics were proportional to the town’s demographic composition.

3.1 | Environmental awareness

Figure 3 presents the questions used in assessing the ASCI and the summary of results. About 93% of the respondents agreed that soil protection was an essential component in their farm operations, while 72% agreed that the local government has the responsibility to enforce soil conservation measures for the community in general. The majority said that they invest in farm-based soil conservation measures (81%) and that they continually seek additional training to learn more about conservation methods (68%). Post-survey discussions revealed that the additional training and technical support for soil protection had been provided mainly by the Municipal Agriculture Office. Almost three in five (59%) either agreed or strongly agreed that regulations and penalties for non-compliance of soil conservation measures are justifiable, while only one in two respondents (52%) agreed on the imposition of additional fees towards soil conservation.

3.2 | Payment card

The mean WTP/HH from the PC-CVM was estimated to be ₱79.98 ($1.80)/year, with 77% of the respondents’ selected price bid of ₱100 or less. When the zero bids were excluded, the mean WTP increased to ₱87.95 ($1.98). For context, the
region’s daily minimum wage for farmworkers was ₱319, indicating the average WTP is about one-fourth of a farmworker’s daily wage. The summary of Pearson product-moment correlation coefficients is presented in Table 2. WTP was found to have significant moderate correlation with education (r = .225, p < .001), income (r = .332, p < .001) and ownership (r = .306, p < .001). Environmental awareness, measured through the ASCI, was also found to be positively correlated with WTP (r = .152, p < .05), with those who consider soil conservation as essential in their decision-making more likely to give higher WTP values. As for the analysis of variance, the results show the effects of ownership (F = 5.357, p < .001), income (F = 4.888, p < .001) and education (F = 4.627, p < .001) on WTP are significant, corroborating the results of the Pearson correlation analysis.

Table 3 presents the results of the variance inflation factor (VIF) analysis. The VIF analysis shows that there was no significant issue of multicollinearity, and none of the variables should be excluded in the model. Ordinary least square regression was then performed, and the summary of results is shown in Table 4. In Model A-I (R² = 0.214), four of the eight variables were found to have significant influence on WTP: income (t = 2.949, p < .01), education (t = 2.601, p < .01), land ownership (t = 3.293, p < .001) and ASCI (t = 3.029, p < .01). In Model A-II (R² = 0.148), when zero bids were censored and stepwise log-linear regression was performed, the same four variables were found to be significant determinants of WTP: land ownership (t = 2.906, p < .01), education (t = 2.873, p < .01), ASCI (t = 2.709, p < .05) and income (1.861, p < .05). These results suggest that whether or not protest bids were included or excluded in the analysis, the WTP determinants would include these four variables.

The ANOVA results for WTP and landslide hazard map index are presented in Table 5. There was no statistically significant difference between the means of each landslide hazard class group as determined by one-way ANOVA (F(3,272)=1.248, p = .29). Likewise, the Pearson coefficient was computed between stakeholders’ WTP values and erodibility, with the results indicating no significant correlation (r = .109, p = .07).

### 3.3  Dichotomous choice

The summary detailing the acceptance rates at the various price bids is presented in Table 6, while the results of the double-bounded dichotomous choice logit model are shown in Table 7. For the Turnbull approximation, The WTP was computed to be P87.73 ($1.98), while the median value (50th percentile) was found within the same price bid range of P75-P100. For the spike model, the utility difference under the DC format was ΔV = α – βA = 1.254 – 0.017A, which means that the approximated WTP is $88.53($2.00). Similar to the analysis in PC-CVM, a logit regression model was generated that included the stakeholders’ attributes and environmental awareness. The generated logit model is able to predict 76% of expected probabilities. The results of the model show that price bid and the income level are both significant in affecting the probability of the respondent’s WTP. The income coefficient is positive, which means high-income earners are more likely to agree. Price bid has a negative coefficient, which means that the higher the proposed fee, the less likely respondents would be willing to accept the proposal. Having a significant negative coefficient for price bid suggests that the respondents took the survey seriously and not merely randomly.

Table 8 presents the summary of results of the mean WTP and variance analysis for the various spatial determinants. Elevation and slope showed no significant influence on WTP, while proximity to river and forest amenities had a significant positive influence on WTP estimates. Those
who lived within 1 km from the river system had significantly higher mean WTP (₱92.50) compared to those living outside (₱71.69). Similarly, those living close to the protected forest reserves substantially had higher WTP values. The 2 km and 4 km proximal zones showed significant difference in WTP values \( (p < .05) \), with those living inside these zones having higher mean WTP than those living outside.

**4 | DISCUSSION**

The results reveal a positive attitude towards soil conservation among the respondents. Aside from having high ASCI values, the zero bids constituted only 9% of respondents. Past studies have found various reasons for respondents’ non-WTP. Vieira et al. (2016) found that the respondents gave zero WTP values because of their doubt that their contributions would resolve the environmental damage and due to their dissatisfaction with the government. Chen and Hua (2015) found that aside from those with substantial government distrust, zero bids were due to low familiarity with the environmental amenity. In this study, the protest bids were caused not by government distrust nor the lack of appreciation for soil benefits. When inquired for their non-WTP, the responses were mainly due to two main reasons: economic constraints and disagreement with additional taxation for

**TABLE 2** Summary for PC-CVM results. Pearson correlation coefficients for WTP and one-way ANOVA for discrete explanatory variables

| Respondent attributes | Correlation coefficient | p-value | ANOVA | F | p-value |
|------------------------|-------------------------|---------|-------|---|---------|
| Gender                 | 0.056                   | .353    |       |   |         |
| Age                    | 0.073                   | .229    |       |   |         |
| Farm size              | 0.109                   | .069    |       |   |         |
| Household size         | 0.034                   | .569    |       |   |         |
| ASCI                   | 0.152                   | .012    |       |   |         |
| Education              | 0.225                   | .000    | 4.627 | .000*** |         |
| Income                 | 0.332                   | .000    | 4.888 | .000*** |         |
| Ownership              | 0.306                   | .000    | 5.357 | .000*** |         |

Abbreviation: ASCI, Agricultural Sustainability Consciousness Index.

***p < .001 level; **p < .01 level; *p < .05 level.
environmentalism. Aside from those who are financially restricted from participating, others believe that the funds needed for conservation should not be shouldered by farmers but by the general public who directly and indirectly benefit from soil protection.

Land tenure was shown to have significant influence on WTP, with landowners found to be more willing to invest in soil conservation. People who have greater stakes with the land are more compelled to protect it. This suggests that land right is not just a social issue but also an environmental matter. Education and environmental consciousness were also found to have significant positive correlation. Such findings were similar to the conclusions from past studies. Yao et al. (2014) found significant those who had completed at least a tertiary education to provide higher WTP preferences. Khan and Damalas (2015) found that highly educated farmers and those who perceived significant health risks by pesticides were more likely to give higher WTP values. Similarly, we consider education as proxy indicator for the respondent’s knowledge on soil amenities; those with higher education are more likely to recognize and appreciate soil benefits and thus put higher premium towards soil conservation.

Income was unsurprisingly found to have significant positive effect on WTP. Previous studies have suggested that a significant correlation between income and WTP is a positive indicator that the respondents took the survey seriously.

### TABLE 3  
Variance inflation factor matrix. Summary of VIF values to test multicollinearity among independent variables

| Independent variables | Dependent variables | Gender | Age | Area | Household | Education | Income | Owner | ASCI |
|-----------------------|---------------------|--------|-----|------|-----------|-----------|--------|-------|------|
| 1 Gender              |                     |        |     |      |           |           |        |       |      |
| 2 Age                 |                     | 1.020  |     |      |           |           |        |       |      |
| 3 Area                |                     | 1.022  | 1.094 |     |           |           |        |       |      |
| 4 Household           |                     | 1.018  | 1.065 | 1.017 |           |           |        |       |      |
| 5 Education           |                     | 1.013  | 1.052 | 1.019 | 1.059     |           |        |       |      |
| 6 Income              |                     | 1.017  | 1.094 | 1.015 | 1.047     | 1.089    |        |       |      |
| 7 Owner               |                     | 1.022  | 1.075 | 1.018 | 1.066     | 1.238    | 1.214  |       |      |
| 8 ASCI                |                     | 1.017  | 1.092 | 1.020 | 1.063     | 1.240    | 1.397  | 1.223 |      |

Note: VIF > 3 indicates possible multicollinearity; and VIF > 5 indicates strong possibility of multicollinearity.

### TABLE 4  
Regression model results of the PC-CVM. Model A-I: DV = WTP, and IV includes all parameters. Model A-II is a stepwise linear regression model, DV = ln (WTP)

| Parameters     | Model A-I Coefficients | Model A-II Coefficients | t-value | t-value |
|----------------|------------------------|-------------------------|---------|---------|
| β              | Std Err | Std β | β        | Std Err | Std β | t-value |
| (Constant)     | −21.976  | 25.851 | −0.850 | 3.276   | 0.201 | 16.284*** |
| Education      | 8.870    | 3.410  | 0.157 | 2.601*** | 0.112 | 0.039 | 2.873*** |
| Income         | 8.647    | 2.932  | 0.189 | 2.949*** | 0.063 | 0.034 | 1.861*** |
| Ownership      | 7.787    | 2.364  | 0.198 | 3.293*** | 0.073 | 0.027 | 2.906*** |
| ASCI           | 11.183   | 3.692  | 0.165 | 3.029*** | 0.125 | 0.043 | 2.709*** |
| Gender         | −18.959  | 8.531  | −0.122 | −1.022 |       |       |         |
| Age            | 0.328    | 0.257  | 0.073 | 1.278   |       |       |         |
| Farm size      | 3.791    | 3.445  | 0.060 | 1.100   |       |       |         |
| Household      | 0.402    | 2.075  | 0.110 | 0.194   |       |       |         |
| R²             | 0.214    | 0.148  | 0.148 | 0.148   | 0.148 |       |         |
| F              | 9.060    | 10.662 | 3.389 | 3.389   |       |       |         |
| F-critical (α = 0.01) | 2.578 |       |       |       |       |       |         |

Abbreviation: ASCI, Agricultural Sustainability Consciousness Index.

***p < .001 level; **p < .01 level; *p < .05 level.
People with higher income would more likely have greater disposable funds, which they could then spend on other things, such as conservation measures, while those with limited income would be more unlikely to agree to additional fees. Our post-survey FGD verified that money was indeed a major limiting constraint to the respondent’s WTP, particularly for those earning less than ₱40,000/year. Given that income and land ownership are implicit indicators of the population’s ability-to-pay (ATP), the results suggest ATP is highly correlated with WTP for soil conservation. Improving the ATP, particularly of agricultural households, would mean higher WTP and higher stated value for soil amenities, and may consequently lead to increased soil conservation expenditure and more soil protection measures.

Understanding stakeholders’ willingness to pay for soil amenities advances discussions on the economic valuation of soil and can encourage greater public participation towards conservation measures. WTP estimates can be used as proxy for stated economic value and serve as pecuniary measure for soil benefits to a particular group. By being able to estimate the value of soil functions or specific amenities, the trade-offs can be sufficiently reflected based on associated costs and societal benefits of potential policy decisions. As a decision-making tool, estimating soil economic value can lead to a deliberative process where various stakeholder groups and their interests are revealed. Several policy strategies and administrative innovations can result from the economic assessment of the environment. For example, WTP estimates can be used as basis to set up community funds to supplement conservation measures, which democratizes the decision-making process and stimulates participation. Valuation can also be used to establish prices for Payment for Ecosystem Services to translates the economic externalities of resource extraction and commodity production into supportive and restrictive financial incentives.

In terms of potential limitations, this study has two main research constraints. First, while CVM has progressed significantly in the past few decades, particularly in valuing environmental goods, there remain considerable reservations whether it can effectively be used to measure value. Intrinsic methodological limitations and respondent biases may be present in CVM studies, ranging from hypothetical

| Score | Risk level  | N      | WTP mean | SE    | 95% Conf. Int. Lower | Upper |
|-------|-------------|--------|----------|-------|----------------------|-------|
| 1     | Negligible  | 161    | 75.78    | 4.129 | 67.62                | 83.93 |
| 2     | Low risk    | 26     | 75.96    | 10.785| 53.75                | 98.17 |
| 3     | Moderate risk| 59     | 86.02    | 7.699 | 70.61                | 101.43|
| 4     | High risk   | 30     | 94.17    | 11.477| 70.69                | 117.64|

**TABLE 5** ANOVA results for WTP and landslide hazard map index

| WTP value | ₱ 25 | ₱ 50 | ₱ 75 | ₱ 100 | ₱ 125 | ₱ 150 | ₱ 175 | ₱ 200 | ₱ 225 |
|-----------|------|------|------|-------|-------|-------|-------|-------|-------|
| Total     | 19   | 70   | 90   | 67    | 69    | 68    | 10    |       |       |
| Yes (accepted) | 17 | 51   | 55   | 32    | 21    | 11    | 12    | 10    | 1     |
| No (rejected) | 2  | 19   | 35   | 39    | 67    | 56    | 57    | 58    | 9     |
| Accept rate (%) | 89.47 | 72.86 | 61.11 | 45.07 | 23.86 | 16.42 | 14.71 | 10    |       |

*Note:* ₱ denotes Philippine Peso.

**TABLE 6** WTP responses and acceptance rate for the double-bounded dichotomous choice CV

**TABLE 7** Parameter estimates of the double-bounded logit model for the DC-CVM

| Variable          | B     | SE    | Wald  |
|-------------------|-------|-------|-------|
| Constant          | 0.649 | 0.884 | 0.539 |
| Price bid (WTP)   | −0.023| 0.002 | 102.226*** |
| Income            | 0.334 | 0.099 | 11.522*** |
| Gender            | −0.062| 0.307 | 0.040 |
| Age               | −0.007| 0.009 | 0.631 |
| Household size    | 0.001 | 0.070 | 0.000 |
| Education         | 0.121 | 0.114 | 1.116 |
| Ownership         | 0.128 | 0.081 | 2.523 |
| ASCI              | 0.177 | 0.129 | 1.880 |

*Abbreviation: ASCI, Agricultural Sustainability Consciousness Index.***p < .001 level; **p < .01 level; *p < .05 level.*
bias, methodological misspecification, participation bias and information bias. Follow-up work can be done to determine the magnitude and impact of these possible forms of bias. Second, only a limited number of regressors were included in this study. Future studies can explore other determinants that could influence WTP values, including pedometric attributes, farming practices and other environmental risks. The size of the sample population was another limitation due to logistical constraints. Using a 95% confidence interval, the 274 samples drawn from 13,200 agricultural households (2013 estimates) in Norzagaray yielded ± 5.86 points. Future studies can also look into analysing the effect of using other survey platforms (e.g. phone interviews, mail-in questionnaires) and questionnaire formats, and using other forms of stated preference techniques in determining and analysing explicit soil value.

5 | CONCLUSION AND POLICY IMPLICATIONS

Soil valuation can become an effective means to better appreciate the various soil services and provide pecuniary estimation of their contributions to human well-being. However, due to intrinsic difficulties and inherent methodological limitations, there has been limited research dealing with estimating soil's economic worth. This study employs a multi-stage valuation approach that integrates PC- and DC-CVM formats to estimate soil value and analyse the parameters that influence value heterogeneity. The binary-level format provides a simultaneous relative check on the precision and validity of CVM results, which could be missing in most single-level valuation approaches.

Several observations were noted in the planning, implementation and analysis of results in this study. First, a major challenge in CVM is ensuring that the respondents provide truthful responses reflecting their normative preferences. Aside from persuading respondents to participate in the project, building trust is a major factor affecting result accuracy. Gaining the support of the local government, community leaders and the farmers’ organization was crucial in carrying out this research, from communicating with the respondents to providing assistance and security when required. Second, stakeholder engagement should be further promoted in environmental valuation. In this study, stakeholder participation was not limited to the implementation of the survey but included activities throughout the development process, including questionnaire improvement and post-evaluation discussion. And third, the questions to measure environmental awareness are explicitly designed for farmers and serve only as a preliminary design. It would need to be further improved to elicit a more descriptive and comprehensive picture of the respondent's awareness level.

Given the current limited research in soil valuation, the findings and methodology of this study can be used in developing a more comprehensive characterization of soil
use-value that integrates spatial analysis in econometric modelling. The results of this study would also be useful for decision-makers in understanding stakeholder preference and cognition, which are essential in developing sustainable conservation policies and soil management strategies. Moreover, this study can offer new insights into agricultural and environmental policy discussions, particularly with regards to the role of stakeholders in environmental conservation, the use of environmental valuation in policymaking, and long-term sustainable soil use and management in rural communities.

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APPENDIX 1

Survey questionnaire

The translated language of the CVM questionnaire are as follows:

The Municipal Government of Norzagaray through the Agriculture Office is creating a community fund that will be used to finance soil conservation measures catered to mitigating erosion in private farmlands.

Voluntary Payment System:

1. Would you be willing to participate/contribute soil conservation measure if it was going to be on a voluntary basis? □yes □no

2. If the community-initiated fund is to be set-up aimed at assisting farmers and farm-workers with soil conservation and rehabilitation, and it is voluntary, how much will you be willing to contribute annually?

□0 □25 □50 □75 □100 □125 □150 □175 □200

Environmental Awareness Test: Please state if you agree or disagree with each of the following statement:

1. I consider soil protection as an essential consideration in farming.
   □strongly disagree □ disagree □ neutral □ agree □ strongly agree

2. I deliberately allocate substantial time and money towards soil conservation measures
   □strongly disagree □ disagree □ neutral □ agree □ strongly agree

3. I regularly seek training or consultation on soil use and conservation methods.
   □strongly disagree □ disagree □ neutral □ agree □ strongly agree

4. Local government has the responsibility and authority to enforce measures that will protect soil resources in the community.
   □strongly disagree □ disagree □ neutral □ agree □ strongly agree

5. I am agreeable to community-based regulations and ordinance that will promote soil conservation, which would include the imposition of penalties for non-compliance.
   □strongly disagree □ disagree □ neutral □ agree □ strongly agree

6. I am amenable to the collection of additional fees that will supplement the budget towards community-level soil conservation measures.
   □strongly disagree □ disagree □ neutral □ agree □ strongly agree

Compulsory Payment System:

1. If it was decided that a mandatory fee would be imposed, and each land-holding household will be taxed ______ amount annually, would you be willing to accept?
   □yes □no

2. If you answered YES to the previous question, and the amount was raised by ₱25, would you be willing to accept such plan? If you answered NO and the amount was lowered by ₱25, would you be willing to accept the plan?
   □yes □no