Philippine Journal of Science
154 No. (2): 263-276, April 2025
ISSN 0031 - 7683
Date Received: 03 Sep 2023

Potential Contribution of Tourism for Groundwater Conservation in Mt. Makiling, Philippines

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Calamba City and Los Baños in Laguna, the Philippines, benefit from the water ecosystem services of Mt. Makiling. Being a dormant volcano, it supplies hot water to springs and groundwater in the area, giving rise to a resort-based tourism industry. Over the years, the number of resorts has significantly increased, placing a toll on groundwater resources. Given the heavy reliance on groundwater by resorts in the area, this paper presents the findings of a contingent valuation (CV) study that examined tourist knowledge of resort water sources, reasons for their visits, and their willingness to pay (WTP) for improved water conservation of Mt. Makiling. The CV survey was implemented online using Microsoft Forms. The payment card method was used to elicit WTP, and the mean WTP was estimated using interval regression. About 50% of 492 respondents indicated awareness of the resort's water source, mostly saying it is hot springs, but only a few knew groundwater as the water source. The main reasons for visiting the resorts are for relaxation as well as their accessibility and affordability. The estimated mean WTP is PHP 75/visit. If captured, this can raise PHP 159.52 million/yr, with a present value of PHP 1.358 billion at a 10% discount rate over a 20-yr discounting period. The respondents' primary motivation for WTP was conserving Mt. Makiling's limited groundwater. Those unwilling to pay cited affordability concerns and opposition to paying for pool water recycling. Insights about implementing a CV survey online are also discussed. This study recommends that local governments enact policies to capture WTP for improved groundwater conservation, utilizing the funds generated for Mt. Makiling management and resort water conservation measures.

Keywords: contingent valuation, ecosystem services, Mt. Makiling Philippines, payment card, resorts, swimming pools

INTRODUCTION

The Makiling Forest Reserve was established in 1910. In 1960, Proclamation No. 692 transferred the administration of the land embraced by the Makiling National Park to the University of the Philippines (UP) for the use of the College of Forestry. UP continues to administer and manage what is now known as the Mt. Makiling Forest Reserve (MMFR) through the College of Forestry and Natural Resources and directly by the Makiling Center for Mountain Ecosystems. MMFR was designated the 33rd ASEAN Heritage Park in 2013 due to its significance in conserving the Philippines' rich floral and faunal biodiversity (MCME 2023).

Mt. Makiling, a vital watershed, supplies water for domestic, agricultural, and industrial needs. This dormant

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volcano is the water source of hot springs and groundwater in Calamba City and Los Baños, fueling the growth of numerous hot spring resorts. Resort numbers have risen dramatically over time. Calderon *et al.* (2021) reported 871 resorts in Calamba and 172 in Los Baños (1,043 total) as of 2020. This significantly increased from 193 Calamba resorts in 1998 to 466 in 2014 (Jago-on *et al.* 2017). The growing number of resorts has naturally led to a surge in tourism. A key issue arising from this expanding industry is the inefficient use of pumped hot groundwater by resorts for pools and other purposes.

An initial ocular survey of resorts in Calamba and Los Baños revealed that the temperature of pool water ranged from ambient (> 30 °C) to 50 °C for an average pool size of 80 m^3 (Balangue *et al.* 2014). The authors also found the pH of water from hot springs in Pansol, Calamba, to range from 6.65–6.87, whereas the cation analysis showed that the thermal waters were of the Na-K-Cl-HCO_3 type with a trace amount of heavy metals. The drained pool water ultimately reaches the Laguna de Bay. Because of these findings, Balangue *et al*. (2014) emphasized the need to regulate and monitor the pool water discharge in the area to protect the lake and the groundwater resources.

Groundwater is scarce, but in many places in the world, it is being depleted faster than it is being recharged (Megdal 2018). Resorts utilizing water for recreation in the country must obtain permits from the National Water Resources Board (NWRB 2005) and relevant local government units. Resorts in the area predominantly rely on pumped groundwater due to its lower cost than the metered water district supply. Most resorts, especially the smaller ones, often dispose pool water by draining it onto roadways. This is a wasteful practice and is not allowed per Rule I, Section 15.i of the Amended Implementing Rules and Regulations of the Water Code of the Philippines (NWRB 2005). The lower cost of groundwater extraction allows resorts to provide their services at lower rates. Public resorts typically charge between PHP 50–200 per visitor, whereas smaller private resorts can be rented for 12 h at prices ranging from PHP 1,800–30,000, depending on size, amenities, time of year, and time of day.

This paper examines visitors' willingness to pay (WTP) for improved water conservation at resorts and the protection of MMFR, addressing the issue of wasteful groundwater use driven by low resort fees. It explores visitors' knowledge of resort water sources, analyzes the motivations for their willingness or non-WTP for water conservation, and estimates the potential benefits of capturing the visitors' WTP.

The study employed the contingent valuation method (CVM) to estimate the WTP of tourists for the conservation of water from MMFR that resorts use in their swimming pools and baths. The CV method is a stated preference technique that uses a questionnaire to discover people's preferences, especially preferences that affect the monetary valuations of costs and benefits (Bateman *et al*. 2002). Stated preference techniques may be used when it is not possible to infer or observe people's WTP from markets or when markets are absent, as in the case of the groundwater resource of Mt Makiling. The CVM is considered the most widely applied non-valuation technique (Sajise *et al*. 2021).

The CV survey was originally intended to be implemented through in-person interviews, but the COVID-19 pandemic necessitated that it be conducted online. Online surveys offer several advantages: they are time-efficient, reduce fieldwork and data collection costs, and provide a user-friendly interface that allows respondents to complete them at their own pace (Evans and Mathur 2005, 2018). Additionally, online surveys enable a clear and consistent presentation of information, allowing participants to revisit questions, answer them in any order, and skip irrelevant ones based on previous responses. These web-based methods are particularly effective in CV surveys for discreetly randomizing bid offers, ensuring respondents remain unaware of the process (Malinauskaite *et al.* 2019).

Similar conservation-related online administered CVM surveys have been conducted to estimate the WTP for various conservation efforts. Rojas-Nazar *et al*. (2022) estimated the WTP for the protection and management of marine reserves in Taputeranga and Kapiti, New Zealand; Tian *et al*. (2020) investigated urban residents' perceptions of ecosystem services and disservices provided by urban green spaces in Wuhan, Changsha, and Nanchang, the core cities in the Middle Reaches of the Yangtze River, China, whereas Malinauskaite *et al*. (2019) applied CVM to elicit preferences and estimate WTP for the expansion of an existing whale sanctuary in Faxaflói Bay, Iceland.

Study Area

The MMFR covers an area of 4,244 ha and is located about 65 km south of Metro Manila. The Reserve straddles parts of Los Baños and Calamba in Laguna and Sto. Tomas in Batangas. The MMFR is divided into four watersheds – Molawin-Dampalit and Tigbi, which drain to Los Baños and Calamba, and Sipit and Cambantoc (Figure 1).

The City of Calamba is a first-class component city in the province of Laguna, with a total land area of 14,480 ha (City of Calamba n/d). It is situated 54 km from Metro Manila. It is bounded in the south by the municipality of Los Baños, Laguna; in the east by Laguna de Bay; in the north by the city of Cabuyao, Laguna; and in the west by the cities of Sto. Tomas and Tanauan, Batangas. The city has 54 *barangays* and a population of 539,671 people as

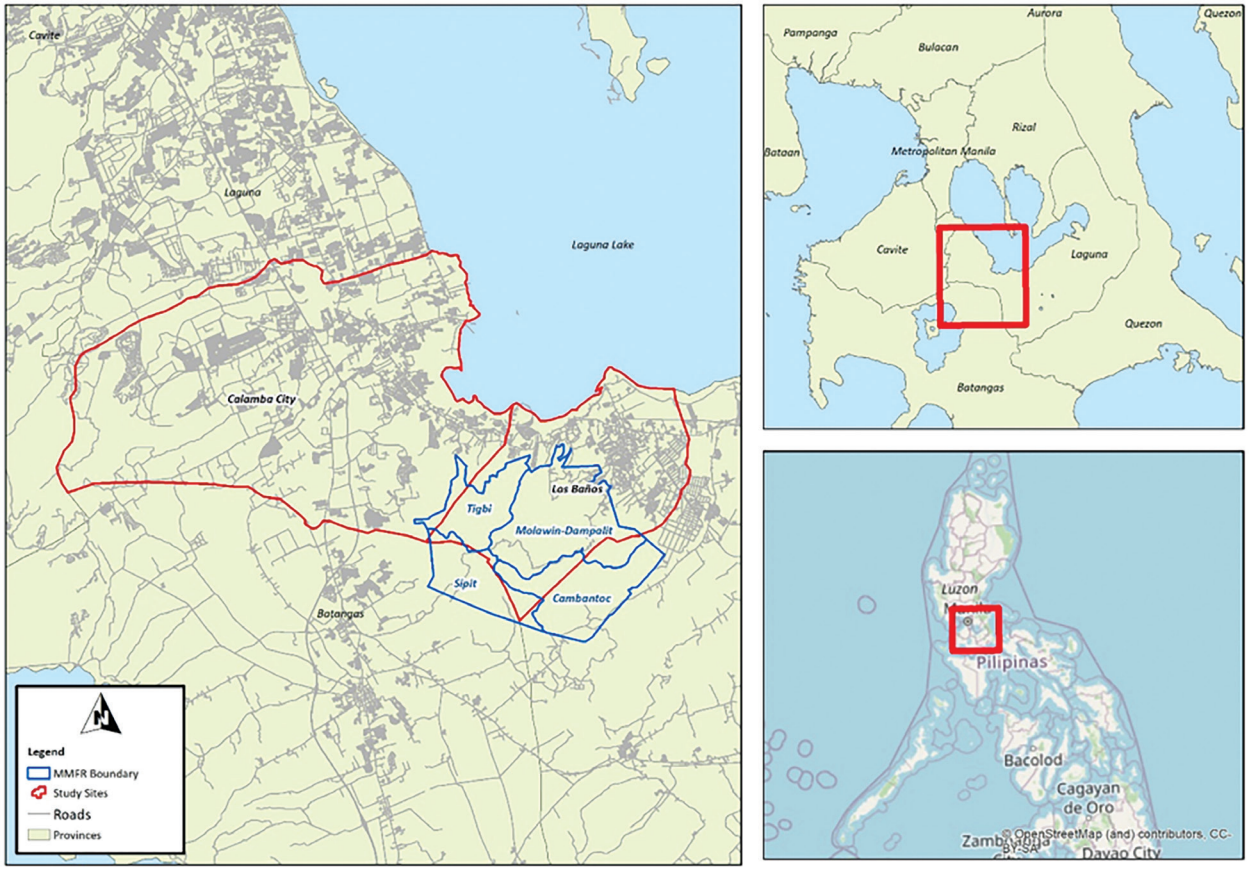

Figure 1. Location of the Mt. Makiling Forest Reserve, City of Calamba and Los Baños, Laguna, the Philippines.

of 2020. Tourism is a major income source of the city, with its numerous hot spring resorts.

Los Baños is a first-class municipality in Laguna with a land area of 5,650 ha and can be found 63 km southeast of Manila (Municipality of Los Baños n/d). To the south and southwest of Los Baños is Mt Makiling, to the north is Laguna de Bay, to the northwest is Calamba, and to the east is the municipality of Bay, Laguna. Los Baños has 14 *barangays* and a population of 115,353 as of 2020.

The annual temperature of Calamba ranges from 24.22–30.67 °C, whereas in Los Baños, the annual temperature ranges from 24.01–30.41 °C. In both areas, May is the warmest month, February is the coldest month, and July and February are the wettest and driest months, respectively (Weather and Climate n/d).

Most of the resorts in Calamba are in the *barangays* of Pansol, Bucal, and Bagong Kalsada. In contrast, the *barangays* of Lalakay and Bambang have the highest number of resorts in Los Baños (Figure 2).

METHODS

Contingent Valuation Survey

The CV survey was originally intended to be implemented through in-person interviews. However, the COVID-19 pandemic led to travel bans, the total closure of these resorts from March–May 2020, and their intermittent opening from June 2020–March 2021. Even when health protocols were relaxed, a reduction in visitation rate was observed due to the visitor's hesitation to engage in this form of recreation. Thus, the project changed the implementation of the CV survey to online mode. The survey questionnaire was transformed to its online version using Microsoft Forms (a copy of the survey questionnaire is available upon request). Microsoft Forms was used over other freely available online survey builders. Compared to Google Forms, it offers various question types and has a logic branching feature that suits the skipping pattern of the questionnaire design. This is important because the survey flow involved a different set of follow-up questions, for example, after a "yes" or "no" response or if the respondent visited a public or private resort. Also, since it is part of the Microsoft 365 products suite, it features in-depth analytics and can be easily imported into Excel.

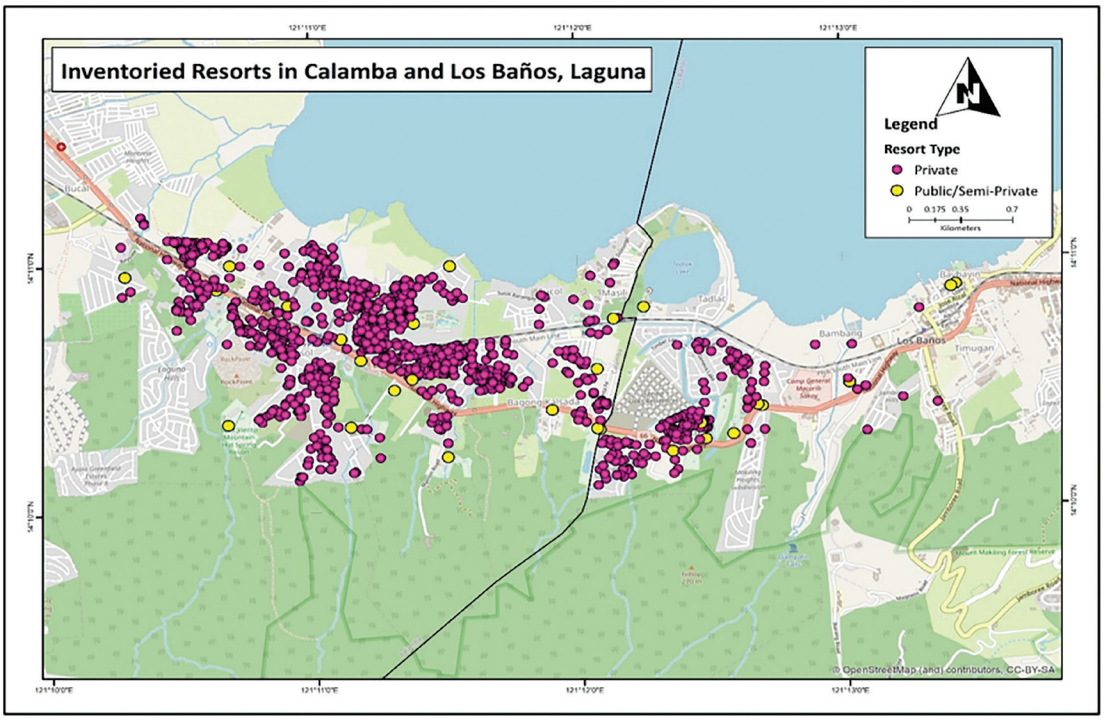

Figure 2. Distribution of resorts in Calamba and Los Baños, Laguna, the Philippines.

The following steps in conducting a CV study were employed (Champ *et al.* 2003):

- **Identify the change in the quality to be valued**, *i.e.* improved conservation of water from MMFR used by resorts.
- **Identify whose values will be estimated**, *i.e.* the WTP of tourists visiting resorts in Los Baños and Calamba. The target population consisted of previous visitors to a resort or resorts in Calamba and Los Baños in 2019.
- **Select a data collection method.** The data for the CV survey was supposed to be collected through personal interviews but was redesigned for online implementation due to the COVID-19 pandemic using Microsoft Forms.
- **Choose a sample size.** Originally, the researchers planned to use stratified random sampling of the resorts from which the CV survey respondents would be drawn using lists of resorts registered with the LGUs of Calamba and Los Baños as sampling frames. This was no longer possible with the online implementation of the CV survey. As the researchers did not have estimates of the number of visitors of all resorts in Los Baños and Calamba per year, the sample size of survey respondents was determined using G*Power (Faul *et al.* 2007) at a 95% confidence level, resulting in a sample size of 500 respondents. The G*power is a power analysis software used to determine the minimum sample size needed to have enough power to detect an effect. The z-test with alpha = 0.05 and power = 0.95 was used for this study to estimate the sample size. Prospective respondents were those who visited a resort in Calamba and Los Baños in 2019 and who either worked or stood as household heads. When the CV study was designed for in-person interviews, respondents were supposed to be screened based on income and/or employment to ensure that they would be able to answer the WTP question of the survey. However, these criteria were removed from the online survey because Facebook advertising policies do not allow assertions or implications about a person's personal attributes, including financial status. Instead, more general terms relating to vacations, resorts, and swimming pools, among other terms, were used.
- **Design the information component of the survey instrument.** This included the source of water of resorts, current practices in water use and disposal, a hypothetical water conservation program to be funded by visitors' payments for resorts to enhance water conservation practices and provide payments to a fund for the conservation of MMFR, and the payment vehicle, among other things. Aside from the literature review, inputs were obtained from two focus group discussions with

LGU environment and natural resources officers and five key informant interviews with the chairs of the LGU environment and natural resources committee, the Department of Environment and Natural Resources's (DENR) Region IV-A Office, pool operators, and resort owners.

- **Design the CV question.** The respondent's WTP was elicited using the payment card method, with a water user fee to be added to the entrance fee collected by resorts as the payment vehicle. The respondents were presented with a payment card on which 16 alternative bid amounts were listed and were asked to choose the amount that best represented their true WTP. The payment card approach was developed as an improved alternative to the open-ended and bidding game methods of eliciting WTP and has been found to facilitate the valuation task because the WTP amounts presented on a card provide context to the bids, avoid starting point bias, and reduce outliers (OECD 2018). The study addressed the hypothetical bias associated with CVM by making the payment mechanism a requirement rather than voluntary, employing a cheap talk script, adding certainty questions, and designing the CV scenario to be credible and realistic (OECD 2018).

The payment card approach in CV surveys offers several advantages, particularly when administered online. This method mitigates starting point bias and simplifies the decision-making process for respondents by presenting a predefined range of monetary values, making it easier for respondents to indicate their WTP without feeling overwhelmed by open-ended questions or complex bidding processes [Karam *et al.* (2022); Withey *et al*. (2019), as cited by Bressane *et al*. (2024)]. The approach also ensures higher response accuracy and reduces non-response rates, as respondents can select from a range of values that reflect their maximum WTP. This is beneficial in online surveys, where the lack of face-to-face interaction can make clarifying questions difficult (Xu *et al.* 2024).

The CV question used in the survey is presented below:

> Consider a scenario where the Local Government of Los Baños/Calamba will pass an ordinance that will require resorts to reuse and treat pool water and will no longer allow the twice daily, daily, weekly, or monthly disposal of pool water. However, this may increase the operating costs of the resorts and may translate to higher entrance fees or resort rental fees that will be passed on to consumers.
>
> To address this, the ordinance will authorize the collection of a water user fee that will cover the resort's cost of properly maintaining water quality to meet international standards of pool water quality (50%) and the conservation of Mt. Makiling (50%). The Mt. Makiling conservation component of the fee will be collected by the local government unit to be turned over to the Makiling Center for Mountain Ecosystems, the manager of MMFR. This will help conserve the groundwater resource of Mt. Makiling and ensure its sustainable use.
>
> Considering your income and expenses, please select the amount below to be added on top of the entrance fee that represents your true willingness to pay for the conservation of the groundwater resource of Mt. Makiling.

The bid amounts of PHP 0, 10, 20, 30, 40, 50, 60, 70, 80, 100, 120, 140, 150, 160, 180, 200, and > 200 per visit were presented in a random manner to encourage respondents to look for the amount that represented their true WTP:

- **Develop auxiliary questions**. The data obtained from the auxiliary questions were used to analyze CV responses (e.g. socio-economic data, knowledge, perceptions, practices) and follow-up questions to ensure respondents' understanding of questions.
- **Pre-test and implement the survey**. Two pre-tests were conducted. Before the pandemic, the first in-person pre-test was conducted in March 2020 and involved 21 resort visitors. The second pre-test was conducted online through Facebook with 10 respondents. Both the in-person and online pre-tests allowed the researchers to observe how respondents understood and answered the questions and identify questions that were difficult to understand, which were revised accordingly. The bid amounts presented to the respondents in the final survey were generated from the pre-tests.

  Two sets of questionnaires were prepared in English and Taglish using Microsoft Forms to give respondents an option regarding the language in which they were more comfortable. The online survey respondents' qualifications were those who visited a resort in Calamba and Los Baños in 2019 and who either worked or stood as household heads. Initially, a Facebook page was created under the Business Service Category, where information, particularly the project description, location, and contact details, were added for page legitimacy. The objectives and implementors of the project were also mentioned in the description. After publishing the survey (i.e. instruction, links, post-

er) on the Facebook page, a campaign ad was created through Facebook Ads. The target audience was set up based on age, employment status, and interests. However, the first two restrictions were removed because they appeared to violate Section 4 Rule No. 12 of Facebook's advertising policies:

> "Ads must not contain content that asserts or implies personal attributes. This includes direct or indirect assertions or implications about a person's race, ethnic origin, religion, beliefs, age, sexual orientation or practices, gender identity, disability, medical condition (including physical or mental health), financial status, voting status, membership in a trade union, criminal record, or name."

In terms of interests, more general keywords were included - namely family vacation, hot spring, relax, resort, staycation, summer, swimming, swimming pools, tourism, vacation, vacation rental, and water park. The campaign budget and schedule were then set, after which the ad was approved.

The survey duration was initially set at 10 survey days but was later extended to 15 days. During the first two days of the survey, the team observed a low engagement rate, probably due to restrictions on resort visits and employment or household head status. The previously used poster may also have been too formal to catch attention. To address these problems, the team decided to augment the recruitment of respondents by requesting friends not based in Calamba or Los Baños to post the survey links on their Facebook pages. Different sets of friends were contacted on different days. The researchers did not post the survey links on their pages because the pre-test experience when they did this resulted in many respondents coming from Calamba and Los Baños, with many being their friends, acquaintances, or students.

The conduct of the online survey was closely monitored. Suspicious responses from two persons were verified, which resulted in the invalidation of 12 responses. The online pre-test and survey proper were undertaken from December 2020–February 2021.

- **Data analysis**. Maximum likelihood estimation techniques were used to estimate the log-likelihood WTP function and parameters, which yielded an estimate of visitors' WTP of tourists for the improved management of MMFR and water conservation by resorts. The econometric model is discussed in the next section.

Econometric Model

The data from the contingent valuation survey using the payment card elicitation method were analyzed using interval regression. Following Haab and McConnell (2002), assume that there are K payments, t_1, …, t_K arranged in ascending order. When a respondent chooses t_k, the probability that the respondent picks this payment is the probability that the WTP lies between this payment tk and the next highest payment t_{k+1}, or:

$$Pr(\text{choose}tk) = Pr(tk < WTP < tk+1) \qquad (1)$$

Payment card responses can be treated in a parametric model by specifying *WTP* as $WTP = \mu + \varepsilon$. Letting $\varepsilon \sim N(0, \sigma 2)$, then:

$$Pr(\text{choose}tk) = \Phi\,(tk + 1 - \mu) / \sigma) - \Phi\,((tk - \mu) / \sigma) \qquad (2)$$

where $\Phi\,(tk + 1 - \mu) / \sigma)$ is the standard normal cumulative distribution function (CDF) evaluated at $(tk + 1 - \mu) / \sigma$.

The log-likelihood function of the responses can then be written as:

$$\ln L = \sum_{i=1}^{T} \ln\left(\Phi\left(\frac{tk+1(i)-\mu}{\sigma}\right) - \Phi\left(\frac{tk\,(i)-\mu}{\sigma}\right)\right) \qquad (3)$$

where individual *i* picks payment t_k (i). This is a form of an interval model where every individual selects some payment.

According to Morrison et al. (2019), the model is a generalization of a Tobit model and is estimated using the *intreg* command in Stata 15 IC. Given that covariates are included in the estimated model, μ is replaced with $zi\beta$ and mean WTP estimates are generated by summing the constant and the model coefficients multiplied by the mean of their respective variables, as shown in Equation 4:

$$\overline{WTP} = \beta_0 + \beta_1 \bar{X}_1 + \ldots + \beta_n \bar{X}_n \qquad (4)$$

In eliciting the respondent's WTP through the payment card approach, the respondent's WTP was assumed to be systematically distributed within the given interval. Since the respondent's true point valuation lies somewhere in the interval between the chosen value and the next higher one (Cameron and Huppert 1989), this assumption is reasonable. Under this assumption, the mean or expected WTP was computed using the predict command [predict e(a,b)] in Stata, which calculates E(xb + u | a < xb + u < b), the expected value of y|x conditional on y|x being in the interval (a,b).

The mean WTP estimate was used to compute potential benefits if the WTP would be captured by multiplying it by the average number of visitors to Calamba and Los Baños. The present value of the stream of potential benefits (assuming constant annual benefits) was obtained using the country's social discount rate of 10% (ICC 2016) and a 20-yr discounting period.

RESULTS AND DISCUSSION

Characteristics and Origins of Respondents

Initially, there were 500 online survey respondents, but eight were invalidated, leaving 492 qualified respondents. There were more female (65%) than male (37%) respondents and more single (71%) than married (23%) respondents. For education, 64% of the respondents were college graduates, whereas 21% were college undergraduates. The respondents' mean age was 29 yr, whereas the average family size was 5.6 members, which was higher than the country's average household size in 2020 of 4.1 persons per household (PSA 2022a). The respondents' average monthly personal and household incomes were PHP 29,967 and 48,650, respectively, with the latter being almost twice the country's average monthly household income of PHP 25,599 (PSA 2022b). The respondents' average monthly income falls between the lower middle-class and middle-class categories of the Philippine Institute for Development Studies as of 2022 (Peña-Reyes 2022).

In terms of provinces of origin, all respondents came from Luzon – particularly Regions I, II, III, IVA, IVB, and V, as well as the National Capital Region. Region IVA and NCR were the highest sources of respondents at 49.6% and 43.1%, respectively (Table 1). Province-wise or city-wise, Laguna had the highest number of respondents (29.3%), followed by the City of Manila (13.4%) and Cavite (11.8%). These results are consistent with the expectation that the highest number of visitors would come from Laguna, where Calamba City and Los Baños are found. The high proportion of visitors from NCR, in general, is also expected because of its proximity to the study sites. During the peak season, long vehicle queues may be observed at the Calamba Exit of the South Luzon Expressway, many of them ferrying vehicles to the resorts in Calamba and Los Baños.

Reasons for Visiting Resorts

The main reasons of the respondents for visiting the resorts in Los Baños or Calamba are for relaxation (53%), to be with family and friends (39.6%), and because of the resorts' accessibility (40%) and affordability (37.2%) (Table 2). About a fourth of the respondents went because they heard positive reviews either of a specific resort (28.3%) or the resorts in Los Baños and Calamba in general (27.4%) and for therapeutic or health reasons because of the perceived therapeutic properties of the hot water common in the pools (25%). Most visitors (81.7%) were repeat visitors, having visited resorts in the study area twice or more. The main sources of information about the resorts visited by the respondents were social media or online sites (62%) and word of mouth, with information shared by family members, friends, or members of their organizations.

Table 1. Province of origin of respondents.

Region/ Province/ City	Frequency	Percentage (%)
Region I – Ilocos	**4**	0.8
La Union	2	0.4
Pangasinan	2	0.4
Region II – Cagayan Valley	**1**	0.2
Nueva Vizcaya	1	0.2
Region III – Central Luzon	23	4.7
Bataan	1	0.2
Bulacan	15	3.0
Nueva Ecija	1	0.2
Pampanga	5	1.0
Tarlac	1	0.2
National Capital Region	**212**	43.1
Metro Manila	212	43.1
Caloocan City	37	7.5
Las Piñas City	7	1.4
Makati City	16	3.3
Mandaluyong City	6	1.2
Manila City	66	13.4
Marikina City	3	0.6
Muntinlupa City	6	1.2
Navotas City	1	0.2
Parañaque City	15	3.0
Pasay City	8	1.6
Pasig City	6	1.2
Quezon City	25	5.1
San Juan City	2	0.4
Taguig City	6	1.2
Valenzuela City	8	1.6
Region IVA – CALABARZON	**244**	49.6
Batangas	22	4.5
Cavite	58	11.8
Laguna	144	29.3
Quezon	12	2.4
Rizal	8	1.6
Region IVB – MIMAROPA	**1**	0.2
Palawan	1	0.2
Region V – Bicol	7	1.4
Camarines Sur	1	0.2
Sorsogon	6	1.2

Table 2. Reasons for visiting resorts in Calamba or Los Baños, Laguna, the Philippines.

Reason[a]	Frequency	Percentage (%)
For relaxation/ enjoyment	262	53.3
Accessible place to bring family or friends	197	40.0
Just went with family or friends	195	39.6
Affordable place to bring family or friends	183	37.2
Have heard positive reviews about specific resort	139	28.3
Have heard positive reviews about Los Baños/ Calamba resorts in general	135	27.4
For therapeutic/ health reasons	123	25.0
For educational purposes	22	4.5
Workshop/ training/ company outing	4	0.8

[a]Multiple responses

Table 3. Awareness about resort's water source.

Awareness	Frequency	Percentage (%)
Yes	259	52.6
Hot spring	129	26.2
Groundwater	36	7.3
Water district	20	4.1
Mt. Makiling	73	14.8
Lake	1	0.2
No	233	47.4
Total	492	100.0

Perception, Knowledge, and Attitude about Water Supply and Use

Over half of the respondents (52.6%) were aware of the resort's water source. Of those who knew, 26% identified hot springs, 14.8% named Mt. Makiling, and 7.3% mentioned groundwater (Table 3). In hydrology, a spring may be defined as an "opening at or near the surface of the Earth for the discharge of water from underground sources. A spring is a natural discharge point of subterranean water at the surface of the ground or directly into the bed of a stream, lake, or sea" (Britannica 2020). On the other hand, a hot spring is "also called thermal spring, spring with water at temperatures substantially higher than the air temperature of the surrounding region. Most hot springs discharge groundwater that is heated by shallow intrusions of magma (molten rock) in volcanic areas," even though some are not related to volcanic activity (Britannica 2017). These definitions confirm that the hot water many resorts use is due to Mt Makiling's being a dormant volcano.

A notable finding was that while 40.7% of respondents correctly identified pumping as the method for filling the pools, 34.1% mistakenly believed the water flowed naturally. In reality, many resorts have shifted from using naturally flowing hot springs to pumping groundwater.

The respondents' perception of groundwater supply was explored. Almost all respondents (98.4%) agreed about the importance of good forest cover in securing groundwater supply, whereas 66.7% knew that groundwater supply is not unlimited. These point to a general appreciation of the role of forests in securing groundwater supply. However, 33% of respondents perceived that the groundwater supply is unlimited regardless of how water is used, which is disturbing and may imply a need to improve citizens' understanding of water scarcity.

Prior to questions about pool water usage, respondents were provided with definitions of public (entrance or swimming fee charged) and private (entire place rented) resorts as used in this study. Among public resort visitors, 45.5% believed pool water was changed daily, and 38.4% thought it was changed weekly (Table 4). Less than 10% believed it was changed monthly (9.6%) or every few months (6.5%). Regarding desired frequency, 27% preferred water changes before each group's use, and 39% wanted daily changes. However, 17.9% opined that frequent changes were not necessary if the water was treated according to pool standards.

Among visitors to private resorts, 42.5% believed the pool water was changed daily, and 19.3% thought it was changed every 12 hours (Table 4). Regarding desired frequency, 46.5% preferred a water change before each group's use, while 23% wanted daily changes. Additionally, 16.3% felt frequent changes were unnecessary if water quality standards were maintained. During peak season, these private pools are typically rented twice daily, once from 6 AM–6 PM and again from 6 PM–6 AM.

The respondents were also asked if they knew that properly maintained and monitored pool water need not be changed in 2–5 yr. If pool water is filtered, it does not need to be replaced every year. With proper maintenance and monitoring of a pool's chemical levels and cleanliness, the frequency of water change can range from 3–5 yr (Cooper 2023). About a quarter of the respondents (23.4%) answered in the affirmative, whereas 76.6% said they were not aware. Furthermore, 67.9% of the respondents said their satisfaction would decrease if they learned that the pool water had not been changed in 2 yr, even if it was regularly maintained and properly treated. This points to the need for information dissemination about safe pool water standards.

Table 4. Respondents' knowledge and attitude about public resort pools' water usage.

Frequency of changing pool water	Public resort		Private resort	
	Freq.	%	Freq.	%
Knowledge about the frequency of changing pool water				
Just before a group of customers uses it	0	0	1	0.2
Every 12 hours	0	0	95	19.3
Every day	224	45.5	209	42.5
Every week	189	38.4	143	29.1
Every month	47	9.6	44	8.9
Every few months	32	6.5	0	0
Desired frequency of changing pool water				
Just before a group of customers uses it	133	27	229	46.5
Every day	192	39	113	23
Every week	57	11.6	52	10.6
Every month	22	4.5	18	3.7
Does not have to be frequently changed as long as water is treated following swimming pool standards	88	17.9	80	16.3

Willingness to Pay (WTP) for Groundwater Conservation

The bid amounts used in the survey are PHP 0, 10, 20, 30, 40, 50, 60, 70, 80, 100, 120, 140, 150, 160, 180, 200 and > 200 per visit. A total of 488 respondents selected an amount greater than 0 from the payment card presented to them to represent their true WTP for the conservation of the groundwater resource of Mt. Makiling (Figure 3). The respondent's true "point" valuation is inferred to lie between the selected bid amount and the next highest option (Cameron and Huppert 1989). Similar percentages of respondents chose PHP 50/visit (25%) and PHP 100/visit (25.81%), with PHP 20/visit being the next most common choice (11.2%). Only four respondents (0.81%) indicated a zero WTP. As Boyle (2017) noted, payment cards avoid a spike of zero values as respondents tend to provide a specific monetary value. Furthermore, 8.1% chose the highest bid amount of PHP 200/visit. None of the respondents revealed a WTP greater than PHP 200/visit, which may imply that the highest WTP was captured by PHP 200/visit, or the respondents were limited by the amounts presented and did not consider the > PHP 200/visit choice. The mean WTP of PHP 75/visit was predicted using the conditional expected value method. Morrison *et al.* (2019) note that the payment card approach tends to give a more conservative estimate of WTP than, for example, the referendum model.

The interval regression model is highly significant at a 1% level of significance ($Pr > \chi^2 = 0.0026$) (Table 5). Interval regression results indicate that age and water-conserving behavior were significant predictors of WTP at the 5% level (Table 5). The inverse relationship between age and WTP suggests that younger individuals exhibit a higher WTP. This is similar to the finding of Mamboleo and Adem (2022) that younger people had higher WTP for wetland conservation in Lake Victoria mainly because younger people in the area tended to have more education than older people. Ureta *et al.* (2024) also found that respondents' likelihood to pay for water quality improvement in South Carolina, United States, decreased with age. This was related to respondents' degree of non-consumptive water use, *i.e.* young and middle-aged residents are more engaged in water-based recreational activities and were thus more likely to support interventions that would enhance recreational use. The findings of Mumbi and Watanabe (2021) were also similar to the study, which revealed that the younger population is more likely to have a higher WTP because they are optimistic about the possibility of addressing the water pollution and restoring Sosiani River in Eldoret, Kenya.

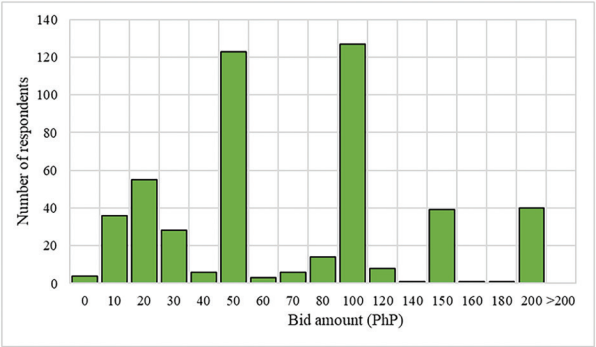

Figure 3. Amounts selected by respondents representing their true WTP using the payment card format.

Table 5. Results of the interval regression model.

Variable name	Coefficient	Standard error	z	P > z	Marginal effect (dy/dx)
sex	0.18494	5.57	0.03	0.974	0.185
age[a]	–0.80238**	0.38	–2.09	0.037	–0.802
cs	7.19330	7.25	0.99	0.321	7.193
educ	5.82005	6.09	0.96	0.339	5.820
members_no	–1.66052	1.10	–1.51	0.132	–1.661
hh_inc	0.00011	0.00	1.60	0.109	0.000
know_forest	–16.48670	21.43	–0.77	0.442	–16.487
know_groundwater	0.50245	5.75	0.09	0.930	0.502
behave1[b]	–27.22951**	11.22	–2.43	0.015	–27.230
_cons	105.2004	28.23	3.73	0.000	
/lnsigma	4.066777	0.03	117.93	0.000	
sigma	58.36856	2.01			

**Significant at 5%
LR $\chi^2(9) = 25.31$
Log likelihood = –1487.1694
Prob > $\chi^2 = 0.0026$
[a]Age (in years) of the respondent
[b]Behavior: [0] respondent does not practice water conservation consistently; [1] respondent practices water conservation consistently

Interestingly, respondents who do not consistently practice water conservation demonstrated a higher WTP. Conversely, those who already engage in water-conserving behaviors showed a lower WTP, possibly reflecting costs they have already absorbed for their current practices. This result may differ from the findings of some studies that have examined the impact of behavior on WTP. For instance, Vicente *et al.* (2021) found that WTP for improved environmental quality is positively influenced by perceived behavioral control and environmental activism. However, the study also noted that pro-environmental behaviors, such as practicing waste management, water conservation, reuse, and green purchasing, do not significantly impact the willingness to incur additional costs in support of the environment. Similarly, the studies of Kang *et al.* (2012) and Islam *et al.* (2022) indicate that higher levels of environmental concern, attitudes, and behaviors are associated with a higher WTP. A person's WTP decreases by 0.802 for each year of increase in age, as shown by the marginal effect of age (–0.802). Similarly, consistent water conservation practices are associated with a 27.23 decrease in WTP compared to those who do not consistently conserve water.

Debriefing questions were asked to determine the respondents' understanding of the questions, the results of which are summarized in Table 6. About 84% of the respondents agreed or completely agreed that the conservation of Mt. Makiling would enhance groundwater supply, whereas 78% agreed and completely agreed that recycling pool water would help conserve groundwater supply. Finally, 75% of respondents agreed or completely agreed that the scenario regarding the groundwater conservation program used in the CV survey was plausible. For all three questions, there were more respondents who completely agreed than only agreed.

Reasons for Willingness to Pay (WTP)

The primary motivation for WTP was a desire to contribute to groundwater conservation on Mt. Makiling (82.2%), followed by the belief that this resource is finite (52.3%). Only 28.2% of respondents viewed current resort water use as wasteful. Conversely, the four respondents with zero WTP cited disbelief in resource limitations (2), affordability concerns (1), and the opinion that they should not pay for pool water recycling (1).

Potential Benefits of Capturing WTP

Using the mean WTP of PHP 75/visit, potential benefits were calculated for a proposed ordinance requiring a water user fee. This fee would be split, with 50% allocated to pool water quality maintenance and 50% to Mt. Makiling conservation. The estimated benefit was determined by multiplying the mean WTP by the average number of resort visitors. Calamba's three-year average (2013, 2014, and 2018) was 2,015,124 visitors/yr, whereas Los Baños averaged 111,821 visitors/yr over 6 yr (2013, 2015, 2016, 2017, 2018, and 2019).

Based on average annual visitor numbers of 2,015,124 for Calamba and 111,821 for Los Baños, estimated

Table 6. Agreement to statements about Mt Makiling and groundwater supply.

Statement	1		2		3		4		5		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
The conservation of Mt. Makiling will enhance groundwater supply	24	4.9	2	0.4	54	11	120	24.4	292	59.4	492	100
Recycling pool water will help conserve groundwater supply	25	5.3	7	1.4	76	15.5	161	32.7	222	45.1	492	100
I found the scenario regarding the groundwater conservation program plausible	18	3.7	3	0.6	100	20.3	162	32.9	209	42.5	492	100

[1] completely disagree [2] disagree [3] indifferent or neutral

[4] agree [5] completely agree

potential benefits were PHP 151.13 million/yr and PHP 8.39 million/yr, respectively. Combined, capturing visitor WTP in Calamba and Los Baños resorts could generate PHP 159.52 million annually. Assuming constant annual benefits, this translates to a present value of PHP 1.358 billion at a 10% discount rate over a 20-yr discounting period. This present value can be used to decide policy options that will contribute to the conservation of Mt Makiling's groundwater resources. Following the CV scenario, 50% of the annual potential revenue, or PHP 79.76 million/yr, can be allocated for the improved management of Mt Makiling, and the same amount can be used to promote pool water conservation practices among resorts.

Insights into Implementing an Online CV Survey

The implementation of the online CV survey faced some limitations. The team did not have the opportunity to ask follow-up or probing questions. In terms of the reach of the survey using Facebook, those who answered the survey were likely Facebook users who encountered the team's posts and advertisements during the survey period. It is also possible that most of the respondents who answered the survey were those who were heavy users of Facebook, were interested in answering online surveys, and were familiar with Microsoft Forms. According to a Pulse Asia Survey conducted in September 2021 (Malig 2021), Facebook remains a dominant social media platform among internet users in the Philippines, particularly in Metro Manila and Luzon. A significant portion of these users utilize the internet to consume content of their interest.

The challenge of ensuring that respondents have visited resorts in the study area was addressed by asking the respondent to indicate the name/s of the resort/s in Calamba and/or Los Baños visited in 2019. However, this was not required to be able to proceed to the next question, as the team considered the possibility that the respondent may have forgotten the name of the resort. The instruction for prospective respondents also specified that there should only be one respondent per household. The team closely monitored responses and saw that there were multiple submissions with similar patterns of responses. They used the same digital wallet number, which resulted in dropping these respondents. This shows that some people did not take the survey seriously and instead saw it as an opportunity to earn money through their digital wallet accounts.

CONCLUSIONS AND RECOMMENDATIONS

The results of the study reveal that only a small proportion of respondents were aware that most resorts pump groundwater for their pools and other uses and that most of them prefer frequent pool water change. The mean WTP estimated using the payment card format was PHP 75/visit. Most respondents were willing to pay, primarily because they wanted to support the conservation of Mt. Makiling's groundwater resources and recognized its limited availability. In contrast, a few respondents were unwilling to pay, as they did not believe the groundwater supply was limited, found the additional cost unaffordable, or felt they should not be responsible for covering the expenses of properly recycling pool water.

Capturing visitors' WTP to resorts in Calamba and Los Baños could generate PHP 159.52 million annually, with a present value of PHP 1.358 billion over a 20-yr period at a 10% discount rate. These funds could support the enhanced management of Mt. Makiling and help resorts implement water conservation measures while

maintaining pool water quality at international standards, reducing unnecessary and excessive water disposal.

The study recommends developing and implementing a strengthened information, education, and communication program. This initiative should target resort owners, the public, and local and national government officials to raise awareness about the increasing groundwater scarcity in Mt. Makiling and other parts of the country. Additionally, resort owners should be informed about the importance of proper pool maintenance to minimize frequent and unnecessary water replacement. In contrast, resort visitors should be educated on how pool water can meet international quality standards without excessive water use. Lastly, the study suggests formulating policies incorporating visitors' WTP to support groundwater conservation efforts.

ACKNOWLEDGMENTS

We sincerely appreciate the support of the Foreign Assisted and Special Projects Service of the DENR for funding this project. We are also grateful to the Local Governments of Calamba City and Los Baños, DENR Region IV-A, and the Makiling Center for Mountain Ecosystems (MCME) for their assistance. Furthermore, we thank the anonymous reviewers for their valuable comments and suggestions, which have helped improve the quality of this paper.

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