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Economic valuation for the conservation of the Huallaga River by the population of Tingo María, Las Orquídeas – Naranjillo de Leoncio Prado section

Valoración económica para la conservación del río Huallaga por la población de Tingo María tramo las Orquídeas – Naranjillo de Leoncio Prado

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Abstract

The objective of the research work was to estimate the economic valuation for the conservation and/or protection of the Las Orquideas to Naranjillo section of the Huallaga River on behalf of the population in Tingo Maria, [Peru], and the nearby areas. In order to estimate the willingness to pay (WTP; DAP in Spanish), a survey was done [with a] questionnaire, organized according to the contingent valuation method. For the statistical analysis, the probabilistic, logistic, and multiple linear regression econometric models were used. According to the results of the analysis, it was concluded that the demand curve of the probabilistic model was: WTP-P = 1.097*X7 + 0.762*X12 + 0.443*X13 – 0.219*X16 – 0.582*X17; [for the] logistic model, it was: WTP-L = 1.811*X7 + 1.313*X12 + 0.778*X13 – 0.374*X16 – 0.999*X17; and [for the] multiple linear regression model, it was: WTP-RLM = 0.494 + 0.051*X1 + 0.267*X7 + 0.194*X12 + 0.109*X13 – 0.062*X16 – 0.169*X17; where X1: type of home, X7: assessment of the Huallaga River, X12: intervention [in the] conservation of the Huallaga River, X13: level of education, X16: price they were willing to pay, and the WTP. The average willingness to pay predicted at 84.54% [accuracy]. For the probabilistic model, the average WTP was 6.87 soles, with a variation of 52.97%; [for] the logistic model, the average WTP was 6.84 soles, with a variation of 52.60%; and [for] the multiple linear regression model, the average WTP was 14.92 soles, with a variation of 23.10%.

Keywords: Economic valuation, willingness to pay, econometric model, Huallaga River.

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Resumen

El trabajo de investigación ha tenido por objetivo estimar la valoración económica para la conservación y/o protección del río Huallaga por la población de Tingo María y aledaños en el tramo Las Orquídeas – Naranjillo, para estimar la disponibilidad de pago, se utilizó una encuesta y su cuestionario, organizado de acuerdo con el método de valoración contingente, para el análisis estadístico se emplearon los modelos econométricos probabilísticos, logístico y regresión lineal múltiple; de acuerdo al análisis de los resultados se concluyó que la curva de demanda con el modelo probabilístico es: DAP-P = 1,097*X7 + 0,762*X12 + 0,443*X13 – 0,219*X16 – 0,582*X17; modelo logístico es: DAP-L = 1,811*X7 + 1,313*X12 + 0,778*X13 – 0,374*X16 – 0,999*X17; y modelo de regresión lineal múltiple es: DAP-RLM = 0,494 + 0,051*X1 + 0,267*X7 + 0,194*X12 + 0,109*X13 – 0,062*X16 – 0,169*X17 (donde X1: tipo de vivienda, X7: apreciación del río Huallaga, X12: intervención la conservación del río Huallaga, X13: grado de instrucción, X16: precio de la disponibilidad a pagar, y X17: forma de pago del DAP); la media de disponibilidad de pago predice un 84,54%, para el modelo probabilístico la media del DAP es de 6,87 soles y una variación de 52,07%, el modelo logístico la media del DAP es de 6,84 soles con una variación de 52,60%, y el modelo de regresión lineal múltiple la media del DAP es de 14,92 soles con una variación de 23,10%.

Palabras claves: Valoración económica, disponibilidad a pagar, modelos econométricos, río Huallaga.

INTRODUCTION

A natural human right is access to water, due to its multiple functions that it has for every living being, both in quality and quantity, which is why it is essential for the health of humanity, since within the composition of the human being , 70% is water, and by only losing 1% of the water in the human body, the person begins to feel thirsty, and with the loss of 10% of the water in the human body, the person is in danger of death; This is why it is important to study this resource, in order to value it and become aware that there are strong threats of scarcity and contamination by the same population and by public and private institutions that do not comply with the guidelines established in each country; The population has to understand that they have to commit directly to conserving and/or protecting this resource, because if they do not, as time goes by, it will be more complex and difficult to make commitments, due to the high level of contamination and scarcity, so now it is in the people's own hands to take on this challenge.

The Provincial Municipality of Leoncio Prado does not have a wastewater treatment plant, as well as its 10 districts, so all these effluents end up in the waters of the Huallaga River and it has also been seen in the marginal part of this river, solid waste, which is thrown by some people nearby and/or who live near the Huallaga River; then it is understood that these activities contrary to our legislation alter the environmental quality of this resource, as well as the ichthyological

biodiversity and the scenic and/or aesthetic beauty, since, in addition, the population of the city of Tingo María uses this resource as a spa recreation. and also takes advantage of the ichthyological resource for human consumption; So logically there is an environmental problem with this resource, and this in turn being generated by the population of the city of Tingo María and surrounding areas; and it is also important to emphasize that the Seda – Huánuco company uses groundwater, and that it is located on the right bank of the Huallaga – Puente Corpac river, for the consumption of almost the entire population of the city, from what is understood, that In a way it is also part of the Huallaga River, due to hydrological processes; It is then understood that for all the ecosystem and environmental services that this water resource provides, its conservation and/or even its protection is essential, which is why the economic participation of the population is necessary, since they themselves would benefit directly and indirectly. for this water resource, thus leaving a legacy for future generations; and not be so hopeful that the state will invest in the conservation and/or protection of the Huallaga River, so all of this would be a bureaucratic process that would take a long time, until that would get worse and generate a more significant alteration to the resource. water, with few possibilities for its restoration; These are the reasons for carrying out this research, it is necessary to understand what the perception of the population of Tingo María is and what is the economic predisposition to protect or conserve it, since the municipality does not develop projects for this purpose.

Since there is evidence that the water of the Huallaga River shows contamination and there are no works on the economic valuation of the contamination of the Huallaga River, the objective of the research work is to estimate the economic valuation for the conservation of the Huallaga River by the population of Tingo María section. The Orchids – Naranjillo by Leoncio Prado, 2022.

MATERIALS AND METHODS

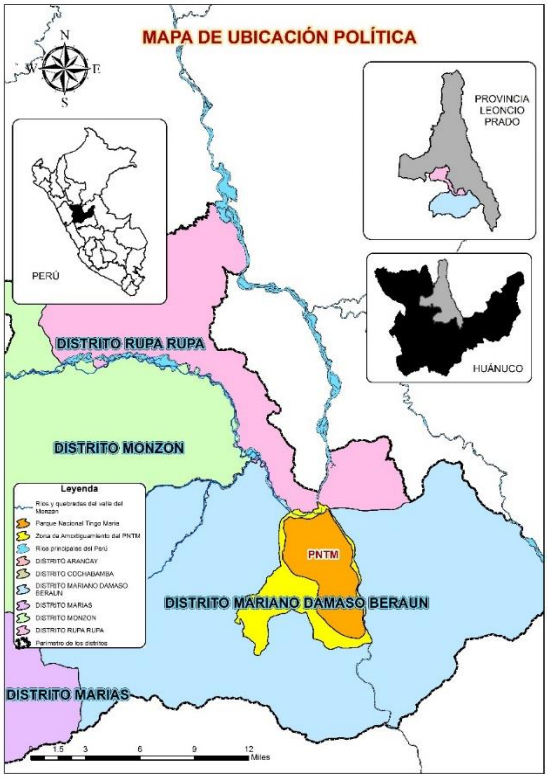
General characteristics of the study area

Political location

The research study was carried out in the city of Tingo María in the sections of Las Orquídeas - Naranjillo, which is politically located in the department of Huánuco, province of Leoncio Prado, district of Rupa Rupa and Luyando.

Figure 1

Political location map



Geographic location: The center of the city of Tingo María is geographically located according to the coordinates in UTM Datum WGS84, zone 18L:

Table 1

Geographic location of the study area

Coordenadas geográficas		
Zona	**Este**	**Norte**
Tingo María	390323	8972095

Living zone

The life zone of the locality in terms of the classification of plant formations in the world and according to the bioclimatic diagram of Holdrige (1994), Tingo María is in the life zone of very humid Premontane Subtropical Forest (bhm - PST) (ZEE-Huánuco, 2017).

Weather conditions

The Bella Alta meteorological station that corresponds to the district of Mariano Dámaso Beraún registers an annual average maximum temperature of 29.7 ºC and an annual average minimum temperature of 20.4 ºC, with the annual average temperature being 25.0 ºC, for the year 2020. Relative humidity annual average is close to 85%. The average annual precipitation is 3,847.3 millimeters.

Materials and equipment

Materials

Field notebook and pencils, pilot surveys, definitive surveys, cartographic materials, economic valuation information log, paperwork, and field material (boots, machete, hoods, etc.).

Equipment

Garmin Map 64s GPS Navigator, Canon SX420 IS 20 MP Camera, Hp Laptop Pavilion 15-CW1008LA 15.6" RYZEN 7 512GB 8GB Laptop, EPSON EcoTank L5190 USB WiFi Multifunctional Printer, Yamaha XTZ 125 motorcycle.

Methodology

To estimate the economic value, the contingent valuation method was used. This method has allowed us to determine the price of the willingness to pay of the population of the city of Tingo María and surrounding areas, to conserve the Huallaga River, to determine the perception of value. economic, there must be changes in the well-being of the population, these behaviors occur from certain conditions that an environmental asset or an ecosystem offers as a good or service (Azqueta, 1995). In the study, the contingent valuation method was applied, and the survey technique was used and the data collection instrument was a dichotomous and polytomous class questionnaire. Also for the DAP question, a hypothetical scenario was created in order to to conserve and/or protect the Huallaga River (Riera, 1998; Pearce and Turner, 1995; Mitchell and Carson, 1989).

Riera (1998) indicates that to apply contingent valuation, the field or object of application of the CV must first be taken into account, adequate sampling of the relevant population must also be

carried out, hypothetical scenarios for the valuation must be generated, selection of the technique for conducting the survey, preparation of the questionnaire for its pilot and definitive application, application of the surveys to the sample, performance of the statistical analyzes according to the econometric models under study.

Study analysis

Variable and research indicators

The X or exogenous variable: economic valuation

The Y or endogenous variable: conservation of the Huallaga River

The intervening variables: Population of Tingo María section Las Orquídeas - Naranjillo

Table 2

Indicators of the research variables

Code	Indicators	Description
x1	Housing type	Open nominal variable: Wood (1), Fine material (2) and Wall and corrugated board (3)
x2	Sex	Nominal variable: Feminine (0) and Masculine (1)
X3	Type of uses given to RH water	Nominal variable: For irrigation (1), For bathing in the river (2), For fishing (3), Wash vehicle (4), Wash clothes (5), Direct consumption (6), Other (7), More than two options (8)
x4	Frequency of recreational use of RH / month	Ordinal variable: Never (1), Once a month (2), Twice a month (3), Three times a month (4), and More than four times a month (5)
X5	Learn about water pollution	Dichotomous nominal variable: No (0) and Yes (1)
X6	Ways you think it is contaminated	Nominal variable: When they throw solid waste (1), With the drains (2), Washing clothes with detergents (3), With agrochemicals from crops (4), With oils - washing cars (5), All (6), Others (7), and More than two options (8)
X7	Consider that the RH is contaminated	Dichotomous nominal variable: No (0) and Yes (1)
X8	Magnitude of RH contamination	Ordinal variable: Light pollution (1), Medium pollution (2), and Highly polluted (3)
X9	Water quality of the Huallaga River	Ordinal variable: Excellent (1), Good quality (2), Acceptable (3), Contaminated (4), and Heavily contaminated (5)
x10	Who are in charge of taking care of HR in the province?	Nominal variable: Municipality (1), JASS (2), ALA (3), The population (4), Senasa (5), and Others (6)
X11	Water pollution causes harm to humans. Does this worry you?	Ordinal variable: A lot (1), A little (2), and Does not care (3)
x12	You intervene in the care of the Huallaga River	Dichotomous nominal variable: No (0) and Yes (1)
X12-1	Form of intervention for HR care	Nominal variable: Not throwing RS (1), Helping with cleaning (2), Raising awareness (3), Segregating (4), and others (5)
X13	Educational level of the head of the family	Ordinal variable: Illiterate (1), Primary (2), Secondary (3), and Higher (4)
X14	Current occupation of the head of household	Nominal variable: Employee (1), Farmer (2), Businessman (3), Transporter (4), and Others (5)
X15	Monthly family income	Ordinal variable: Less than s/. 1025 (1), Of s/. 1025 as/. 2000 (2), From s/. 2000 as/. 3500 (3), and More than s/. 3500 (4)
Y1	Willingness to pay (WTP)	Dichotomous nominal variable: No (0) and Yes (1)

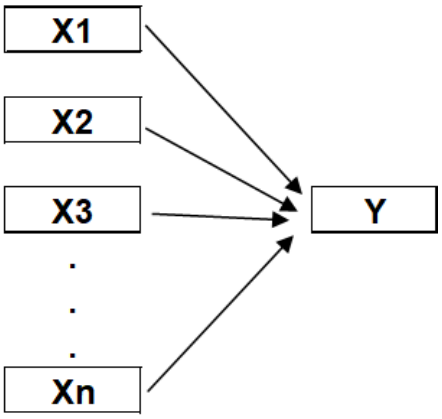
Y2	Willingness to pay (WTP) according to price	Dichotomous nominal variable: No (0) and Yes (1)
X16	Price - DAP	Ordinal variable: s/ 1.00 (1), s/ 2.00 (2), s/ 3.00 (3), s/ 4.00 (4), s/ 5.00 (5), s/ 7.50 (6), ys/ 10.00 (7)
X17	How would you like the payment method to be?	Nominal variable: Included in the water/electricity rate (1), Included in taxes (2), Other form (3), and Voluntary form (4)

Design and research

The research design was non-experimental, cross-sectional or correlational-causal.

Figure 2

Research design outline



Statistic analysis

For the analysis, the test of the behavior of the data was considered, to subsequently model with the logistic, probabilistic functions and the multiple linear regression function, for the validation of the indicators the t statistic was used and for the general model the chi was used. square (Mendelhan, 1990).

Descriptive statistics were also used, such as the average, minimum and maximum values, variance, standard deviation, coefficient of variation and statistical error (Daniel, 1991, Mendenhall, 1990).

To select the variables and/or indicators, the t statistic was used and the chi square was used to validate the model.

Definition of the object of valuation

Burneo (2002) indicates that frequently most environmental goods and services can be quantified from modeling and therefore can be applied. The object is to carry out the economic valuation of the Huallaga River for its conservation and protection.

For this, the use of econometric functions such as logistic, probabilistic, and multiple linear regression was considered.

These models will allow generating coefficients or rates of change. suitable for their respective variables under study, which generates the demand curve for the environmental good or service to conserve the Huallaga River, subsequently the selection of the significant variables for the demand curve model will be carried out, this procedure was carried out for each function econometric, once the demand curve models have been available, simply through an algebraic operation the individual economic value (availability of payment) has been determined, to then have the average of the WTP and subsequently the coefficient of variation of this parameter.

The value that comes from the DAP simply measures the tastes and preferences of individuals, due to the importance that the population believes it should be (Pearce and Turner 1995).

Population

The study population was represented by the number of private homes with occupants present (generally there is one family per home) in the town of Tingo María, so in this study there were 14,540 homes (INEI, 2022).

Sampling

To determine the sample size, the formula proposed by Hernández et al. (2014):

$$n = \frac{Z^2_{1-\alpha/2} N^* p^* q}{(N-1)E^2 + Z^2_{1-\alpha/2} * p^* q}$$

Where:

n = Number of respondents (486 households)

N = Total homes in the town of Tingo María (14540)

Z = 95% confidence level=1.96

p = Affirmative proportion (50%)

q = Negative proportion (50%)

E= Precision (estimation error) (5% = 0.05)

Market simulation

Riera (1998) indicates that the hypothetical scenario to determine the economic value must be a real fact. In the case of the research, a hypothetical scenario of an environmental project was created that allows conserving and protecting the water resource through reforestation, riverbank protection, wastewater treatment plant, solid waste management and implementation of environmental standards. that help to conserve and protect the resource, and to have a final result of quality and quantity of water from the Huallaga River which can allow the use of water for recreational purposes without any risk, reduction of flooding, wastewater that meets water quality standards, regulations that help recover ichthyological diversity, so that fish consumption is safe and without the risk of getting sick; Safe ways of collecting the population's contribution were also considered as a question. This question guarantees trust in the population (Riera, 1998 and Linderbg and Halpenny, 2001). With respect to the starting prices, pilot surveys were carried out, this theme guaranteed the reduction of starting biases, presenting them with a fair price and the average availability of the population; The final questionnaire was divided into three parts, first on the socioeconomic and environmental conditions, the second part on the questions on the availability of payment, and the third on the general information of the respondent.

Surveys and interviews

The pilot survey helped in the preparation of the final survey, the use of an initial survey allows biases to be reduced, therefore, it is understood that the questionnaire is reliable. The final questionnaire was structured in three parts. The first part focused on the collection of general information about the respondent, the second part consisted of collecting information on the socioeconomic factors or characteristics of the respondent such as the level of education achieved, the occupation they currently have and the economic income, in this factor were considered significant ranges, in order to give confidence to the respondent and not embarrass him for what he perceives monthly, he could also generate honesty in his answers (Riera, 1998); as well as obtain information on his level of knowledge regarding the Huallaga River; and the third part consisted of explaining the

hypothetical conservation and/or protection scenario to define its DAP.

The sample was selected randomly, the surveys were carried out between the months of August to December 2022. The surveys will be carried out in the urban area of the city of Tingo María, especially around the bed of the Huallaga River between the sections of Las Orquídeas up to approximately Naranjillo; Furthermore, the methodology establishes that it is preferable for the respondent to observe the landscape and/or setting while the interviewer asks him how much he would be willing to pay to enjoy that landscape and promote its protection and/or conservation.

The modality of the survey will be personal and on-site with the families of the population of the city of Tingo María, leisure time will be taken advantage of, which is frequently in the afternoons, with this it was achieved that individuals are willing to collaborate with a survey (which takes time away); In addition, only 18 questions were considered, this in order not to make the respondent feel like a waste of time, and in this way biased responses were avoided, which adversely influences the analysis of the results, the completion of the survey lasted between 10 to 20 minutes, this has depended on the form of attention and patience of the respondent to the interviewer and/or interviewer.

RESULTS AND DISCUSSION

Characteristics of socioeconomic and environmental indicators

According to the results of the surveys, it has been found that 46.3% of the homes are made of wall and corrugated board, 40.5% of the homes are made of noble material, and 13.2% of the homes are made of wood. , it is necessary to specify that the largest number of surveys carried out randomly on homes were in the marginal strips and surrounding the banks of the Huallaga River in the district under study; Furthermore, INEI reports that one in three homes have inadequate physical characteristics, also indicating that the use of noble construction materials prevails in the urban area (MPLP, 2018), so it can be indicated that the results differ relatively according to reported by INEI, it can then be understood as the updating of information on the conditions of the homes, currently the construction sector has increased significantly where homes of inadequate conditions have been replaced by more resistant materials in the city, this also It can be defined as a positive relative economic growth, which is good for the population of the city of Tingo María, so they could take on interesting challenges, such as economic contributions for the conservation and protection of this natural resource “Huallaga River” that every month and year they have been degrading and altering their natural biocapacity

It has also been found that 43.6% of the respondents were male and 56.4% were female, with a difference somewhat relative to what was reported by the INEI (2022), who indicate that in Rupa Rupa the male sex represents 49.4%; It is necessary to specify that these results were obtained during work hours, where possibly the male sex at that time was not at home.

It was also found that 49% of the population does not use the water of the Huallaga River directly, 15% uses the waters of the Huallaga River for

recreation purposes, 10.3% uses the water to wash clothes, 6.6% use it to wash their vehicles; It can also be seen that 4.3% of the population uses the water of the Huallaga River to bathe and wash clothes, 3.9% to bathe and wash their vehicles, 3.1% use the water for the purpose to carry out recreational activities such as fishing, 2.3% use water to irrigate some crops and also carry out recreational activities, 2.3% carry out fishing activities and bathing; Therefore, it can be seen that approximately 50% of the population carries out different daily activities in the river, observing that with the passage of time the population has less impact on the direct use of the water of the Huallaga River, something that in previous years the use of this resource was more frequent, it is understood that this fact happens due to the pollution generated to the Huallaga River and this makes the population increasingly less interested in the direct use of this resource, there being certain fears when using the water of the Huallaga River.

It was also found that 49% of the population does not use the water directly from the Huallaga River, while 23.9% uses the water at least once a month, 10.7% uses it at least twice. per month, 8.0% use water approximately three times a month and 8.4% use water directly more than four times a month. Figure 3 indicates the most frequent uses given to the waters of the Huallaga River; Also specify the population that uses the most of these resources are those who live in the marginal strip and around the Huallaga River.

It was also found that 99% of the population knows about issues related to water pollution, while 1% of the population is unaware of the issue. These results are directly related to the INEI report, which indicates that the illiteracy rate In the town it is 4.5%, but it can also be indicated that despite this, some population without any study knows about pollution issues, so it could be assumed that it is due to the social environmental education programs bombed by the television and radio media, understanding that it directly influences the population.

The result was also found that 42.4% of the population perceives that the waters of the Huallaga River are contaminated with the discharge of solid waste and sewage that comes from the drains, 21.8% of the population indicates that pollutes with solid waste, drains, agrochemicals, detergents, motor vehicle oils, 20% of the population believes that the pollution problem is solid waste thrown into the river, 13.6% believes that pollution occurs through sewage, 0.4% indicates that the contamination is due to solid waste and agrochemicals; Therefore, it can be noted that there is knowledge of the environmental problems generated by solid waste, a topic quite developed by the provincial municipality of Leoncio Prado and the educational institutions of schools, technical institutes and higher education institutions, it can then be understood that There is adequate work on the part of all state institutions regarding training and social projection on environmental issues.The results were also found that 97% consider that the Huallaga River is contaminated, while 3% indicate that the Huallaga River is not contaminated; corroborating this perception according to the determination of the quality of the Huallaga River in Tingo María based on physicochemical and microbiological parameters by Dimas (2012), who states that the

river water is at risk for recreational use and much more so for consumption use. human.

It was also found that 65.9% of the population perceives that the water of the Huallaga River is moderately contaminated, while 26.8% of the population perceives that the water of the Huallaga River is highly contaminated, and 7.3% of the population perceives that the water of the Huallaga River is slightly contaminated, with respect to this issue, the Provincial Prosecutor's Office Specialized in Environmental Crimes indicates that the Huallaga River is highly contaminated, this assessment is due to the fact that all cities, centers Towns and hamlets that are adjacent to the Huallaga River discharge their wastewater, contaminating the river, where Barreto (2020), in his investigation of wastewater discharge and its influence on the pollution of the Huallaga River, demonstrates that it directly influences the pollution of the river water.

It was also found that 54.5% of the population perceives that the water is contaminated, while 22.2% of the population perceives that the water of the Huallaga River is heavily contaminated, 19.5% of the population perceives that The water of the Huallaga River is of acceptable quality, 3.5% of the population perceives that the water of the Huallaga River is of good quality, and 0.2% of the population believes that the water is of excellent quality; Within the scope of the ALA Tingo María, 69 potential sources of contamination were located, of which 52 were domestic wastewater, 11 solid waste dumps, 3 industrial discharges, 2 mine water discharges and one mining liability (ANA, 2015), this This fact affects the quality of the water of the Huallaga River, therefore the perception of the pollution of the Huallaga River by the population of the city of Tingo María.

It was also found that 71.4% of the population considers that they are in charge of protecting and conserving the Huallaga River, while 24.7% considers that the Provincial Municipality of Leoncio Prado is in charge of conserving and protecting. 2.5% consider that those in charge of conserving and protecting are the National Superintendency of Sanitation Services (SUNASS), and 0.2% of the population consider that those in charge of conserving and protecting the Huallaga River are the Local Authority of the Water.

It was also found that 63% of the population is very concerned about the damage that contamination of the water of the Huallaga River can cause to public health, since it is used in recreational activities, as well as 35% of the population is concerned. Little about the pollution of the Huallaga River can be understood, because they are people who live far from the Huallaga River and do not carry out any direct activity, and 2% are not concerned about the damage that the Huallaga River may cause to the population.

In the work developed by Cantú (2020) on concern and deterioration of environmental quality, he has found that 43% of the population cares little about environmental quality, statistically maintaining a relationship according to the results obtained, this behavior is possibly gives to the irrational externalization of the human being in the face of environmental events or changes (Clavijo et al., 2018), becoming responsible for the structural modifications and functioning of the ecosystem from the various

activities that the population develops to survive (Marín et al., 2016).

It was also found that 68.3% of the population does intervene in the care of the sources of the Huallaga River to the extent of its possibilities, such as not throwing solid waste into the river, raising awareness among the population about the importance of the quality and quantity of the water, participating in revegetation programs, and being willing to collaborate economically for the conservation of this resource; but 31.7% of the population does not intervene in the care of the Huallaga River, possibly this behavior is because they think that the state agency is responsible for conserving and protecting this environmental resource. In Figure 15 it can be seen that 72.0% of the population that intervenes in the care of the Huallaga River (68.3%) takes care not to throw solid waste into the Huallaga River, 6% raise awareness, 3.9% secrete solid waste, 1.4% help with cleaning on the banks of the Huallaga River, and 16.7% carry out other activities such as revegetation in the marginal strips.

It was also found that 46.9% of the population has a complete secondary education level, 32.3% of the population has a complete primary education level, 18.5% of the population has a technical and higher education, and 2.3% of the population has no education; The INEI (2022), projects according to the census carried out in 2017, 4.5% of the illiterate population for the district of Rupa Rupa, which according to the results obtained, the level of illiteracy is lower; Espejel & Flores (2012) indicate that environmental programs that contain viable and concrete actions can reduce or mitigate environmental problems by generating values, skills and competencies in the studied or trained population; Likewise, Arriola (2017) has found that there are statistically significant relationships between the empirical variables of a conative, cognitive, and affective dimension, and the active participation of environmental awareness in environmental education.

It was also found that 27.4% of the population is employed by both public institutions as well as private companies, 19.3% of the population is independent having their own businesses, 12.3% of the population is a farmer, 11.7% of the population are transporters, and 29.2% of the population carries out other activities such as students of institutes and universities and some of them are unemployed due to the economic situation of the country.

It was also found that 64.8% of the population has an income less than the minimum vital remuneration (less than S/1025), 27.7% of the population has an income between S/1025 to S/2000, 6.8% of the population has an income between S/2000 and S/3500, and 4.7% of the population has an income greater than S/3500; in the study on the willingness to pay for maintaining the use of drinking water from the Morroa aquifer (Álvarez & Schmalbach, 2017) has found a statistically significant relationship with the empirical variable monthly income, as well as in the study of willingness to pay for a plan of conservation of the Tunjuelo River Bogotá - Colombia, in his study he has found a significant direct and indirect statistical relationship between the empirical variable income and the willingness to pay, Mendieta (2000) in an econometric analysis demonstrates

that the variable income is statistically significant naturally, which is always in the economic models of non-marketable goods and services; That is why its determination is of great importance, but also to understand as data, this variable is sensitive, not all respondents provide this information in a deliberate manner, this data always leads to certain biases in the econometric models, that is why in this Care has been taken when asking this question, indicating that the surveys are confidential and that the data will only be used strictly academically.

It was also found that 85.8% of the population has a willingness to pay monthly for the conservation and protection of the Huallaga River, while 14.2% does not have a willingness to pay monthly, generally due to variables that They are related to income, level of education, gender, etc., especially the education variable plays a very important role when making the decision about your availability to pay; and according to the results, it is related to the educational level of the district's population.

17.9% of the population is willing to pay S/5.0 for the conservation and protection of the Huallaga River, 15.8% of the population is willing to pay S/2.0, 15.1% of The population is willing to pay S/1.0 for the conservation and protection of the river, 12.8% of the population is willing to pay S/3.0, 12.6% is willing to pay S/4, 0, 12.6% of the population is willing to pay S/7.5, 12.4% of the population is willing to pay S/10.0, 0.4% of the population is willing to pay S/7.0, and 0.2% of the population is willing to pay S/1.5 and S/2.5.

According to the results, 63.8% of the population would like their contribution or willingness to pay to be included or collected in municipal property taxes, such as self-assessment; 18% of the population would like their willingness to pay to be charged in electricity rates or water rates, 16.8% of the population would like their willingness to pay contribution to be charged voluntarily, considering that the provincial or district municipality should have an office to collect contributions; and 1.4% of the population would like their contributions to be collected through other mechanisms such as door-to-door collection or through cable TV, etc.

Estimation of the demand curve for the environmental asset

Table 3 shows that 12 indicators have a coefficient of variation of less than 50%, such as: type of housing (X1: 29.90%), types of uses given to the water of the Huallaga River (X3: 35.17%), knowledge about water contamination (X5: 10.21%), consideration or appreciation that the Huallaga River is contaminated (X7: 17.86%), magnitude of the Huallaga River contamination (X8: 25.0%), appreciation of the quality of the water of the Huallaga River (X9: 19.19%), who consider that they are in charge of caring for the Huallaga River in the province (X10: 40.81%), consider that water contamination causes damage to humans. Does this worry you? (X11: 37.75%), educational level of the head of the family (X13: 26.72), assessment of willingness to pay (WTP) without price (Y1: 40.72%), and how you would like the form of payment (X17: 39.18%), it is important to highlight the behavior of the data, because it is important to know the level of homogeneity (Mendenhall, 1990 and Wayne, 1991), according to the results it can be indicated that Although the evaluation was carried out in

different economic strata of the city of Tingo María, the majority of the population understands the pollution issues and the current state of the Huallaga River; However, nine indicators have a coefficient of variation greater than 50%, indicating that there is heterogeneity in their responses, such as thesex or gender of the respondent (X2: 113.8%),frequency of recreational use of the Huallaga River per month (X4: 63.81%), ways that the population believes the Huallaga River is contaminated (X6: 54.78%),the population intervenes in the care of the Huallaga River (X12:68.18%), form of intervention to care for the Huallaga River (X12-1: 81.36%), Current occupation of the head of household (52.25%), Monthly family income (X15: 54.09%) , willingness to pay (WTP) according to the proposed price (Y2: 73.09%), and Price – proposed WTP (X16: 64.73%).

Table 3

Descriptive statistics of the variables under study

Indicators	Code	Minimum	Maximum	Median	Half	Variance (n-1)	Standard deviation (n-1)	Coefficient of variation (%)
Housing type	x1	1	3	2.00	2.33	0.49	0.70	29.90%
Sex	x2	0	1	0.00	0.44	0.25	0.50	113.80%
Type of uses given to RH water	X3	1	8	7.00	5.84	4.21	2.05	35.17%
Frequency of recreational use of RH / month	x4	1	2	2.00	2.03	1.68	1.30	63.81%
Learn about water pollution	X5	0	1	1.00	0.99	0.01	0.10	10.21%
Ways you think it is contaminated	X6	1	8	6.00	5.33	8.52	2.92	54.78%
Consider that the RH is contaminated	X7	0	1	1.00	0.97	0.03	0.17	17.86%
Magnitude of RH contamination	X8	1	3	2.00	2.19	0.30	0.55	25.00%
Water quality of the Huallaga River	X9	1	5	4.00	3.95	0.57	0.76	19.19%
Who are in charge of taking care of HR in the province?	x10	1	6	4.00	3.31	1.82	1.35	40.81%
Water pollution causes harm to humans. Does this worry you?	X11	1	3	1.00	1.39	0.28	0.53	37.75%
You intervene in the care of the Huallaga River	x12	0	1	1.00	0.68	0.22	0.47	68.18%
Form of intervention for HR care	X12-1	1	5	1.00	1.92	2.43	1.56	81.36%
Educational level of the head of the family	X13	1	4	3.00	2.82	0.57	0.75	26.72%
Current occupation of the	X14	1	5	3.00	3.03	2.51	1.58	52.25%

head of household								
Monthly family income	X15	1	4	1.00	1.51	0.67	0.82	54.09%
Willingness to pay (WTP)	Y1	0	1	1.00	0.86	0.12	0.35	40.72%
Willingness to pay (WTP) according to price	Y2	0	1	1.00	0.65	0.23	0.48	73.09%
Price - DAP	X16	1	10	4.00	4.39	8.08	2.84	64.73%
How would you like the payment method to be?	X17	1	4	2.00	2.29	0.80	0.90	39.18%

In Table 4 you can see the demand function of the willingness to pay based on the probabilistic econometric model and with significant and highly statistically significant indicators or variables, which means that the coefficients have statistical significance, where they efficiently explain the behavior of the demand curve; You can also see the indicator protection; Indicator , and it is also observed that the indicator of the Huallaga River; while the indicators and the indicator of water and light; Through this probabilistic model, it can be seen that the variable or indicate monthly income is not found, because its coefficient does not show statistical significance.

Mendieta (2020) indicates that individuals tend to maximize their utility under a budget restriction, which evidently It is represented by disposable income, but the model observes other qualities inherent in the individual, giving greater importance and meaning to the natural resource or environmental asset, where Arriola (2017) has found in his research a direct and significant relationship with respect to the level educational regarding environmental awareness, allowing it to be materialized in a payment provision.

Furthermore, Álvarez & Schmalbach (2017) in their research on willingness to pay found that income is not statistically significant to the behavior of demand for the use of drinking water; Likewise, Charry & Delgado (2015), in their investigation of willingness to pay for a conservation plan in the Tunjuelo river basin Bogotá – Colombia, have found that income is not statistically significant in the demand curve model; Ramírez et al (2022), In his research on economic valuation and willingness to pay for water in rural communities, he has determined that for a rural community the willingness to pay is zero with respect to the income variable, understanding that it is not statistically significant, while in the other five communities shows a willingness to pay, also Mamani (2020) in his research willingness to pay for the conservation of the fauna resource of the interior bay of Puno of Lake Titicaca, has determined that income does not significantly influence the conservation of fish and birds. , while for amphibians they do significantly influence the demand curve model.

A possible explanation for this behavior could be given to the diversification of societies where they are also influenced by the needs of the population regarding the use of a natural resource, and the level of education of the

society, since we live in a fairly heterogeneous society where There is not necessarily a direct relationship between the level of education and income.

Table 4

Probabilistic econometric model of the willingness to pay variable

Variable	Coefficient	Standard error	t statistic	Significance level	Average
X7	1.0970	0.2804	3.9130	0.0001	0.9691
x12	0.7617	0.1493	5.1030	0.0000	0.6831
X13	0.4432	0.0882	5.0260	0.0000	2.8169
X16	-0.2186	0.0249	-8.7610	0.0000	4.3920
X17	-0.5818	0.0737	-7.8960	0.0000	2.2881

Where: X7 = consideration or appreciation that the Huallaga River is contaminated, X12 = the population intervenes in the care of the Huallaga River, what is the payment method

In Table 5 you can see the demand function of the willingness to pay from the logistic econometric model and which have significant and highly statistically significant indicators or variables, just like the probabilistic model, where the coefficients have statistical significance, efficiently explaining the behavior of the demand curve; You can also see the indicator conservation and protection; The indicator protection, and it is also observed that the indicator and protection of the Huallaga River; while the indicators and the indicator of water and light; Through this logistic model it can be seen that the variable or indicate monthly income is not found, as well as in the probabilistic model, because its coefficient does not show statistical significance, Mendieta (2000) and Carlos et al. (nd), indicates that individuals tend to maximize their utility under a budget constraint, which is evidently represented by disposable income, but the model observes other qualities inherent in the individual, giving greater importance and meaning to the natural resource.

Table 5

Logistic econometric model of the willingness to pay variable

Variable	Coefficient	Standard error	t statistic	Significance level	Average
X7	1.8111	0.4742	3.8190	0.0001	0.9691
x12	1.3133	0.2605	5.0410	0.0000	0.6831
X13	0.7781	0.1550	5.0190	0.0000	2.8169
X16	-0.3740	0.0445	-8.3960	0.0000	4.3920
X17	-0.9991	0.1319	-7.5720	0.0000	2.2881

Where: X7 = consideration or appreciation that the Huallaga River is contaminated, X12 = the population intervenes in the care of the Huallaga River, what is the payment method

In Table 6 you can see the demand function of the willingness to pay from the multiple linear regression econometric model and which have significant and highly statistically significant indicators or variables, just like the probabilistic and logistic model, where the coefficients have a

statistical significance, efficiently explaining the behavior of the demand curve; It can be seen in the model that the constant is statistically significant, having a positive starting point and a value of +0.4939; Unlike the other econometric models (probabilistic and logistic), this model includes the indicator Huallaga; You can also see the indicator conservation and protection; The indicator protection, and it is also observed that the indicator and protection of the Huallaga River.

While the indicators and the indicator of water and light; Through this multiple linear regression model, it can also be seen that the variable or indicate monthly income is not found, as well as in the probabilistic and logistic model, because its coefficient does not show statistical significance, also emphasize that Klink & Alcántara (1994), Mendieta (2000) and Carlos et al. (nd), indicates that individuals tend to maximize their utility under a budget constraint (disposable income), but the model observes other qualities inherent in the individual, giving greater importance and meaning to the natural resource or environmental asset or ecosystem service. just as it happens in the probabilistic and logistic models.

Table 6

Econometric multiple regression model of the willingness to pay variable

Variable	Coefficient	Standard error	t statistic	Significance level	Average
Constant	0.4939	0.1361	3.6300	0.0003	
x1	0.0509	0.0254	2.0050	0.0455	2.3313
X7	0.2674	0.1023	2.6130	0.0092	0.9691
x12	0.1935	0.0386	5.0200	0.0000	0.6831
X13	0.1091	0.0235	4.6320	0.0000	2.8169
X16	-0.0619	0.0062	-9.9470	0.0000	4.3920
X17	-0.1691	0.0197	-8.5900	0.0000	2.2881

Where: X1 =Housing type, X7 = consideration or appreciation that the Huallaga River is contaminated, X12 = the population intervenes in the care of the Huallaga River, X13 = level of education of the head of the family, be the payment method

Estimation of the willingness to pay for the environmental asset

In Table 7 you can see the estimate of the willingness to pay of the population of the city of Tingo María to conserve and protect the Huallaga River with three econometric models, with the probabilistic model there is an average of the willingness to pay of S /.6.8657 and a coefficient of variation of 52.07%, the predisposition of the population being heterogeneous due to its availability to pay; Likewise, with the logistic model there is an average of the availability of payment of S/.6.8411 and with a coefficient of variation of 52.60%, so they also have a heterogeneous behavior; but according to the multiple linear regression model there is an average willingness to pay of S/.14.9245 and a coefficient of variation of 23.10%, this model having a more homogeneous behavior compared to the two previous models. , the problem with the estimation of this model is that the price of willingness to pay is outside the maximum range

proposed according to the pilot survey, so it would not adjust to the reality of the population under study (Klink & Alcántara , 1994 and Mendieta, 2000), while the probabilistic and logistic models are within the price range of the proposed willingness to pay (Azqueta, 1994, Bishop et al, 1995, and Fasciolo, 2001), the advantage is that between There is a minimum difference of 0.36% between the two models and it represents 0.499% of the average income of the population.

According to the goodness of fit of the probabilistic and logistic model (See Annex 3), it shows that the model predicts 377 of 486 observations correctly or 77.572% of the observations correctly, which is a good indicator of the prediction capacity of the model. demand (Azqueta, 1994, Bishop et al, 1995, and Fasciolo, 2001); In the case of people who answer no to the question of willingness to pay for the conservation and protection of the Huallaga River, it correctly predicts 64.497% of the data, that is, of the 169 individuals who truly answered no to the question about availability. to pay, the model predicts 109; In the case of the individuals who answered yes to the willingness to pay for the conservation and protection of the Huallaga River, we have that of the 317 who really answered yes, the model predicts 268 correctly, that is, in this case the model's prediction is of 84.543%, which is a very good indicator of the prediction capacity of the demand model (Freeman, 1994, Pearce & Turner, 1995, Hanemann, 1996, Riera, 1998, Mendieta, 2000).

In the research work of Ramírez (2022) entitled economic assessment of the landscape beauty of the Sleeping Beauty of the PNTM by the population of the city of Tingo María, he has determined that the availability of payment is S/.2.70 on average with a coefficient of variation of 34.43% with the Logistic econometric model, and having as statistically significant indicators the price-DAP, family income, sex, age, level of education (Oré et al, 2022); which can be seen that there is a predisposition on the part of the population of the city of Tingo María and surrounding areas, since 51% use the Huallaga River directly for recreational or domestic purposes, the maximum value that the population gives it can then be understood. , for the conservation and protection of the Huallaga River at least in the sections from Orquídeas to Naranjillo.

Table 7

Estimation of willingness to pay for the conservation and protection of the Huallaga River

Indicators	Code	Minimum	Maximum	Median	Half S/.	Variance (n-1)	Standard deviation (n-1)	Coefficient of variation (%)
Willingness to Pay Price - Probabilistic Method	P-Y2	-5,958	13,953	7.2352	6.8657	12.7820	3.5752	52.07%
Willingness to Pay Price - Logistics Method	P-Y2	-5,934	14,007	7.1732	6.8411	12.9497	3.5986	52.60%

Price of Willingness to Pay - Multiple Linear Regression Method	P-Y2	4,011	21,376	15.9458	14.9245	11.8842	3.4473	23.10%

Castañeda (2021) in his research on the economic, social and environmental assessment of the ecosystem services of water regulation in Cutervo – Cajamarca determines that the predisposition of the population is S/.8.32; Likewise, Cotrina (2016) in his research evaluation of the provision of water resources and rice cultivation, with an economic valuation approach, determined that there is a medium to high relationship between the willingness to pay and the use of water, as well as Also Huamán (2019) in his research entitled environmental economic assessment of the water resource of the cloud forest Mijal, Chalaco, Morropón, Piura determined that the predisposition is between S/.7.16 to S/.9.79; As can be seen according to other experiences and realities, the assessment is higher. A possible explanation for this difference is due to the need that each user or population has, in comparison to the study carried out as it is located in a geographical area of tropical jungle. , there is still no need for water, so the population tends to value the environmental asset less; But something that can be rescued is that although the evaluation was developed in different spaces, cultures, and socioeconomic conditions, the population is aware that there is a need to conserve and/or protect the water resource, and they are willing to collaborate economically. for its legacy and/or existence of the ecosystem service.

CONCLUSIONS

The statistically significant demand curve with the probabilistic model is: DAP-P = 1.097*X7 + 0.762*X12 + 0.443*X13 – 0.219*X16 – 0.582*X17; logistic model is: DAP-L = 1.811*X7 + 1.313*X12 + 0.778*X13 – 0.374*X16 – 0.999*X17; and the multiple linear regression model is: DAP-RLM = 0.494 + 0.051*X1 + 0.267*X7 + 0.194*X12 + 0.109*X13 – 0.062*X16 – 0.169*X17.

The mean of the availability of payment has a model prediction of 84.54%, for the probabilistic model the mean of availability of payment is 6.87 soles with a coefficient of variation of 52.07%, for the logistic model the the mean of the willingness to pay is 6.84 soles with a coefficient of variation of 52.60%, and for the multiple linear regression model the mean of the willingness to pay is 14.92 soles with a coefficient of variation of 23.10%.

The research hypothesis is accepted, since the average payment availability is greater than 5.0 soles per month and per family.

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