JEL: Q01, Q57, Q59

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ECONOMIC VALUATION OF ECOSYSTEM SERVICES IN BALATIN RIVER SUB-WATERSHED, SOUTHERN PHILIPPINES

Purpose. *The study aimed to estimate the economic value of the ecosystem services provided by the Balatin River Sub-Watershed (BRSW) as a basis for policy recommendations focused on its conservation.*

Methodology / approach. *The economic values were estimated through the Total Economic Value approach. To estimate the use values of the provision of water supply for households and irrigation use, the market price method and productivity method were used, respectively. Meta-analysis benefit transfer was used to estimate the non-use values.*

Results. *An estimated 1,327,560 m^3 of water is supplied to households every year with total revenue of PHP 20,626,441.20 per year. PHP 4,026,773.80 is generated annually to provide irrigation water. In addition, regulating services of the BRSW generate an amount of PHP 12,191,487.85 in 2021 price levels as a benefit for the residents. This generates an estimated total economic value of PHP 36,844,702.85 with benefits spread across the users in the community. The water for drinking benefits accrue to the residents whose water is supplied by the BRSW through the Wao Water District, the benefits of irrigation water are mostly received by farmers, and the benefits of regulating services accrue entirely to the residents within the BRSW and the surrounding communities.*

Originality / scientific novelty. *This study was able to obtain a relatively higher estimated value by using multiple valuation methods in contrast to the conventional method of using a single approach. Additionally, the study contributes to addressing the limitation in existing literature particularly in the BRSW and the remaining sub-watersheds of Lanao del Sur which also suffer from degradation.*

Practical value / implications. *The results of this study show that the BRSW is currently an indispensable resource for the municipality. The study is a first in the municipality and can therefore be used as an input in the appraisal of the watershed's economic value. The estimated economic value generated by the watershed illustrates a portion of what has been neglected over the past decades as the deterioration of BRSW continues.*

Key words: *economic valuation, total economic value, use values, non-use values, ecosystem services, watershed.*

Introduction and review of literature. A healthy watershed provides for the well-being and livelihood of humans and sustains the services of the ecosystem function. In contrast, a degraded watershed will not be able to provide quality ecosystem services which will, in turn, disrupt cycles and affect communities [1].

The Philippines is abundant in freshwater resources. Of the 30 mln hectares, 70 % of the country's total land area is considered watershed areas [2]. Its general population relies on watersheds as a significant source of drinking water, irrigation water for agriculture, and electricity for industries [3]. About 163 irrigation systems in the country are highly dependent on 143 priority watersheds to meet the irrigation's major water requirements.

While the Balatin River Sub-Watershed (BRSW) provides numerous benefits to communities, much of these benefits are neither traded nor supplied in the market. Hence, the benefits provided by the BRSW are difficult to assess and are therefore underappreciated. As a result, although the management and conservation of the watershed are considered important, the lack of monetary value estimation makes it difficult to decide on appropriate policies, identify the best alternative solutions, and allocate sufficient funds necessary to implement and maintain the specified management plan.

To obtain a proper monetary value estimation of the benefits provided by the BRSW, these values must be estimated using environmental valuation methods. Economic valuation, according to Ozdemiroglu & Hails [4], can produce evidence that can be used to compare financial costs/benefits to environmental costs/benefits to aid in decision-making regarding policy, investment, and budget allocations. It provides us with a tool to assist with the difficult decision involved by providing a means for measuring and comparing the various benefits of environmental resources [5]. However, economic values only comprise one aspect of decision-making and do not automatically imply that the right decisions will be made.

Nevertheless, economic valuation can provide the empirical data necessary for the policymakers and stakeholders involved in the management and conservation of the BRSW to understand the value of the sub-watershed better, assess costs and benefits, and capture values not considered in markets. The identified economic value is evidence that can be used to convince decision makers to invest in watershed management and forest conservation of the BRSW.

According to local authorities, there is no literature or studies that specifically attempt to estimate the economic value of the watersheds in Wao, Lanao del Sur. If there was such a document, the local authorities were not notified of such a study and they do not have a record of it. However, such a study exists, a case study about the Lower Magat Forest Reserve of Wao. This study by Francisco [6] provided a net present value for the WAO forestlands by using the benefits transfer method. By applying the DENR per unit cost estimates generated from multiple forestry project values to the proposed land use allocation of the Wao forestlands, the study was able to estimate an NPV of PHP 99,238 per hectare or an estimated value of 1.96 billion PHP for the entire project area. It is important to note that this estimate considered direct use value only, hence, this estimate is conservative. In addition, the study did not account for site variables or socio-demographic variables which may be significant. Although it did provide insight into the application of benefit transfer in economic valuation, it can be deduced that the value has declined since then because the estimated values were based on the assumption that effective land use allocation and watershed management systems are in place after 2003, which did not happen.

While there is a severe lack of previous valuation studies specifically for ecosystems in Wao, there are many studies that use various valuation techniques in estimating the economic value of tropical forests, forested watersheds, riverine, and groundwater wetlands.

The studies of Thapa et al. [7] and Baral et al. [8] are among the several economic valuation studies which used multiple valuation methods in an attempt to estimate the total economic value of all identifiable ecosystem services from their specific sites. Thus, both studies generated higher economic value estimates compared with using just a single method. Additionally, it can also be inferred by comparing the two studies that the value people place on an economic good or service is positively related to their level of awareness about the services, or their perceived level of importance based on their collective experience.

Among the most common methods used in previous studies in determining direct use values are variations of the market-based valuation. Market-based valuation is distinct from non-market-based valuation for its use of existing market behavior and market transactions in its methods as the basis for valuation [9]. One of the methods under the umbrella of market-based valuation is the market-price method or the use of direct market prices to determine the value of ecosystem service [9; 10]. This valuation method is usually applied to provisioning ecosystem services since the outputs produced by this type of ecosystem services are traded in the market [7; 8; 11; 12].

The study by Septarianti et al. [11] used the market price method as a way to determine partially the value of marketed goods derived from the Gasing Watershed. The results of the study showed that based on the residential rate and industrial rate of water use and the monthly consumption rate per cubic meter, the direct use value of the water resources is USD 122,695.27. In contrast, the study by Arfitryana et al. [12] used the market price method in estimating the total economic value of Traditional Prohibition Forest Kenegerian Rumbio by multiplying different water uses (household consumption, fishery, and direct sale) by their respective market prices. Because the study only accounts for direct use values, it can be said that this study only accounted for the partial value of the study site. Such is the limitation of the market price method – it is limited only to ecosystem services with existing markets and market prices which is very limited since so many of the ecosystem services are still not officially traded or do not have an existing market [13].

Another widely used market valuation method is the production function method or net factor income. This valuation method is especially useful in estimating the economic value of ecosystem services that are input in the production of a commercially available product or service [14]. In the study by Mesa-Jurado et al. [15], the production function method was used to estimate the marginal value of water for irrigated olive groves in the Guadalbullon River Sub-basin area. In the context of this study, unregulated irrigation water is an input in the production of olives. The study result showed that the net marginal value of water is USD 0.7962 per hectare and could decrease to USD 0.70331 for the water right allowance per hectare. In the study by Iman [16], the production function was employed by using the cost and returns of producing potable, residential, commercial, and institutional water in determining the economic value of the forest catchments in the state of Johor, Malaysia. The study found that the use-value of the water resources amounts to an annual value of USD 301,704.662. Similar to the market price method, the production function method is limited only to ecosystem services that can be used as inputs in producing marketed goods. Additionally, an understatement of its true value to the community can occur because not all ecosystem services are related to the production of the marketed commodities [17].

From the reviewed studies thus far, it can be inferred that market-based valuation techniques are severely limited to traded goods only which are mostly provisioned goods and services. For non-marketed goods, there are a plethora of other valuation techniques that can be used among which is the contingent valuation method. The contingent valuation method (CVM) is among the most frequently used stated preference approach in valuation studies when there is no market information about the non-use value and revealed preference methods are unusable or inappropriate [18; 19]. It generates people's preference for public goods by finding out how much they would pay for the good or for specific improvements of it which is referred to as willingness to pay (WTP), or how much they would like to be paid as compensation for managing or improving an ecosystem which is referred to as willingness to accept (WTA) [18; 20]. CVM provides the opportunity to obtain useful information about the preferences of consumers for non-market goods [21; 22; 23].

The study by Bueno et al. [24] used CVM to estimate the WTP of San Pablo City residents to restore the water quality of Sampalok Lake. The findings showed that the respondents have a positive WTP for the improvement and/or rehabilitation of the lake, specifically the lakeshore villages assigned a WTP of USD 4.17 per household per month. The WTP was attributed to the following: conservation of the lake which can benefit their children and generations to come, restoration of the lake's former beauty, tourism, and recreational benefits. The unwillingness of 28.9 % of the respondents was due to financial limitations, reasoning that the accountability for funding such projects lies with the government alone, lack of trust towards the institutions in charge, and absence of land ownership. Meanwhile, the study by Calderon [25] employed CVM to estimate the monthly WTP of Oroquieta City residents on the protection and management of Layawan Watershed. The study showed that the people of Oroquieta have a high level of environmental awareness which can be attributed to the tragedy that struck Iligan City and Cagayan de Oro during the onslaught of Typhoon Sendong. The respondents were willing to pay a mean WTP of 1.28 USD to 1.36 USD per household per month. However, some respondents were unwilling to pay primarily because they cannot afford the bid amount. This shows that people's willingness to pay depends on their income, with the higher the income, the higher their willingness to pay, and vice versa.

The study by Quispe-Mamani et al. [26] estimated the value of a bundle of ecosystem services provided by the Coata river basin using also CVM. The study results showed that age, gender, distance from the study site, and frequency of using the ecosystem services all have significant effects on a person's willingness to pay.

Primary valuation studies such as the studies discussed thus far can be costly in terms of money, labor, and time [27]. As an alternative, benefit transfer studies can be performed instead. Benefit transfer or value transfer is an economic valuation method that utilizes secondary data from primary valuation studies in estimating the value of ecosystem services in the policy site [14; 28]. It is a quick and low-cost approach compared with primary valuation studies.

The study by Yaping [29] utilized both the CVM and BT methods in order to compare the "actual" and benefit transfer value of a recreational lake in Wuhan, China. When conducting the BT method, selection criteria were put in place to ensure that the study sites have almost the same characteristics as the policy site and to ensure that the studies are comparable, as a result, three comparable studies were retained. Additionally, adjustments in transnational transfer and time factors were performed by using GDP per capita adjustment and price index adjustment, respectively. The study revealed that the BT values, compared with CVM values were either very close or over eight times different. This implies that the method can give either a meaningful value or biased results depending upon whether the difference in time and embedding effects were controlled.

When values from multiple primary studies are used to estimate a value function which is then used to calculate the unit value of the ecosystem services at the policy site, the value transfer is referred to as meta-analytical function transfer or meta-analysis benefit transfer (MA-BT) [14]. The study by Shin et al. [30] made use of MA-BT in estimating the annual total benefit, annual net benefit, and adjusted net benefit generated by households from the Han River which are USD 699,314,129.86, 373,360,164.98, and USD 689,811,734.97, respectively. The dependent variable considered for the study is the willingness to pay for the benefits obtained from the study area and the independent variables consisted of relevant socioeconomic characteristics of the households as well as relevant survey characteristics from the primary valuation studies. In both independent variables, the majority were dummy variables. The study presented how MA-BT can be used as a policy instrument not only for raising awareness but as a practical solution to mediate disputes about the distribution of ES especially that of water resources.

The study by Brander et al. [31] assessed the value of mangroves in Southeast Asia by estimating a value function based on 130 value estimates from primary valuation studies. The MA-BT study generated an estimated mean value of 239 USD/ha/year in 2007 base price. Accordingly, the biophysical characteristics of the site and the socioeconomic characteristics of the users are among the main factors that affect the value of the ecosystem services of mangroves across different study sites. This study, in particular, utilized studies with different valuation methods.

Meanwhile, the study by Bockarjova & Botzen [32] constructed two meta-analyses functions in estimating the economic value of the services provided by nature-based solutions in urban areas in Europe, whereby the first one consists only of studies that used revealed preference methods and the other consist only of studies that used stated preference methods. The studies were categorized accordingly to control for the difference in services being valued wherein the former estimates values of marketed services while the latter estimates values of non-marketed services. The regression analyses from the first meta-analysis which consider the benefits perceived by homeowners revealed that tourism under the cultural ecosystem services and water purification under the regulating ecosystem services are valued higher than other ecosystem services provided by urban nature. On the other hand, the regression analyses from the second meta-analysis which considered the willingness to pay of the general public were able to generate a monetary estimate of 58,608 USD/ha/year in 2016 base price. The study recommended that in order to capture a better value estimate, the studies considered could have been limited to the European-only value sub-sample since the policy site is in Europe. In this way, the results could have better reflected the preferences of the European population only.

To summarize, different valuation techniques can be used in determining the economic value of different ecosystem services, however, existing studies usually use market-based valuations for marketed goods and stated preference methods such as CVM for non-marketed goods. Since the previous studies worked on study areas or sites that the people were already benefiting from, the results of the studies resulted in positive economic values. Although, these values are highly influenced by sociodemographic characteristics such as household income, household size, gender, age, and educational attainment, among others. Household income is of particular importance since the people's willingness to pay whether for the services or improvements of the services is subject to their budget constraints. The economic values depend not only on the aforementioned but also on the estimation models used, with some more conservative than others. Benefit transfer is a quick and low-cost alternative to primary valuation studies. Accordingly, value function benefit transfer is more favorable as it is statistically more reliable than unit transfer [33]. However, the problem with the value function transfer is to ensure that the characteristics of the study area are representative of the policies so that the value of the benefit transfer is meaningful.

The purpose of the article was to estimate the economic value of the ecosystem services provided by the BRSW located in Wao, Lanao del Sur, Southern Philippines as a basis for policy recommendations focused on its conservation. Specifically, the study aimed to: describe the demographic and socioeconomic profile of BRSW users; identify the ecosystem services provided by the BRSW; quantify the direct use values of selected ecosystem services provided by the BRSW; quantify the indirect use values of selected ecosystem services provided by the BRSW; aggregate the value estimates from the identified ecosystem services; and, draw possible local policy recommendations based on existing literature.

Methodology. The study was conducted in Wao, Lanao del Sur, Philippines. It is an agricultural municipality with 90 % of the population engaged in agricultural activities [34]. The municipality relies on watersheds for water supply, irrigation, and timber supply among others. Currently, the town uses seven major sub-watersheds which are also shared with some barangays in neighboring municipalities in Cotabato and Maguindanao [35]. Among the seven major sub-watersheds in the municipality is the BRSW which has a drainage area of about 8,800 hectares. The sub-watershed supports more than half of Wao's communities whereby the tributaries of the sub-watershed provide for the consumption and production needs of the people [35].

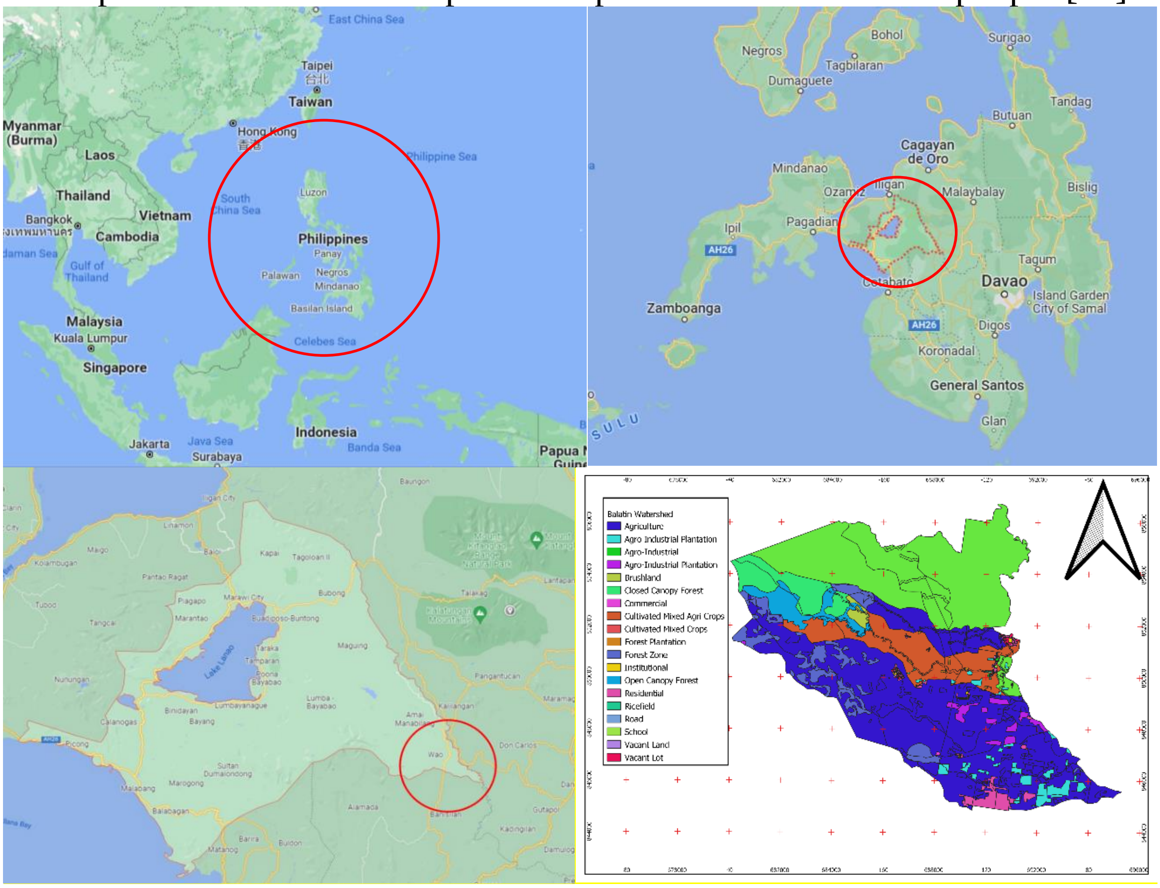

Figure 1. BRSW Location Map

Source: Top Left, Philippine Map – Google Maps; Top Right, Lanao del Sur Location – Google Maps; Bottom Left, BRSW Location – Google Maps; Bottom Right, BRSW Map – Wao MENRO.

Although 55.89 % (20,039.962 hectares) of the total land is categorized as timberland and only 44.11 (15,364.426 hectares) is classified as agricultural/alienable and disposable (A&D), about 23,813.50 ha of land is said to be dedicated to agriculture which is an unfortunate consequence of hasty population growth [34]. As of 2022, only about 2,480.77 hectares (29.5 %) of the total land area of BRSW are classified as forest lands while the agricultural/A&D lands account for about 5,928.62 hectares (70.5 %) of the total land area [36]. This implies an about 36.9 % decrease in forestlands and the same percent increase in A&D lands since the previous official survey in 2003.

Problems of degradation had arisen and continue to foster because of the lag in the development of timberland areas where many of the watersheds situate. According to the Forest Land Use Plan [37] of the municipality, forest and forestland management has not been a priority for the municipality's budget and thus reflects on its lack of development. More than a decade later, the gradual degradation of watersheds in Wao continues to persist [35].

The BRSW contains many ecosystem goods and services, however, no single method is suitable for measuring the value of all goods and services, so several valuation methods were used in the study. Specifically, this study primarily employed (1) market price method, (2) productivity method, and (3) meta-analysis benefit transfer (MA-BT).

In this study, the market price method was used to estimate the economic value of drinking water provision. To estimate the value of the drinking water provision service, the total revenue formula (Equation 1) was applied. In this context, the market price of potable water (Price) was multiplied by the quantity of potable water sold (Quantity). The market price has a unit of measurement of PHP/m^3 while the quantity is measured in cubic meters (m^3). Because there are different water rates per interval of m^3 sold, the monthly total revenue formula (Equation 2) was derived from the original total revenue formula to account for this characteristic whereby: H denotes the number of households, P_0 denotes the base price or the minimum charge per month, P_1 denotes the excess price per m^3 at 10–20 m^3 interval, P_2 denotes the excess price per m^3 at 21–30 m^3 interval, P_3 denotes the excess price per m^3 for excess consumption of 31 m^3 and onwards, while Q denotes the maximum consumption per excess consumption interval. Finally, to find the total annual revenue (Equation 3), the total monthly revenue (Monthly TR) was multiplied by the number of months (12).

$$Total\ Revenue = Price \cdot Quantity \quad (1)$$

$$Monthly\ Total\ Revenue = [H(P_0)] + [Q_1(P_1)] + [Q_2(P_2)] + [Q_3(P_3)] \quad (2)$$

$$Annual\ Total\ Revenue = Monthly\ TR \cdot 12 \quad (3)$$

The volume of freshwater produced and distributed in a period was determined by procuring the household consumption report from Wao Water District. Through the same agency, the water rates for residential were determined as well as the number of users. Lastly, the annual total revenue was used to determine the annual monetary value of the freshwater service.

This study used the productivity method to estimate the value of water used for irrigation. In order to estimate the value of water used for irrigation, the net profit from rice production, the main agricultural crop produced in the municipality was used. To determine the net profit (Equation 4), the difference between the total gross revenue and the total cost of production per cropping cycle was calculated. To solve for the annual net profit (Equation 5), the net profit from different agricultural crops was aggregated and multiplied by the number of cropping cycles in a year.

$$Net\ Profit = Total\ Gross\ Revenue\ - Total\ Cost\ of\ Production \quad (4)$$

$$Annual\ Net\ Profit = \ Net\ Profits \cdot Number\ of\ Cropping\ Cycles\ in\ a\ year \quad (5)$$

In this study, the yearly value of the water used for irrigation was estimated based on the annual net income of the farmers that utilize the water from the BRSW to irrigate their lands. A key informant interview (KII) with a farmer who utilize water from the BRSW was conducted to determine the costs of production as well as yield and gross revenue from producing rice in the irrigated farmlands. A KII with the municipal assessor and head-of-office of Wao-MAFAR along with report procurement from the said agencies was also conducted to create an alternative ‘no-irrigation’ scenario and to determine the changes in production for different land use. In total, three KIIs were conducted. The annual net profit of the irrigators was used to determine the annual monetary value of the water used for irrigation while the changes in production were used to determine the marginal benefits or costs.

The meta-analysis benefit transfer (MA-BT) was employed in this study to estimate the value of the BRSW's regulating services. To perform the meta-analysis benefit transfer, this study adhered to the guidance manual of Brander [14]. Firstly, a meta-analysis of the ecosystem goods and services of interest was conducted which entailed constructing a database of primary valuation studies that contain information about the value of the priority ES.

Table 1

Summary table of Meta-Analytic Function Variables

Meta-analytic function variables	Description
Willingness to pay (WTP)	Adjusted to 2021 USD
Intercept	Constant
Study variables	
Average annual household income	Adjusted to 2021 USD
Average household size	Number of people
Site variables	
Size	In hectares
Provision change	Dummy variable (0 – no provision change; 1 – with provision change)
Ecological domain	
Tropical forest (TF)	Dummy (0 – not applicable; 1 – characteristic of study site)
Spring (Sp)	Dummy (0 – not applicable; 1 – characteristic of study site)
Ecosystem services	
Flood control	Dummy (0 – not applicable; 1 – characteristic of study site)
Climate regulation	Dummy (0 – not applicable; 1 – characteristic of study site)
Erosion prevention	Dummy (0 – not applicable; 1 – characteristic of study site)

Source: adapted from Brander [14].

Because the data are expected to be reported in different temporal and physical units, the values were then standardized into similar sets of units, currency, and year of value, specifically, USD per household per year to ensure that the values can be compared and analyzed directly. To control for methodological differences among value estimates, this study only considered studies that applied stated preference methods in the conduct of their study.

The aforementioned variables in Table 1 were relevant in estimating the multiple regression equation (Equation 6) whereby the $\hat{y}$ denotes the predicted WTP per household per month; lnINHH, lnHHSIZE, and lnSITESZ denote the natural logarithm of average annual household income, average household size, and site size in hectares, respectively; PRCH, TF, SP, FC, CR, and EP denote the dummy variables' provision change, type of biome (TF – tropical forest, SP – spring), and ecosystem services being valued (FC – flood control, CR – climate regulation, EP – erosion prevention). Coefficients β_1 to β_9 are the model parameters to be estimated.

$$\hat{y} = \alpha + \beta_1 lnINHH + \beta_2 lnHHSIZE + B_3 lnSITESZ + \beta_4 PRCH + \beta_5 TF + \\ + \beta_6 SP + \beta_7 + \beta_8 CR + \beta_9 EP \quad (6)$$

The second step was to gather the relevant data for the policy site in relation to the parameters (explanatory variables) and quantity of units (dependent variables) which is presented in Table 1. After which, for the third step, the unit value of the ES at the policy site was estimated by keying in the policy site parameter values into the meta-analytic value function (Equation 7).

$$Policy\ Site\ WTP = \Sigma(MA\ function\ coefficients \cdot Policy\ site\ characteristics) \quad (7)$$

The last step was to solve the value of the ES at the policy site by multiplying the estimated unit value by the number of units.

On standardization and consistency. The dependent variable for the MA-BT is the WTP estimates with a unit of measurement of USD/year/household. Since the WTP estimates are expected to be reported in different currencies and time periods, the monetary estimates were converted to 2020 USD. For studies that use time units other than years (i.e., quarters, months) the WTP was adjusted accordingly to fit the USD/year measure (e.g., multiplying a WTP/month by 12 to get the annual WTP). Additionally, for studies with different agent units (i.e., individual), the WTP per individual was set to WTP per household to achieve consistency. Moreover, the household income and WTP values are standardized using the 2020 GDP price deflator in order for values from different years to be compared. Additionally, to correct for purchasing power differences, the standardized values were multiplied by the purchasing power parity (PPP) in local currency units with 2020 as the base year. Both the GDP deflator and PPP were based on the World Bank database [38; 39]. Meanwhile, the ecosystem services listed in the table are the priority ES of the BRSW based on the municipality's FLUP [37] which are bundled together as they are all regulating services that are interrelated.

Data sources. Primary data was gathered in order to establish the baseline scenario as well as to measure the economic value of water used for irrigation. The primary data were acquired through a series of KIIs. The key informants were from the following agencies/offices/organizations all from the Municipality of Wao: Municipal Environment and Natural Resources Office (MENRO), the Ministry of Agriculture, Fisheries, and Agrarian Reform (MAFAR), Municipal Assessor's Office, and a farmer of an irrigated farmland through the BRSW.

KII was chosen for this study in order to determine the initial conditions of the Balatin sub-watershed, to identify and assess the potential impacts of policy options on the watershed's services, and to estimate the water used for irrigation. Additionally, the research instrument was used in order to contextualize the quantitative data from reports as well as to generate policy suggestions and recommendations based on the results of this study. In planning and implementing the KII, this study mainly followed the Conducting Key Informant Interviews Performance Monitoring & Evaluation TIPS of the USAID Center for Development Information and Evaluation [40]. Prior to the conduct of the KII, communication letters addressed to the aforementioned agencies were sent in order to ask the respondents for their consent to conduct the KII and to gather and subsequently review existing data.

After which, the supplementary/additional information needed was identified as well as the target population for brainstorming possible informants. Since the required information was available only to some members of the community and additionally required a high degree of interpretation, the selected key informants were in particular the heads of offices/chairmen of the above agencies and organizations, with the exception of the farmer. To assist the proponents in establishing the environmental baseline, the head of the MENRO office was selected as the key informant. For data concerning the water use for irrigation, the municipal assessor, a farmer, and the head of the MAFAR office were chosen as the key informants. The informant from MENRO was also selected to identify and assess the potential impacts of policy options in order to determine the priority ecosystem services. While the important ecosystem services were already identified in the municipality's FLUP [37], the document was reported almost 2 decades ago, hence, there is a need to check if the priority ES of the beneficiaries may have shifted or the importance of these ES still hold in the present. By the end of the data collection, four individuals were successfully interviewed. Initially, more farmers were expected to be interviewed, however, this was not possible due to the limitations in time and mobility, availability of prospects, limited available data, and unexpected drawbacks.

The KIIs were administered through a semi-structured face-to-face individual interview with a combination of closed and open-ended questions. Prior to the interview, an informed consent form and a copy of the interview questions were given to the informants. During the interview, safety protocols (i.e., wearing of face mask and 1-meter social distance) were observed due to the COVID-19 pandemic. The interviews lasted for at least 20 minutes. The responses were then documented by note-taking and consented audio recording using a smartphone's voice recording application.

Secondary data were collected as part of the planning stage of the KIIs whereby secondary data from the aforementioned agencies and offices in the form of publications and reports were obtained and subsequently reviewed in order to identify needed missing or supplementary information. The reports gathered were the following: Municipal Profile of Wao; Forest Land Use Plan, collected from MENRO; Draft of Balatin Watershed Management Plan also from MENRO; Summary of Average Water Consumption of Households retrieved from Wao Water District on December 2021; Household data of Wao residents obtained from the Municipal Planning and Development Coordinator; and, Data about the Population of Wao retrieved from the Local Civil Registrar's Office. Moreover, to supplement the data for the irrigation use in farmlands, data on the costs and returns of Palay production in Bansangmoro Autonomous Region in Muslim Mindanao (BARMM) were obtained from the Philippine Statistics Office through their online database OpenStat.

Metadata observations were gathered from the data generated from existing studies that estimate the willingness to pay for changes in the quality or quantity of groundwater-dependent wetlands, rivers, and/or tropical forests, or their ecosystem services. In determining which studies are relevant, this study employed the seven inclusion/exclusion criteria adapted from the study retrieval methodology of ESVD Update of global ecosystem service valuation data [41]. Literature search – studies considered for this study were taken from multiple databases and a search engine which are: the Ecosystem Services Valuation Database (ESVD), Environmental Valuation

Reference Inventory (EVRI), The Economics of Ecosystems and Biodiversity (TEEB) Southeast Asian and Global database, and Google Scholar. For academic quality or type of publication – all forms of publication were considered including journal articles, books and book chapters, reports from governments and international institutions, working papers, and other grey literature sources. For the year of publication or year of value estimate – studies published, released, or reported in any year were retained. For geographic area and scale – the studies were considered relevant if they focused on or included countries fully located in the tropics zone, also, the study sites considered can be at any scale. For the type of ecosystem or biome – studies were retained if they focused on and/or included the following biomes: groundwater wetland/spring, tropical forest/rainforest, and river. For the ecosystem services – the studies considered were those that were addressing at least one of the following regulating services: storm protection, erosion prevention, and climate regulation, also, studies that addressed one of the following as part of a bundle of ecosystem services were retained. For valuation metric – studies that reported values measured in monetary units were considered. Finally, for valuation method – as mentioned, the studies considered are only primary valuation studies, additionally, the methods considered were narrowed down to stated preference methods (i.e. contingent valuation method and choice experiment method) for uniformity of the dependent variable. To be included in the database, the study must meet the seven basic criteria. The selection criteria are put in place to ensure that the study site characteristics would be as close to the policy site as possible. Failure to comply with all of the seven selection criteria would imply that the study will be excluded from the database.

Furthermore, this study adhered to the meta-regression analysis (MRA) research guidelines of Stanley et al. [42] for research literature searching, compilation, and coding. This included comprehensive documentation of the research literature searching process which consists of (1) exact databases or other sources used, (2) the exact combination of keywords applied, and (3) the date that the search was completed. As mentioned, this study used the ESVD, EVRI, TEEB Database, ASEAN TEEB Database, and Google Scholar in searching for original ecosystem valuation studies. This translates to four databases and one search engine. The main keywords used in searching for the studies are a combination of search strings which include the following: "economic valuation", "ecosystem services", "stated preference", "willingness to pay", "tropical forest", "forested watershed", "river", "wetlands groundwater", "spring", "indirect use value", "non-use value", "regulating service". The date for search completion was on May 11, 2022.

The information from the literature relevant to MA-BT was then encoded and cleaned in a Google Sheets file. While only one proponent searched and read the literature, two proponents were responsible for encoding the relevant literature. Sheet 1 labeled as "Overview of the primary valuation studies" contains the author/s name, type of publication, year of publication, study site/s, geographic location, type of biome/ecosystem/s, and the number of observations. Sheet 2 labeled as "Dependent variable" contains the WTP estimates from the retained studies which, as mentioned, were adjusted in 2020 USD per household per year. Sheet 3 labeled as "Explanatory variables" contains the study variables, stated preference method used, type of biome/ecosystem, and ecosystem services.

Results and discussion. The beneficiaries identified in this study were the residents of Wao, Lanao del Sur comprised of 50,366 individuals subdivided into 26 barangays and further grouped into 12,949 families of four according to the Wao Municipal Planning and Development Coordinator. As presented in Table 2, a usual household of four members earned an average annual income of PHP 110,169.76 which implies an average monthly income of PHP 9,180.81.

Table 2

Population and Annual Average Income per Barangay from CENSUS 2020 and Community-based Monitoring, 2021, Wao Lanao, del Sur

Barangay	Population	Number of families	Total annual income	Average annual income per family
Located within BRSW				
Balatin	639	110	9,969,040	90,627.64
Banga	1,567	430	30,163,637	70,147.99
Buntongan	1,363	387	31,878,700	82,373.90
Extension	2,425	616	134,001,764	217,535.33
Kilikili East	2,949	648	53,310,567	82,269.39
Kilikili West	3,159	803	71,827,848	89,449.37
Manila Group	3,064	936	153,106,282	163,575.09
Muslim Village	1,178	346	37,648,870	108,811.76
Panang	1,061	204	12,851,008	62,995.14
Park Area	4,000	943	72,817,761	77,219.26
Pilintangan	2,028	660	43,435,097	65,810.75
Serran Village	722	167	21,540,434	128,984.63
Subtotal	24155	6250	672,551,008	-
Surrounding Communities				
Amoyong	1,300	423	30,190,405	71,372.12
Buot	1,756	360	30,572,973	84,924.93
Cebuano Group	2,108	383	37,163,157	97,031.74
Christian Village	1,832	372	42,548,353	114,377.29
Eastern	2,970	650	138,994,795	213,838.15
Gata	1,377	360	46,672,161	129,644.89
Kabatangan	1,327	417	39,445,198	94,592.80
Kadingilan	1,538	370	16,034,488	43,336.45
Katutungan	2,316	747	69,297,756	92,768.08
Malaigang	1,019	228	25,575,996	112,175.42
Milaya	2,144	771	57,631,016	74,748.40
Mimbuaya	949	149	7,994,368	53,653.48
Pagalongan	2,613	802	81,571,882	101,710.58
Western	2,962	667	130,344,678	195,419.31
Subtotal	26,211	6,699	754,037,226	-
Total	50,366	12,949	1,426,588,233.88	110,169.76

Source: Office of the Local Civil Registrar (LCR) & Office of the Municipal Planning and Development Coordinator (MPDC), Wao Lanao, del Sur.

The average monthly household income in the Philippines in the first half of 2021 was PHP 12,498.33 [43]; this implies that Wao's average monthly household income was PHP 3,317.52 lower than on a national basis. In addition, the average monthly household income of the residents of Wao fell under the poor income class (below PHP 10,957.00 monthly income) based on the 2018 Philippine Institute for Development Studies (PIDS) income bracket classification [44].

Ecosystem Services Provided by the BRSW. As presented in Table 3, the key informant from Wao MENRO identified 17 ecosystem services provided by the BRSW. These services were composed of provisioning services, regulating services, and cultural services. According to the informant, regulating services have not been studied yet, so none of them is specified. The services listed were consistent with the ecosystem services of inland watersheds as determined by the MA [45]. From the identified ecosystem services, 5 were selected to be assessed for this study. Water provision for drinking and irrigation, flood control, climate regulation, and erosion prevention. Water provision for both drinking and irrigation was selected as these were considered priority resources in both the municipality's FLUP [37] and Watershed Management Plan Draft [36]. For the same reason, flood control, climate regulation, and erosion prevention were also selected.

Table 3

Ecosystem Services Provided by the Balatin River Sub-Watershed, Wao, Lanao del Sur

Ecosystem Services		
Provisioning services	Regulating services	Cultural services
Food; Fiber and fuel; Ornamental resources; Freshwater for drinking; Water for irrigation	Air-quality regulation; Climate regulation; Water regulation; Natural hazard regulation; Pest regulation; Disease regulation; Erosion regulation; Water purification and waste treatment; Pollination	Recreation & tourism; Aesthetic value

Source: MENRO, Wao Lanao del Sur.

Key Activities and Issues in the BRSW. Presented in Table 4 are the key activities and issues in the BRSW as determined by Wao MENRO. The presence of armed groups in the upland areas of the catchment complicates the management of the catchment and is expected to pose a challenge to the implementation of the proposed catchment management plan currently being developed. At present, these armed groups are burning the forest lands and do not manage the watershed area. In addition, currently, the migration rate is increasing and causing a problem for the watershed. People from neighboring and nearby municipalities who worked in the production areas such as plantations and farms have settled in the upland areas within the BRSW and are adding to the pressure on the watershed. In the case of Wao, foreign workers who do not possess IPRs settle in upland areas specifically in the supposed forest lands of the BRSW and have contributed to the conversion of forest lands into production areas and the increased exhaustion of the sub-watershed.

The forest lands of the watershed at the time of assessment were only at 29.5 % compared to the initially identified 66.4 % in the FLUP [37]. In contrast, the agricultural A&D lands were now at 70.5 % compared to its initial 33.6 % of the total watershed area. While the implementation of protected areas helped decrease and/or slow down the rate of degradation, the water quality has lowered over time due to unsustainable farming practices and anthropogenic wastes on the riverbank. It was learned that the Wao MENRO is drafting a management plan for the BRSW to address the degradation, especially its threat to the ecosystem services; however, there is a gap in information from the research and the academe as the informant stated that they have no access to relevant studies centered on the BRSW and the rest of the major sub-watersheds in Wao, Lanao del Sur.

Table 4

Key Activities and Issues in the Balatin River Subwatershed, Wao Lanao del Sur

Key activities	Key issues
Agriculture	Presence of armed groups' satellite camps; Increasing migration rate; Land conversion of forest lands into production areas
Farming	
Livestock	
Lumber	
Timber	
Poultry	
Recreational	
Tourism	
Resort	

Source: MENRO, Wao, Lanao del Sur.

Value of Direct Use Ecosystem Services of BRSW: Water Used for Drinking. The value of the water used for drinking was estimated based on the number of bills issued and the subsequent usage in cubic meters (m^3) by the Wao Water District which reflected the consumption rate of the households per barangay, and the residential water rates of Wao Water District. The government-owned and controlled corporation has four residential water rates – a base rate of 145.00 PHP for 0–10 m^3 and excess rates of 15.35 PHP per m^3, 16.50 PHP per m^3, and 18.10 PHP per m^3 for excess usage between 11–20 m^3, 21–30 m^3, and 31 m^3 onwards, respectively.

As presented in Table 5, there were a total of 4,543 households whose potable water source is the BRSW which translates to a consumption rate of 110,630 m^3 for the said month. Among the 16 barangays consumers identified, only 5 were located within the BRSW. This implies that the potable water service of the watershed extends beyond the political units located within the watershed. In addition, it is important to note that the number of bills issued, if equated to the number of households, would imply that 35.08 % of the total number of households in the municipality rely on the BRSW for their potable water consumption which further highlights the importance of the sub-watershed and its maintenance to ensure stable and safe drinking water for the users.

Table 5

Billings Issued and Billing Usage per Barangay for the Period December 2021, Wao, Lanao del Sur

Barangay	Bills Issued	Usage (in m^3)
Banga*	277	26457
Bo-ot	109	2113
Cebuano Group	113	1871
Christian Village	168	2562
Eastern Wao	925	20086
Extension Poblacion*	525	9862
Gata	209	3941
Kabatangan	180	2556
Katutungan	12	96
Malaigang	129	1927
Manila Group*	726	14704
Milaya	105	1746
Muslim Village*	132	3155
Pagalongan	377	5700
Pilintangan*	20	326
Western Wao	536	13528
Total	4543	110630

Note. * indicates barangays located within the BRSW.

Source: Wao Water District.

Presented in Table 6 is the water consumption in relation to the residential water rate. The total revenue was derived using the equation below:

$$TR = (4543 \cdot 145) + (39214 \cdot 15.35) + (7863 \cdot 16.5) + (18147 \cdot 18.10).$$

Because the per connection/household base rate was PHP 145.00 regardless of whether the household consumed 0 to 10 m^3 of water, the base rate was multiplied to the number of households instead of the actual maximum usage (10 m^3) to account the households which may not have consumed water for the month. From the information given, the estimated value of the water use for drinking service is PHP 1,718,870.10 per month or about PHP 20,626,441.20 per year. This study evaluated a higher value estimate compared to the study by Septarianti et al. [11] and Arfitryana et al. [12] which also used market price in estimating the economic value of the potable water service of their respective study areas.

Water Use for Irrigation. In this study, the value of irrigation was described through the unit base value of the land, and its productivity per hectare. The data on the unit base value of the land were obtained from office copy of the Municipal Assessor of province of Lanao del Sur's 2021 Schedule of Fair Market Values of Real Property Assessment and Classification. In addition, the productivity per hectare of irrigated land was described through the data gathered from the Key Informant Interview with the informant from the MAFAR – Wao office and a farmer; and regional data of palay (unhusked rice) production in BARMM obtained from the database of the Philippine Statistics Office – OpenStat. As presented in the Table 7, the unit base value of irrigated ricelands was much higher than that of non-irrigated rice lands.

Table 6

2021 Usage per Residential Water Rate per Cubic Meter, Wao, Lanao del Sur

Barangay	Usage per Residential Water Rate per cubic meter			
	145.00 PHP (0–10 m^3)	15.35 PHP/m^3 (11–20 m^3)	16.50 PHP/m^3 (21–30 m^3)	18.10 PHP/m^3 (30 m^3 onwards)
Banga*	2770	2770	2770	18147
Bo-ot	1090	1023	0	0
Cebuano Group	1130	741	0	0
Christian Village	1680	882	0	0
Eastern Wao	9250	9250	1586	0
Extension Poblacion*	5250	4612	0	0
Gata	2090	1851	0	0
Kabatangan	1800	756	0	0
Katutungan	96	0	0	0
Malaigang	1290	637	0	0
Manila Group*	7260	7260	184	0
Milaya	1050	696	0	0
Muslim Village*	1320	1320	515	0
Pagalongan	3770	1930	0	0
Pilintangan*	200	126	0	0
Western Wao	5360	5360	2808	0
Total	45406	39214	7863	18147

Note. * indicates barangays located within the BRSW.
Source: Wao Water District.

Table 7

Value of Farmlands Classified by Productivity and Sub-Classifications, 2021, Wao Lanao del Sur

Riceland	Productivity classification			
	Unit Base Value per hectare (PHP per hectare)			
	1st class	2nd class	3rd class	4th class
Riceland irrigated	218,010.00	187,590.00	147,030.00	-
Riceland not irrigated	147,030.00	126,750.00	106,470.00	-
Riceland upland	121,680.00	101,400.00	91,260.00	86,112.00

Source: 2021 Schedule of Fair Market Values of Real Property Assessment and Classification, Province of Lanao del Sur (Copy of Wao's Municipal Assessor).

The information presented in Table 8 was an estimate provided by the informant from the MAFAR – Wao Office. Due to the lack of available data for other costs incurred besides the cash costs, only the estimated returns after cash costs were estimated instead of net returns. The estimated average gross returns were determined by multiplying the estimated average yield (4,830 kg) with the 2020 mean farmgate price (16.01 PHP per kg) from the PSA [46] data. With the information gathered, the estimated returns after cash costs amounts to PHP 57,778.30. In addition, a farmer interviewed gave a rough estimate of his production costs and returns. He is a farmer in West Kilikili with a 1-hectare rice land irrigated through a flowing spring rather than a formal irrigation canal. The farmer roughly estimated a yield of 90–102 sacks – 42 kg per sack; a cash cost of PHP 18,000; and a net profit of PHP 15,000 to PHP 30,000 per cropping cycle. The estimates given are rough estimates citing reasons such as changing price levels, external problems, and case-to-case situations.

Table 8

Estimated Production Values of Irrigated Palay in Wao, Lanao del Sur, 2021

Estimated minimum yield		Estimated maximum yield		Estimated average yield		Estimated cash costs, PHP	Estimated average gross returns, PHP	Estimated returns after cash costs, PHP
sacks	kg	sacks	kg	sacks	kg			
110	4,620	120	5,040	115	4,830	22,550	77,328.30	57,778.30

Source: MAFAR-Wao.

To supplement the unavailable data from the MAFAR – Wao office, data from the Philippine Statistics Authority [46], were obtained from their OpenStat database and used to determine the productivity of irrigated lands in the BARMM region. The mean values of each category were utilized for the computation of the annual net profit of palay production in both irrigated and non-irrigated rice lands.

As shown in Table 9, the average yield for irrigated palay production was much higher than that of non-irrigated palay production while the total costs of production were close in amount. The gross returns per cropping cycle were higher for irrigated ricelands with a mean of PHP 66,528.33 compared to non-irrigated ricelands with a mean of PHP 44,810.33. Consequently, the estimated per hectare net profits of irrigated palay production were much higher compared to non-irrigated palay production with net profits of PHP 28,762.67 and PHP 8,127.33 per cropping cycle.

Table 9

Costs and Returns of Palay Production in BARMM, 2020

Type of palay	Total costs, PHP	Average yield per hectare, kg	Farmgate price, PHP per kg	Gross returns, PHP	Net returns/income, PHP
Irrigated:	-	-	-	-	-
Dry	37,705	3,668	17.52	64,273	26,568
Wet	38,112	4,666	14.69	68,513	30,401
Average	37,480	4,222	15.82	66,799	29,319
Mean	37,765.67	4,185.33	16.01	66,528.33	28,762.67
Non-irrigated:	-	-	-	-	-
Dry	39,678	2,476	17.52	43,393	3,715
Wet	33,295	3,140	14.69	46,106	12,811
Average	37,076	2,840	15.82	44,932	7,856
Mean	36,683	2,818.67	16.01	44,810.33	8,127.33

Source: data extracted from: BARMM data on production of Palay [46].

Given the data presented in the previous sections, it follows that the per hectare annual net profit or the productivity of irrigated palay production was significantly higher compared to non-irrigated palay production at PHP 57,525.34 and PHP 16,254.66 respectively (Table 10). Multiplied by the number of irrigated lands that were producing rice within the watershed (70 hectares), the estimated value for the provisioned water for irrigation amounted to PHP 4,026,773.80.

Table 10

BARMM Palay Production Estimated Annual Net Profit, 2020

Rice production	Calculation	Annual net profit, PHP
Irrigated	(28,762.67) · (2 cropping cycles)	57,525.34
Non-irrigated	(8,127.33) · (2 cropping cycles)	16,254.66

Source: own calculations.

Value of Indirect Use Ecosystem Services of BRSW. The value of the indirect use services considered for this study (flood control, climate regulation, and erosion prevention) were determined through a meta-analysis benefit transfer. Out of the 230 references produced from searching the databases and search engine, only seven studies met the selection criteria. The seven studies selected as presented in Table 11, met most of the selection criteria mentioned, and although there were some discrepancies, they were addressable.

Table 11

Overview of the Studies Selected for the Meta-Analysis Benefit Transfer

Author / Year / Study	Type of publication	Place of study	Type of biome	Sample size
Diafas (2014) Estimating the economic value of forest ecosystem services using stated preference methods: the case of Kakamega forest, Kenya [47]	PhD Dissertation	Kenya	Tropical Rainforest	147
Rahmat et al. (2012) The economic value of forest hydrological services: a case study at Bukit Suligi protected forest, the upper part of Siak Watershed Riau [50]	Journal Article	Indonesia	Tropical Rainforest	67
Amponin et al. (2007) Willingness to pay for watershed protection by domestic water users in Tuguegarao city, Philippines [52]	Working Paper	Philippines	River/ Spring	401
Negewo et al. (2016) Economic valuation of forest conserved by local community for carbon sequestration: the case of Humbo community assisted natural regeneration afforestation / reforestation (A/R) carbon sequestration project; SNNPRS, Ethiopia [53]	Journal Article	Ethiopia	Tropical Rainforest	218
Dang & Nguyen (2009) Willingness to pay for the preservation of Lo Go–Xa Mat national park in Vietnam [54]	Report	Vietnam	Tropical Rainforest/ Spring	900
Calderon et al. (2004) A water use fee for households in Metro Manila, Philippines [56]	Report	Philippines	Tropical Rainforest/ Spring	2232
Calderon et al. (2012) Households' willingness to pay for improved watershed services of the Layawan watershed in Oroquieta city, Philippines [25]	Journal Article	Philippines	Tropical Rainforest	400

Source: own research.

Among the reasons why the other studies were not considered are the following: none of the ecosystems/biomes considered for this study was assessed; the place of study is not located wholly in the tropics; the studies did not use stated preference methods; and, the studies were not primary valuation studies.

In the study by Diafas [47], the study measured poverty index in place of average income per month/year in which the study revealed that majority of the respondents have low income. According to the study by Ombogo [48], low-income households from Kakamega have a monthly income of KES 14,000 in 2016. The monthly income was transformed to 2014 prices by using the consumer price index (CPI) for the two periods taken from The World Bank database [49]. The study by Rahmat et al. [50] did not disclose the average household size of the respondents, hence, the average household size of four used for this study is from the Statistics Indonesia's [51] Indonesia Demographic and Health Survey 2012. In the study by Amponin et al. [52], the study produced three WTP values, however, only the multivariate approach result was retained as this study also considered multiple variables. On the other hand, the WTP value considered, in the study by Negewo et al. [53] was the max WTP instead of the bid values to maintain commodity consistency. Lastly, in the study by Dang & Nguyen [54], the study used range values for average household size wherein majority of the respondents had 1–5 family members. For this reason, this study will be using the 2009 average household size of 3.8 persons in Vietnam from the study by Guilmoto & Loenzien [55].

After standardizing the dependent and explanatory variables, the values were regressed using the Equation 6 model to obtain the following meta-analytic function coefficients (Table 12, Column 2) which were then multiplied to the policy site characteristics (Column 3). Finally, the values were added to estimate the indirect use values of the policy site. By using the meta-analytic function, the proponents were able to produce a unit value estimate of the BRSW which takes into consideration several important characteristics which includes the income of the beneficiaries, size of the policy site, types of ecosystems, and types of services being valued. Table 12 shows that the estimated willingness to pay of the residents of Wao, Lanao del Sur is USD 47.0161 (PHP 917.28) per household per year, multiplied by the number of households in Wao as of 2020 (12,949), the estimated annual WTP for indirect use services is USD 608,811.4789 in 2020 price levels or PHP 12,191,487.85 in 2021 price levels. Because the people of Wao do not actually pay this amount for the services being valued, it can be said instead that the users generate that level of benefit from the aforementioned regulating services of BRSW.

Compared with the earlier studies, the result from this study is comparable to that of Calderon et al. [25] where the result of their study generated a WTP of USD 40.59 (PHP 791.95) per household per year at 2020 price levels.

It is interesting to note that the coefficient for annual household income has a negative sign, denoting that as income increases by 1 unit, the overall WTP amount is reduced by -0.7622. This implies that for every increase in income, the WTP decreases. This is contrary to the assumption from the study by Calderon et al. [25] that the higher the income, the higher the WTP of the individual/household.

Table 12

Meta-analytic Function Transfer

Meta-analytic function variables	Meta-analytic function coefficients	Policy site characteristics	Coefficients x Policy site characteristics
Dependent: USD/hh/year (ln_WTP)	-	-	-
Constant	8.3122	-	8.3122
Annual Household Income (ln_inhh)	-0.7622	8.6389	-6.5846
Average Household Size (ln_hhsize)	0	1.3863	0
Size of study site in hectares (ln_sitesz)	0.0896	9.0488	0.8108
Provision Change (dummy: prch)	0.2851	1	0.2851
Tropical Forest (dummy: tf)	0	1	0
Spring (dummy: sp)	0	1	0
Flood Control (dummy: fc)	0.8794	1	0.8794
Climate Regulation (dummy: cr)	-0.5746	1	-0.5746
Erosion Prevention (dummy: sp)	0.7221	1	0.7221
Policy Site Value: USD/hh/year (ln)	-	-	3.8505
Policy Site Value: USD/hh/year	-	-	47.0161

Source: adapted from Brander [14].

However, a similar result was generated from the study by Shin et al. [30], whereby the income variable also had a negative sign, suggesting that low- and middle-income households are willing to pay more for water quality improvements than higher-income households. They argued that this may be because higher-income households are relatively less affected by water quality changes and that this income class can afford to find substitutes. Whereas, low and middle-income households are more sensitive to water quality conditions. These income classes are more willing to pay for water quality improvements as they can benefit from it in terms of lowering household water purification costs and lowering the moving/transportation costs to enjoy recreational activities in other areas. Similarly, for this study, it can be inferred that lower-income households can benefit from improvements in regulating services as they can avoid the damages associated with flooding and landslides, among other natural hazards that can be mitigated by the regulating services considered in this study.

It is important to note that in every benefit transfer study, the resulting estimate for the policy site is only as good and as certain as the certainty and accuracy of the values from the primary value studies. For this study, the selection criteria were put in place to minimize the differences in user, site, and study characteristics. As a consequence, the studies gathered were limited and the regression equation may result in more of an estimated figure that does not necessarily adhere to the existing assumptions about the relationships of the variables. According to Brander [14], when a valuation estimate can no longer deliver information that can allow for better decision-making, the degree of uncertainty is deemed to be unacceptable. For this study, the use of the estimated value is for raising awareness and providing a rationale for action, which according to the guide of Brander [14] requires low certainty. The resulting estimate is at best a ballpark figure, which will be useful in the policy recommendations later.

Economic Value of the Balatin River Sub-Watershed. Table 13 shows that the economic value of BRSW estimated from the primary provisioning and regulating services assessed in this study amounted to PHP 36,844,702.85 per year. The water for drinking provision service accounts for more than half of the total annual economic value at 55.9 %, followed by the estimated value of the regulating services at 33.1 %, and last will be the water for irrigation provision service which accounts for 10.9 %. The benefits generated from this study are distributed across different stakeholders. The water for drinking benefits accrue to the residents whose water is supplied by the BRSW through the Wao Water District, the water for irrigation benefits accrue primarily to the farmers, and the benefits of regulating services accrue entirely to the residents within the BRSW and the surrounding communities. It is important to note, however, that the benefits from the indirect use of the ecosystem services provided by the BRSW are not exchanged in the market. The values were expressed in monetary terms to illustrate a portion of the values generated by the sub-watershed.

Table 13

Annual Economic Value of the Balatin River Sub-Watershed, Wao Lanao del Sur

Ecosystem service	Annual value, PHP	Average annual value, PHP	%
Direct use value	-	-	-
Water for drinking	20,626,441.20	4,540.27 per household	55.9
Water for irrigation	4,026,773.80	57,525.34 per hectare	10.9
Indirect use value	-	-	-
Bundle of ES (Flood control, climate regulation, erosion prevention)	12,191,487.85	917.28 per household	33.1
Total	36,844,702.85	-	-

Source: own research.

The result of this study is consistent with the previous studies in that the economic value of the study site, BRSW, is positive. Additionally, consistent with the study by Thapa et al. [7], Baral et al. [8], and Septarianti et al. [11] which utilized multiple valuation methods, this study was able to produce a relatively higher estimated value by employing multiple valuation methods, in contrast to using just a single approach. However, in the study by Francisco [6], the per hectare value of Wao forestlands amounted to PHP 99,238.00, multiplied by the total area of forestlands in BRSW in 2003, the direct use value of BRSW from timber alone was PHP 554,133,083.40, which is PHP 517,288,380.60 (about 15 times) more than the result of this study. It is important to note that unsustainable timber production, through illegal and even legal means, are among the primary issues that have caused the degradation of the watershed in the first place [37]. In addition, the benefits from timber production only accrue to the few people involved in its production and do not serve the interest of other stakeholders. Whereas this study is focused on the value being placed by the residents of Wao, Lanao del Sur wherein the majority are from low-income households. Since the value of an ecosystem is a function of household income, among others, the economic value generated from this study is not expected be as high.

Conclusions. This study estimated the economic value of the ecosystem services provided by the BRSW using a combination of market and non-market-based valuation methods. The primary ecosystem services provided by the BRSW were provisioning services (food, fiber and fuel, ornamental, potable water, irrigation water), regulating services (air-quality regulation, climate regulation, water regulation, etc.), and cultural services (recreation & tourism, aesthetic value). The partial economic value of the BRSW amounts to about 37 mln PHP per year or about USD 747,727.13 per year in 2021 average exchange rate. This illustrates a portion of what has been neglected over the past decades as the BRSW continues to degrade.

The potable water service accounts for the highest value, moreover, this service extends beyond the political units located within the watershed which implies that the BRSW is currently an indispensable resource. Because potable water holds the highest value, interventions centered on improving water quality such as protection (and its maintenance), apprehension of illegal activities, water treatment facilities, etc., should hold priority in the BRSW management plan.

In the planning and preparation of the BRSW management plan, the income level of the residents should also be considered in determining the payment vehicle as majority of the users come from low-income households. Also, it was noted that information about the watershed is mostly compiled in one department – the MENRO. Consequently, verification and gathering of data mostly fall on this department. While it is understood that the department is central in the management of the sub-watershed, the management plan being drafted is multi-stakeholder, and should therefore involve other sectors. As such, collaboration across partners and stakeholders is imperative. In conclusion, this study assessed the partial economic value of selected ecosystem services of the BRSW that can help policymakers in policymaking and implementation.

Due to the limitations in time, access to information, and challenges encountered in the conducting this study, it does not reflect the full-scale extent of the values that the BRSW has. Despite this, the study is a first in the municipality and thereby can be used as an input in the appraisal of the watershed's economic value. Also, improvements on the methodology and scope of future studies are recommended by the authors of this study. In addition, data limitations have placed limitations on study design, so future investigators can use better and more robust study design and analysis. It may also help fill gaps in research and information regarding the Balatin River Sub-Watershed and the remaining sub-watersheds of Wao, Lanao del Sur also suffering from degradation.

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Citation:

Стиль – ДСТУ:

Vicente M. C., Loja P. J., Subade R. Economic valuation of ecosystem services in Balatin River Sub-Watershed, Southern Philippines. *Agricultural and Resource Economics*. 2023. Vol. 9. No. 1. Pp. 139–166. https://doi.org/10.51599/are.2023.09.01.07.

Style – APA:

Vicente, M. C., Loja, P. J., & Subade, R. (2023). Economic valuation of ecosystem services in Balatin River Sub-Watershed, Southern Philippines. *Agricultural and Resource Economics*, 9(1), 139–166. https://doi.org/10.51599/are.2023.09.01.07.