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A Ridge-to-Reef Ecosystem-Based Valuation Approach to Biodiversity Conservation in Layawan Watershed, Misamis Occidental, Philippines

ABSTRACT

Ecosystem services commonly valued by the society usually pertains to marketable ecosystem services while non-marketable ecosystem services, such as biodiversity, are usually left unaccounted for, making it less priority and beset with problems such as insufficient funding for conservation activities. Low appreciation on the economic value of these ecosystem services has led to overutilization, causing negative impacts to the environment. This study aimed to estimate the value of a non-marketable ecosystem service, biodiversity, through household's willingness to pay for its conservation activity in Mt. Malindang Range Natural Park (MMRNP) Layawan Watershed. Similarly, a comparison between a "holistic" and "habitat-exclusive" management approaches was done to determine the best management strategy for implementing a sustainable financing mechanism. An average willingness to pay for R2R biodiversity conservation of PhP 43.58 (USD 0.90) per household per month for five years as compared to PhP 33.02 (USD 0.68) per month from an exclusive Upland ecosystem conservation approach and PhP 30.39 (USD 0.62) per month from an exclusive Coastal ecosystem conservation approach. Therefore, a Ridge-to-Reef approach on biodiversity conservation showed significantly higher willingness to pay from households as compared to habitat-based approach. The R2R approach could eventually generate PhP 7.5 M annually.

Key words: *valuation, payments for ecosystem services (PES), watershed, willingness to pay, ridge to reef*

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INTRODUCTION

Impacts of climate change are rapidly materializing and being felt in many areas around the globe. Ecosystem plays a critical role in addressing climate change. It provide services to mankind in the form of natural resources, therefore rehabilitation, conservation and management of ecosystem services should be a priority in dealing with climate change issues. Due to the rapid global development, ecosystem services are becoming scarcer which were previously provided by nature for free (*Wunder 2005*). Furthermore, decreasing natural resource and ecosystem services increases the vulnerability to the impacts of climate change. The Philippines is highly vulnerable to climate change impacts due to low adaptive capacity of human system, geographical feature, low level of economic development, and exposure exacerbated by poor access to natural resources (*Jabines and Inventor 2007*). The Philippines had been ranked as the 5th most vulnerable country to the impacts of climate change based from the Long-Term Global Climate Risk Index 2015 developed by Germanwatch (*Kreft, et al. 2014*). The report also mentioned that according to the Fifth Assessment Report of Intergovernmental Panel on Climate Change (IPCC), the risks associated with extreme events will further increase due to rising temperatures (*Kreft, et al. 2014*); which is also due to overextraction and degradation of natural resources for economic development.

In the Philippines, degradation of natural resources is rampant and a major threat to Philippine biodiversity and ecosystem services. The Philippines is one of the mega-biodiversity countries in the world according to United Nations World Conservation Monitoring Center (UNEP-WCMC). Unfortunately, the country is also one of world's top biodiversity hotspot due to increasing human population, resource demand, habitat destruction and unsustainable development (*Jabines and Inventor 2007*). The common causes of habitat degradation and biodiversity loss in the country could be attributed to indiscriminate

logging and mining, overharvesting of resources, and infrastructure development (*New Conservation Areas in the Philippines Project [NEWCAPP] 2009*). In addition, environmental policies made become focused on certain areas and bounded by administrative jurisdiction through ordinances. However, the effects of degradation of ecosystem as much as the benefits that it provides are transboundary; hence, on a watershed level. A watershed is an area of land, bounded by a hydrologic system that drains to a common waterway, such as stream, lakes, estuary, wetland, aquifer, or even the ocean (United States Environmental Protection Agency [USEPA]); therefore from ridges to the reef or referred in this study as a Ridge-to-Reef (R2R) approach.

Overall, the underlying threats from these activities could be traced back from weak enforcement, low risk of punishment to illegal-activities, under-valuation of non-monetary values of natural resource, and the lack of a holistic approach in environmental management. These issues could be further traced back to insufficient funding allocation for conservation areas.

Traditional financing sources from grants and national budget allocation do not suffice to sustain effective management of resources (*Lasmarias 2012*). Therefore, innovative approaches on promoting sustainable financing mechanism are necessary for conservation of natural resources. However, these approaches would also result to tradeoffs to communities which should be considered in the implementation of the scheme. Particularly, communities will not engage to conservation activities if they do not see an equivalent incentive, in exchange for their previous economic activities, as this is critical for their household's survival. This insight become the precedent for the growing interest in sustainable financing mechanisms such as the Payments for Ecosystem Services (PES) which recognizes the trade off of using ecosystem services with corresponding compensation (*Ureta et al. 2014*). PES promises a plow back of financial resources to sustain conservation efforts of communities and an opportunity for poverty reduction since conservation activities will be treated as income generating potential (*Lasmarias 2012*). Furthermore, PES addresses the lack of holistic management as it naturally binds together the stakeholders in an agreement concerning the welfare of all parties involved.

Payment for ecosystem services (PES) is an emerging sustainable financing mechanism that has been adopted in several countries such as in Latin America and Asia, including the Philippines (*Padilla et al. 2005*). For instance, La Tondeña Distillery engaged local communities to reforest and rehabilitate denuded lands in Mt. Kanlaon. In exchange, the company trained communities in Agroforestry practices which will yield profit for the community in the future. Similarly, Peñablanca Landscape and Seascape in Cagayan collected a portion of tourism fees for upland communities with a task to protect and conserve the watershed (*Amponin et al. 2007*). According to Sven Wunder (2005), PES should follow 5 principles: voluntary transaction; well-defined environmental service; there is at least one ES buyer; there is a minimum of one ES provider; and if and only if the provider continues to supply the ecosystem service (*Wunder 2005*). The PES framework suggests that recipients of the ecosystem services should support stakeholders that could maintain the continuity of the ecosystem services by protection and conservation of the ecosystem. The support that recipients provide should compensate for the trade off of suppliers in maintaining the ecosystem (*Ureta et al. 2014*). However, due to the voluntary nature of PES, both the amount of contribution from the recipients and the trade off of suppliers is usually unknown and difficult to be quantified. Therefore, one of the initial steps in establishing PES includes economic valuation methodologies for monetizing environment and natural resources.

Ecosystem services are usually valued only through its direct use or the provisioning services therefore many have not realized the overall value that the ecosystem service provide. Therefore, this leads to government programs prioritizing infrastructure development and other sectors rather than environmental and ecosystem service conservation. Other types of services such as supporting, regulating and cultural are often less appreciated and undervalued. Undervaluation of the ecosystems tends to lead to faster degradation compared to the rate of ecosystem recovery.

Ecosystem services can also be classified into use values and non-use values. Use values, which can be further sub-classify into direct or indirect, are ecosystem service values based on actual use, while Non-use values are ecosystem service values based on not associated to actual use (www.ecosystemvaluation.org). Although valuation methodologies have been used since the 1960's to place values on environmental goods and services (*Carson et al. 2001*) using market-based valuation methods, these are more focused on use values. On the other hand, the non-use values are often left unaccounted for since there are no direct proxy that can estimate its value unlike the use values. Hence, non-use values are normally treated as zero which makes the ecosystem service undervalued. Biodiversity, variation of living organisms on earth, is a complex ecosystem service which involves both use and non-use values. Therefore, approximating the value of biodiversity using market based valuation methods will yield an undervaluation of the

ecosystem service.

The alternative method in valuing non-marketable goods is through the use of stated preference methods, such as the Contingent Valuation Method (CVM). The method elicits the stated preference of the respondents to quantify their willingness-to-pay (WTP) for an environmental good or service (*Wedgwood and Sansom 2003*). Unlike the revealed preference approaches where willingness-to-pay are inferred base from actual amounts revealed by respondents in consuming or paying for a good or service in the market; stated preference such as CVM relies on the amount that the respondent will be willing to pay for a hypothetical scenario that will be implemented as a contingent or alternative to the status quo. Therefore, since revealed preferences need actual amount from respondents, estimating a value for non-marketable goods and services, and indirect uses of ecosystem services – such as biodiversity - becomes a challenge. On the other hand, since contingent valuation method uses the preference stated by respondent in response to a hypothetical scenario, this becomes an advantage in valuing non-marketable goods and services, and effects of indirect uses of ecosystem services. Understanding the impacts of non-marketable goods and services, and indirect uses of ecosystem services could affect the decision on the amount that the respondent is willing to pay in order to reach a situation where he will be satisfied contingent to the implementation of an intervention. However, the principal drawback of stated preference methods is that they may not correspond to the actual preference of the respondent (*Bonsall, 1983 as cited by Wardman 1988*). It was only until 1992 that the stated preference methods were conformed to be an alternative of the revealed preference valuation methods (*Hoyos and Meriel 2010*) which makes it relatively new and still subject for academic discussions. Despite the disadvantage of stated preference methods, few studies in the Philippines have already used the contingent valuation method. In 2005, Calderon et al. estimated water user fees for the households of Metro Manila. Similarly, *Amponin et al.* (*2007*) estimated the willingness to pay of domestic water users for watershed protection in Tuguegarao City.

Willingness to pay studies has become a basic tool for establishing sustainable financing mechanisms such as Payment for Ecosystem Services. Determining the baseline values of the ecosystem service is an initial step for establishing sustainable financing mechanisms, hence willingness to pay estimates, whether by revealed preference or stated preference approach, has become a basic tool inestimating the values of ecosystem services. Furthermore, other uses of valuation of ecosystem services can be utilized for policy making such as fees, pricing, and taxation for conservation and protection efforts for the environment.

This study compares the two management approaches of biodiversity conservation- Ridge-to-Reef and habitat-exclusive. Specifically, the paper aims to identify the activities necessary for biodiversity conservation of Layawan Watershed in Mt. Malindang Range Natural Park. Moreover, it seeks to value the identified conservation activities per habitat (i.e. upland, coastal) and for the watershed as a whole using CVM. Lastly, the paper aims to recommend a PES approach that could generate higher monetary value. The results of this study could be used in developing a holistic PES scheme in Layawan Watershed.

MATERIALS AND METHOD

Study Site

The study was conducted in the households of Oroquieta City, in Misamis Occidental (**Figure 1**). Oroquieta City, located in Northern Mindanao, is the capital of Misamis Occidental with a total land area of 26,393.46 ha and an estimated population of 68,945 since 2010 (Philippine Statistics Authority). The town of Oroquieta was inaugurated as a chartered city since January 1, 1970 under R.A. 5518 (City Government of Oroquieta). The city is also one of the political boundaries that have jurisdiction over a portion of the Mt. Malindang Range Natural Park (MMRNP) in which the entire Layawan Watershed is covered.

The Mt. Malindang Range Natural Park (MMRNP) covers the provinces of Misamis Occidental, Zamboanga del Norte and Zamboanga del Sur with a total area of 34,000 ha and the highest peak at 2,402 masl (*Dingal and Balcita 2001*). It was declared as one of the country's ASEAN Heritage Park on August 4, 2012 by the ASEAN Centre for Biodiversity (ACB).

The Layawan watershed is located within the province of Misamis Occidental with the headwater lie atop MMRNP and the river mouth in Oroquieta City. Specifically, the watershed lies within 8.28139N and 8.52250N latitude; and 123.61778N and 123.82028N longitude, and a total land area of 10,706 ha which covers 33 barangays. The majority of the upland area of the watershed is covered by natural forest while the lowland area is used for agricultural production. Furthermore, a tribal community, the Subanen tribe, has been granted an ancestral domain claim which comprises 6,610 ha wherein a portion lies within the strict protection zone inside the Layawan watershed. The Layawan watershed is the major source of water for the city of Oroquieta which they use for drinking, domestic consumption, and irrigation. Oroquieta City households heavily rely on the Layawan watershed and Mt. Malindang Range Natural Park's ecosystem services.

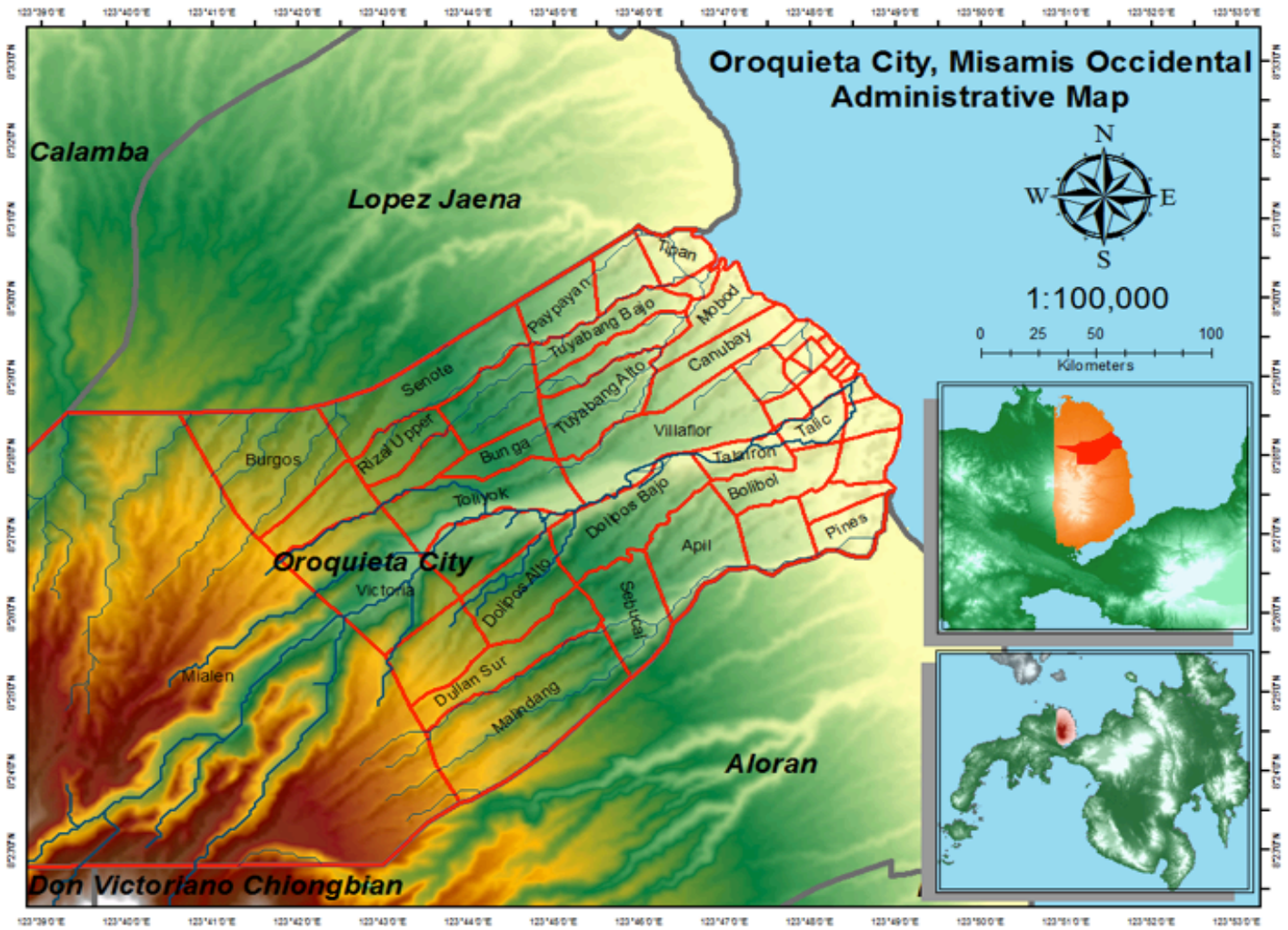

Figure 1. Location Map of Oroquieta City, Misamis Occidental.

Sampling Procedure

A survey was conducted in 900 sample households in Oroquieta City which were split equally into three subsamples to represent CV scenarios of different biodiversity conservation activity approaches– a biodiversity conservation approach to be implemented exclusive for the upland ecosystem of Mt. Malindang Range Natural Park; a biodiversity conservation approach to be implemented exclusive for the coastal ecosystems of Iligan Bay; and a holistic biodiversity conservation approach that will be implemented for the Layawan watershed or a Ridge-to-Reef approach on biodiversity conservation. In order to maintain the equal probability in choosing the respondents per subsample, all respondents were randomly chosen through a simple random sampling from the list of residents that has access to water through the water district. The Oroquieta City Water District is the largest distributor of water which covers almost 90% of the population, hence, covering majority of the beneficiaries of the ecosystem service. Overall, among the 900 households that were included in the survey, only 817 respondents were successfully processed. The decrease was due to the data which lacks substantial responses due to difficulty in terms of providing answers in the interview which were considered "bad data".

The target respondents for the household survey were the household heads or any member that were involved in decision-making for finances. The household survey was administered to the household head or any member that was involved in household budgeting. Only one member of each household was interviewed.

Survey Design

The study made use of a four part survey questionnaire which consists of: the baseline information, status quo and current conservation framework, CV scenario for biodiversity conservation activities, and household demographic information.

The first section elicited baseline information from the respondents in terms of their awareness towards the meaning of a watershed, ecosystem services, and the status

of their environment and natural resources. Additionally, perceptions on willingness to participate on potential environmental conservation and protection activities were elicited in this section. On the other hand, the second section dwells mostly on the respondent's awareness on the current issues, threats, and policies for environment and the status of the natural resources in the Layawan watershed. This section also provides respondents with further explanation on ecosystem and its interconnectedness, ecosystem services, and status quo on available finances for environmental conservation and protection. In the conduct of the elicitation, it is important that further explanation of the issues and topics at hand are explained thoroughly after the baseline information is gathered. This is to ensure that all respondents within the subsample are leveled off and have similar understanding on the current pertaining issues. However, this procedure has to be conducted only after the baseline information was already elicited during first section and initial parts of the second section.

The third section focuses on the contingent valuation (CV) scenario. Each subsample was presented different CV scenarios which were based from the results of a focus group discussion. The respondents in each subsample were carefully informed of a hypothetical scenario wherein a program for biodiversity conservation, enumerating the specific activities, is to be implemented, specifically to the category they belonged to; however, at a specific cost. In addition, other essential elements of CVM such as: the framework of the proposed PES program including the institutional arrangements and possible payment mechanism; underlying assumption which supposes that they are paying the average water rate of PhP 254; and an emphasis for the respondents to focus their decision only to the impacts of their household - were included in this section. Although each subsample has different proposed biodiversity conservation activities, specific to the category that they belonged to, all other elements in the CV scenario are the same for all subsamples. Once careful explanation of the contingent valuation scenario was made, the respondents were asked to cast his/her vote for a referendum on increasing the price of the average water bill per month for the next five years. The price increase will be used for the specific biodiversity conservation activities presented to the respondent which were explained in the earlier section of the questionnaire and depending on the subsample that the respondent belonged to. The additional price in the water bill indicates the respondents' willingness-to-pay for the specific biodiversity conservation activities for that particular scenario. The price indicated in the referendum changes per respondent which depends on the assigned bid amount. Lastly, the fourth section of the questionnaire elicits the reasons of the respondent on their vote as well as household demographic and socio-economic profile.

Trained enumerators which conducted the elicitation made use of multicolored images in relaying concepts, framework, and the proposed biodiversity conservation activities in order to carefully explain the status quo and contingent valuation scenario. A training of enumerators was also carefully conducted prior to the survey proper in order to orient the enumerators on properly conducting the survey. A pre-test for 50 households was also done to validate the soundness and completeness of the questionnaire as well as determine the bid amounts by identifying the choke prices of the households' maximum willingness to pay. The pre-test yielded a result of P10 per month as the minimum willingness to pay and P180 per month as the maximum willingness to pay. The final bid amounts used in the study were set to 10, 50, 100, 150, and 200 per month as an addition to their current water bill.

The study made use of a dichotomous choice elicitation method in estimating the respondent's willingness-to-pay through a referendum on increasing the price of water bill per month for the next 5 years. The respondents have to answer whether they are in favor or not in the referendum.

Data Analysis

In estimating the MWTP, the study focuses on using the Hicksian approach of evaluating welfare change. The Hicksian approach could be differentiated into two: the compensating variation approach which is a welfare change analysis keeping the individual's utility to its initial level (U_0); and the equivalent variation approach which is a welfare change analysis in maintaining the individual's utility to his final level of utility (U_1) (*Bateman 2000*). In the case of the study, the referendum on increasing the water rates as their willingness to pay for biodiversity conservation indicates an improvement of their utility from the current (U_0) to the final (U_1). The hypothetical scenario proposes specific activities which aim to improve environmental quality where participants are asked to respond in a referendum.

In order to understand further, let U0 be the status quo where the utility of the respondent if there are no improvement, while U1 is the utility of the respondent if there are improvement. Therefore, the utility of the respondent at status quo could be defined as:

$$U_0 = U(y_0, x_0, q^0, E_0) \quad (1)$$

While the utility of the respondent if there are improvement could be defined as:

$$U_1 = U(y_1, x_1, q^1, E_1) \quad (2)$$

Hence, we can combine the utility function of individuals to be:

$$U_{ji} = U(y_i, x_i, q_j, E_i) \quad (3)$$

Where j= 1,0 which refers to the two state of the environment depicted by the respondents' answer to the referendum whether they agree to pay or otherwise – 1 is willing to pay for the proposed improvement while 0 is not willing to pay; i = 1,2,…,n refers to the number of respondents hence U_{0i} and U_{1i} represent the utilities of the respondents who are willing to pay or otherwise; y_i is the ith income, x_i is a vector of characteristics of respondent i; and q_j is the quality of the good being valued, in this case, the proposed intervention of biodiversity conservation activities. Therefore, the respondent will answer "Yes" to the referendum at a specific bid amount (b_i) will be based on the condition that:

$$U_1(y_1, x_1, q^1, E_1) > U_0(y_1, x_1, q^0, E_1) \quad (4)$$

Equation (4) explains that the respondent will agree to the referendum if his utility in the improved level exceed the previous utility at status quo. Note that y_1 should be net of the current income and the specific bid amount (b_i). Therefore the probability for the respondent to say "Yes" to the referendum is given by:

$$\text{Pr (Yes)} = \text{pr}[U_1(y_1 - b_1, x_1, q^1, E_{1i}) > U_0(y_1, x_1, q^0, E_{0i})] \quad (5)$$

Assuming a separable utility function:

$$U_j(y_1, x_1, E_{ji}) = R_1(y_1) + E_{ji} \quad (6)$$

Therefore, given function (6), the probability of the respondent to answer YES is:

$$\text{Pr (Yes)} = \text{pr}[R_1(y_1 - b_1, x_1, q^1) + E_{1i} > R_0(y_1, x_1, q^0) + E_{0i}];$$

$$\text{Pr (Yes)} = \text{pr}[R_1(y_1 - b_1, x_1, q^1) - R_0(y_1, x_1, q^0) > E_{0i} - E_{1i}]; \quad (7)$$

While the probability of the respondent to answer No is:

$$\text{Pr (No)} = 1 - \text{Pr (Yes)} \quad (8)$$

Given equations (7) and (8), if the preferences are assumed linear to income y, then the model can be simplified as:

$$R_{1j}(y_1) = \alpha x_1 + \beta(y_1) \quad (9)$$

Where y_i is the respondent's income; x_i represents a vector of characteristics of the household; and α is a vector of parameters. Hence the probability of the respondent answering to the valuation question is given by:

$$\text{Pr (Yes)} = \text{pr}[\alpha x_1 + \beta b_1 + E_1 > 0]; \quad (10)$$

Assuming that the error term is normally distributed $e = E_1 - E_{1i}$ and $f(chR)$ as the cumulative distribution function of e, then the probability of the individual is given by:

$$\text{Pr (Yes)} = f(chR); \text{ and Pr (No)} = 1 - f(chR);$$

$$chR = R_1(y_1 - b_1, x_1, q^1) - R_0(y_1, x_1, q^0) \quad (11)$$

Assuming Pi as the actual unobservable WTP, from the assumed WTP function we get:

$$\text{Pi } \alpha x_1 + \beta(y_1) = \alpha_0 x_1 + \beta y_1 + E_1$$

$$= \alpha_1 x_1 + \beta(y_1 - b_1) + E_{1i}$$

$$= \alpha_1 x_1 + \beta(y_1 - WTP_1) e_i$$

Hence:

$$\text{WTP}_1 = (\alpha_1 x_1 + \beta y_1 + e_i) / \beta \quad (12)$$

In this case, if the actual WTP of the household is P_i with a linear relationship to bid and other variables, then the estimated WTP can be presented as:

$\text{WTP}_1 = 1$ if $P_1 > b_1$ and $\text{WTP}_1 = 0$ if $P_1 < b_1$, hence a Logit model:

$$\text{WTP} = \alpha + \beta_i BidAmount + \beta_i CCons + \beta_i UCons + \beta_i WTPCA + \beta_i Certainty + \beta_i HHsize + \beta_i IncomeLevel1 + \beta_i IncomeLevel2 + \beta_i IncomeLevel3 + \beta_i IncomeLevel4 \quad (13)$$

Where *BidAmount* is the additional amount to be included in the water bill as contribution for the implementation of the biodiversity conservation activities; *CCons* represents respondents that only answered coastal conservation; *UCons* represents respondents that only answered upland conservation; *WTPCA* is the respondents willingness to participate with or without constraints; Certainty is the respondent's level of commitment in his answer with 1 being the lowest and 5 being the highest; *HHsize* is the number of people in the household of the respondent; *IncomeLevel 1* is a dummy variable depicting respondents with income from 12501-25000; *IncomeLevel 2* is a dummy variable depicting respondents with income from 25001-37500; *IncomeLevel 3* is a dummy variable depicting respondents with income from 37501-50000; *IncomeLevel 4* is a dummy variable depicting respondents with income greater than 50000;

The mean willingness-to-pay of the respondents for biodiversity conservation activities is estimated by:

$$MWTP = 1*[(Y - \beta(X_{BID})* X_{BID})/\beta(X_{BID})] \quad (13)$$

The variable MWTP is the estimated mean willingness to pay of a respondent. On the other hand, Y is the predicted probability from the logit model, while β is the coefficient of the BID variable, and X_{BID} is the bid amount which reflects the proposed amount that the respondent would pay for the proposed biodiversity conservation activities in addition to their current bills.

A scope test was conducted by comparing the estimated mean willingness to pay per subsample to evaluate if there is a significant difference between the mean estimates per subsample set. This tests the consistency of the results to the hypothesis of the study that respondents have greater value for a holistic R2R approach biodiversity conservation activities as compared to a habitat based which is exclusive to just one ecosystem focus. A wholistic management approach would provide more benefits, hence higher willingness to pay of the recipients, as compared to a simple summation of two or more habitat exclusive approaches, which have lower willingness to pay.

RESULTS AND DISCUSSIONS

Socioeconomic profile of respondents

Although the household heads were the target respondents of the survey, results show that majority of the respondents were females (60%). However, this was not indicative of prevalence of female household headship in the study site. Men were usually working during the time of interview; hence their wives were interviewed instead. Wives were also involved in household budgeting and were qualified to participate in the survey.

The respondents' mean age was 50 years old. Most of them had attained secondary education (40%), while 12% had no formal education. Most of them were locally employed (32%) or self-employed (24%). On the other hand, some were dependent on remittances (11%), while others were unemployed (33%). Wives accounted for most of the unemployed residents. Despite having no sources of income, they cited that they were involved in managing the household budget.

On the average, each sample household had four members and a household monthly income of the PhP 13,626.00. This reflects that most of the households were living above the national poverty threshold of PhP 6,312.00 per month for a family of four (*National Statistics Coordination Board [NSCB] 2012*). Moreover, their average household income was still above the regional poverty threshold and provincial poverty threshold of PhP 6,445.00 and PhP 6,042.00 for a family of four, respectively (*NSCB 2012*).

Identification of biodiversity conservation activities and development of Contingent Valuation scenario

The Focus Group Discussion highlighted the problems of upland, lowland, and coastal communities. Lack of economic opportunities and access to new technology forced upland communities to shift to current unsustainable farming practices such as *kaingin*. Some areas had also been converted to agricultural lands. Similarly, the respondents admitted that there had been occurrences of timber poaching in the upland for charcoal making and cutting of lumber, which they perceived causes high erosion rate. In the same manner, respondents from the upland also observed that the abundance of flora and fauna species had changed. For instance, they observed a decrease in the frequency of sightings for tarsier, wild pigs, and the Philippine eagle. Consequently, eroded soils clogged the drainages and irrigation canals resulting to flooding in some low lying areas. Sediments deposited in the irrigation canals made the canals shallow, hence, water overflowed out of the irrigation system instead of flowing to the fields. In addition to the clogged drainages due to sedimentation, quarrying of the river banks and improper disposal of domestic and agricultural wastes also had been aggravating the flooding situation.

The respondents from the coastal area acknowledged that one of the possible reasons behind declining fish catch was poor quality of corals caused by sedimentation from upland to lowland. In addition, other causes identified were mangrove poaching resulting to destruction of breeding grounds of juvenile fish species, use of illegal fishing methods that damage corals, and encroachment of commercial fishing vessels that add to the tight competition to marine resources.

In response to the highlighted problems of the communities, the FGD also solicited potential activities or management approaches to address the current issues, specifically on biodiversity conservation. The recommendation of the upland community included the development of a Forest conservation program that support continuous reforestation and biodiversity conservation activities; provision of alternative livelihood from charcoal making and promotion of agroforestry and other sustainable farming practices; and enhancement of monitoring and law

enforcement against illegal logging and poaching by providing adequate support to forest guard volunteers, i.e. insurances and equipments. Similarly, for coastal communities, the suggestions were: to develop an enhanced mangrove conservation program which includes rehabilitation and expansion of the current mangrove sanctuary; to craft a comprehensive coastal ecosystem management approach to conserve seagrass and other coastal resources; and enhancement of coastal monitoring and law enforcement against commercial fishers which aggravates the declining fish catch in Iligan Bay. Finally, in both cases, a provision of information and education campaign was included to inform all stakeholders of the programs and its significance.

The suggested programs became the basis for the contingent valuation (CV) scenario of the study. For the respondents within the subsample of Upland habitat conservation approach, the scenario only presented the suggested programs for upland conservation activities– forest conservation, reforestation, strict enforcement of laws. On the other hand, for the respondents within the subsample of Coastal habitat conservation approach, the scenario presented only those that were identified specifically for coastal biodiversity conservation. Finally, for the respondents within the subsample of R2R, all activities included from Upland and Coastal habitat conservation was presented as a holistic R2R approach to biodiversity conservation.

Factors affecting the willingness to pay of households

The logit regression analysis showed the statistically significant variables that affect the respondents' willingness to pay or contribute to the conservation activities. These included BidAmount; CCons; UCons; WTPCA; Certainty; Hhsize; IncomeLevel1; IncomeLevel2; IncomeLevel3; and IncomeLevel4 (**Table 1**).

The BidAmount or the proposed additional amount to be included in the water bill poses a highly significant negative relationship with the respondents' willingness to pay. This indicates that as the Bid Amount increases by 1 unit, in this case in terms of Philippine Peso, the respondents' willingness to pay also decreases by a marginal effect of 0.3%. The willingness to pay of the individual is expected to decrease since the tradeoff becomes higher as the price increase.

Given that respondents were randomly selected per subsample, it could be infer that the type of conservation activities would also affect the probability of their decision to agree to the referendum, hence affecting their willingness to pay. However, it could also be possible that the respondent would be willing to pay the bid amount for the conservation of other habitat (i.e. coastal, upland, R2R). However, that will entail a double bound CVM analysis. The study only adopted a single bound WTP estimate hence; the respondents who disagreed were analyzed as "not willing" within the subsample. The significance level showed that the type of conservation activity highly affects the respondents' willingness to pay. Specifically, the results show that, in comparison to an R2R approach, respondents were less likely to choose habitat specific conservation activities by a marginal effect of 15%. This implies that the respondents are keener to choose an R2R approach of biodiversity conservation activities over upland exclusive and/or coastal exclusive conservation activities. There were two major reasons that could explain this result. First, since R2R approach is a holistic approach, the emerging properties of a holistic ecosystem, functioning as one, provide more

Table 1. Factors affecting the willingness to pay.

Variable	Coefficient	P-value (significance of Coefficient)	Marginal Effects DX/DY	P-value (Significance of Marginal Effects)
BidAmount	-0.0192859	0.000***	-0.0034692	0.000
CCons	-0.9362799	0.000***	-0.1548862	0.000
UCons	-0.9155902	0.000***	-0.1528925	0.000
WTPCA	0.1355651	0.042**	0.0243859	0.042
Certainty	0.5792232	0.000***	0.1041927	0.000
Hhsize	0.1669853	0.007***	0.0300379	0.006
IncomeLevel1 12501 - 25000	0.5785897	0.011**	0.1125371	0.017
IncomeLevel2 25001 - 37500	0.5623041	0.080*	0.1129287	0.109
IncomeLevel3 37501 - 50000	1.765733	0.000***	0.4036828	0.000
Incomelevel4 50000	1.382427	0.066*	0.3138061	0.090
Educ Level 1	-0.3028449	0.359ns*	-0.0524765	0.340
Educ Level 2	0.0502461	0.870ns*	-0.0090629	0.871
Educ Level 3	0.4103079	0.246ns*	-0.0786744	0.274
Educ Level 4	-0.1956578	0.770ns*	-0.0334508	0.758
Distance from the nearest stream	-0.00033	0.368ns*	-0.0000594	0.367
cons_	-0.5418989	0.198ns*		

benefit as compared to a habitat exclusive approach. Also, the interconnectivity of ecosystems will also come into effect which could boost the benefits that can be derived from the ecosystem. Secondly, it could also be attributed to the emerging concerns in river quarrying. The other options does not have a clear activity which could involve the conservation and protection of the river; while on the other hand, due to the holistic approach of the R2R framework, the concerns on quarrying will most likely be addressed.

The variable WTPCA or "willingness to participate to conservation activities" refers to the respondent's willingness to participate in the proposed activity with or without a constraint. This is a perception variable inquired from the respondent even before the scenario was revealed. The results show that respondents who had this characteristic were likely to agree to the referendum by 2%. On the other hand, the variable certainty or "certainty level of decision" represent the level of commitment of the respondent to support the referendum if he agrees, as well as level of certainty if otherwise. Highly committed respondents were 10% more likely to pay as compared to those who were hesitant.

On socio-economic factors, the number of people in the household or the household size also significantly affects the likelihood of the respondent to agree to the referendum. At 1% level of confidence, as the household size increases, the likelihood that the respondent is also willing to pay increases by 3%.

Finally, the Income variable was subdivided into brackets of income by P12500 per month. The model showed that in comparison to households with income lower than PhP 12,500, households with higher income were likely to be more supportive of the conservation activities, hence as income increases, so as the probability of the respondent to agree to the referendum. Specifically, respondents in income brackets PhP 12.501–25,000 and PhP 25,001-37,500 were more likely to agree to the referendum by 11% as compared to respondents with income lower than PhP 12,500. Furthermore, respondents in income bracket PhP 37,501–50,000 had the highest likelihood to agree to the referendum by 40% as compared to respondents with income lower than PhP 12,500. Lastly, households with income higher than PhP 50,000 were more likely to agree to the referendum by 31%.

Although education and proximity to the nearest body of water variables were significant from other studies (*Calderon et.al 2013*), for this particular study, the results showed that these variables had no significant effect to the respondents' likelihood to agree to the referendum.

Estimated values for biodiversity conservation activities

Using equation (14) the estimated willingness to pay were computed, per subsample and yielded results (**Table 2**).

The mean willingness to pay of the respondents for an R2R approach to biodiversity conservation is PhP 43.58 (US$ 0.90) with a 95% level of confidence that the mean willingness to pay lies within the range of PhP 37 to PhP 50. Within the 251 respondents, there were respondents even willing to pay a maximum of PhP 174.43. Furthermore, for exclusive Upland habitat conservation activities, the estimated mean willingness to pay was computed at PhP 33.02 (US$ 0.68) or within the range of PhP 26 to PhP 40. Lastly, the estimated mean willingness to pay for exclusive Coastal habitat conservation activities was PhP 30.39 (US$ 0.62) or within the range of PhP 24 to PhP 36.

The scope test, conducted through a T-test statistics, compared the estimated mean willingness to pay between subsamples. There was a significant difference between the mean willingness to pay of R2R as compared to Upland conservation activities with R2R approach being significantly higher at α=5% (**Table 3**). However, comparing R2R approach with Coastal conservation activities resulted to a mean willingness to pay with an even more significant difference at α=1%. This implies that the hierarchy of willingness to pay of the households would be ordered in such a way that R2R approach was the most preferred and with the highest willingness to pay, followed by Upland exclusive conservation activities, and finally by Coastal exclusive conservation activities.

Estimating potential total annual contribution from the mean willingness to pay

A budget of PhP 4 M annually had been allocated by the Department of Environment and Natural Resources

Table 2. Summary of estimated willingness to pay per category.

Conservation Activities per category	Willingness to Pay Summary				Total number of Respondents
	Max WTP of a respondent	Mean WTP	CI (95%)	Stan. Err	
R2R	276.14	43.58	36.75 – 50.41	3.47	251
Upland	174.43	33.02	25.88 – 40.15	3.62	289
Coastal	231.20	30.39	24.43 – 36.35	3.03	277

Table 3. Independent T-Test of mean willingness to pay (Scope test).

Group	OBS	Mean	Std Error	P-Values (Two-Tailed) PR (|T| > |T|)	P-Values (One-Tailed) PR T < T	P-Values (One-Tailed) PR T > T	TSTAT
R2R	251	43.58042	3.4699	--	--	--	--
Upland	289	33.01832	3.6247	0.0358	0.0179	0.9821	-2.1049
Coastal	277	30.38652	3.0271	0.0043	0.0022	0.9978	-2.8653

(DENR) for the implementation of existing conservation program for the entire Mt. Malindang Range Natural Park (*Manlosa et al. 2013*). In terms of budget allocated per hectare, this will only amount to around PhP 150 ha^{-1}. The conservation cost for the total landscape of MMRNP was roughly around PhP 21.5 M according to Focal Community Assistance Scheme (FOCAS). This cost includes series of conservation activities particularly for upland such as reforestation, agroforestry, eco-awareness, resource utilization, among others. Similarly, a recent exercise of the DENR Biodiversity Management Bureau in developing a business case for protected area management showed that MMRNP would need PhP 144 M in a span of 5 years or an average of PhP 29 M yr^{-1} (*DENR-BMB 2014*). Therefore, the current allocation was not enought to sustain the conservation needs of the entire park. The estimated mean willingness to pay from this study could be an alternative source of funds for conservation activities.

The computed collectible per scenario used the estimated mean willingness to pay vis-à-vis the number of households that would be involved per conservation activity approach. An R2R approach would involve all the households since the scale of the benefit from the ecosystem services affects the entire community. However, Upland exclusive conservation activities would be limited only to households that would be directly impacted by the upland ecosystem services. Similarly, Coastal conservation activity payments would only be collected from the coastal communities.

The projected monthly collectible for an R2R approach will yield PhP 627,000 per month while the combined value of the habitat exclusive approach will yield PhP 462,000 per month; with a breakdown of PhP 313, 000 per month coming from Upland conservation activities and PhP 150,000 per month for Coastal conservation activities.

Table 4. Potential monthly collection for biodiversity conservation activities by category.

	R2R Management R2R ('000)	Individual Ecosystem Management		
		Upland ('000)	Coastal ('000)	Total ('000)
Monthly collection	627	313	150	463
Total # of Hh	14,389	9,465	4,924	

On an annual basis, an R2R approach would yield PhP 7.5 M. This already amounts to 26% of the total annual average budget requirement for the MMRNP protected area management activities as computed by *Manlosa* (*2013*). On the other hand, the annual equivalent for the habitat exclusive conservation activities based on the estimated willingness to pay of the respondents is PhP 5.5 M, with P3.8 million from Upland and PhP 1.8 M from Coastal programs.

The proposed PES financing contribution was supposed to run for 5 years to ensure its sustainability. Therefore a projected total collection for an R2R management program will yield PhP 37.6 M after 5 years as compared to PhP 27.7 M from habitat exclusive biodiversity conservation programs – PhP 18.8 M coming from Upland and PhP 9.0 M coming from Coastal.

Although the total collected contributions yielded a high projected collectibles, the estimates were solely based on household population and the projected willingness to pay values based on the model, hence the projection were crude estimates. A more accurate estimate should also include other factors such as expected inflation rate and population growth. However, for the purpose of the study,

Table 5. Potential annual conservation fund (in PhP Millions).

	R2R Management R2R	Individual Ecosystem Management		
		Upland	Coastal	Total
Potential annual collectible	7.5	3.8	1.8	5.5

Table 6. Potential total PES contribution after 5 years.

	R2R Management R2R	Individual Ecosystem Management		
		Upland	Coastal	Total
5 year collectible per management approach	37.6	18.8	9.0	27.7

a nominal computation was used for simplicity. Overall, the R2R management yields more conservation collection over the period of 5 years as compared with exclusive ecosystem management approaches.

CONCLUSION AND RECOMMENDATION

Results of the study showed that there is an immediate need for biodiversity conservation of Lawayan Watershed. Continuous unsustainable utilization of resources within the watershed affects not just one community, rather, the watershed as a whole. Furthermore, certain activities may be beneficial to one community but could be damaging to the other. Therefore, it would be more beneficial to address the problems on a holistic approach.

Programs such as forest conservation, reforestation and rehabilitation, and effective enforcement of the law have been identified to be potential measures to address the issues in the upland. Furthermore, incentives for guard volunteers, such as provision of insurance and equipment, as well as alternative livelihood opportunities for upland communities are some measures worth considering. On the other hand, mangrove protection and a comprehensive coastal resource management including law enforcement are necessary to properly conserve the coastal biodiversity of Oroquieta City. However, for these identified solutions to be implemented, provision for funds will be needed. Although the government is supportive of these initiatives, the funds are not sufficient for it to cover all the activities, hence, a sustainable financing mechanism, such as PES, is imperative.

In devising the sustainable financing mechanism, it is important to know the value of the ecosystem service. Due to the complexity of biodiversity as an ecosystem service, no market exists which could be the basis for valuation. Therefore, a non-market valuation was conducted through the contingent valuation method. Furthermore, the study also looked into the potential of the value for a holistic ecosystem-based management approach as compared to the conventional habitat exclusive approaches. The results showed that there is a significant difference between the mean willingness to pay of households for an R2R approach, PhP 43.58, as compared to either Upland exclusive, PhP 33.02, or Coastal exclusive, PhP 30.39. This implies that higher collection could be generated to support a holistic management approach as compared to habitat exclusive.

The willingness to pay of the respondents were significantly affected by the variables bid amount or the additional price to be paid in case the program is implemented, household income, certainty of their decision to engage or join the program, and their willingness to participate with or without constraints.

Using the values generated from the CVM, a potential annual collection of PhP 7.5 M could be generated as compared to PhP 5.5 M in total coming from Upland and Coastal exclusive conservation activities. Therefore, this study strongly recommends the use of a Ridge-to-Reef or a holistic watershed approach in designing sustainable financing mechanisms.

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