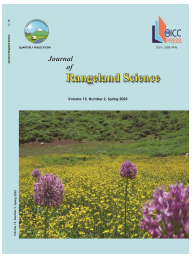

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Valuation and conservation of the Peruvian Puna Ecosystem: Economic and ecological perspectives

Jorge Alarcón-Novoa[1,*], Enrique R. Flores[2], Cecilio Barrantes-Campos[2]

[1]*Department of Economics and Planning, Universidad Nacional Agraria La Molina (UNALM), Peru.*
[2]*Rangeland Ecology and Utilization Laboratory, Universidad Nacional Agraria La Molina (UNALM), Peru.*

[*]**Corresponding author:** jalarcon@lamolina.edu.pe

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Abstract:

Focusing on the Andean Puna ecosystem, a network of interconnected grasslands, wetlands, and shrublands, this review article examines how Andean communities in Peru perceive their economic value. The Puna's ecological services are crucial, making it a vital natural resource. The research was conducted by the authors in two Peruvian regions (*Ancash* in 2014 and *Pasco* in 2011) and we compared residents' perceptions of the grasslands' economic value and the indirect environmental benefits they provide. Both studies utilized the well-established contingent valuation method, as common tool in economic valuation. Interestingly, while residents in both regions expressed a willingness to pay for these services, the amounts differed significantly (US$ 1.60 per household/month in *Pasco* compared to $ 0.82 in *Ancash*). This disparity suggests that environmental context, the directness with which communities experience benefits, and variations in social environments and economic activities all play a role in shaping perceptions. The study emphasizes the importance of increasing education and awareness to ensure communities fully appreciate the valuable environmental products and services provided by the Puna ecosystem.

Keywords: Puna ecosystem; Grassland economic valuation; Ecosystem services; Andean communities; Peru

Introduction

The Puna ecoregion extends above 3,800 m above sea level, from Peru to northern Chile, Argentina, and Bolivia, over a mountainous landscape in the central Andes of Latin America. The dominant vegetation is a combination of grasslands, shrublands, and wetlands, in order of geographic importance, which is primarily used by peasant communities for extensive grazing with camelids, sheep, and cattle (Young et al., 2023). These grasslands also produce a myriad of ecosystem services such as watershed protection, wildlife habitat, open spaces for recreation, and climate change mitigation. Studies on the economics of Puna shepherds reveal that their profit margins are meager and their vulnerability to the impact of climate change is high (Arzamendia et al., 2021). The Puna ecoregion extends across several South American countries.

Grasslands worldwide are under threat due to land use changes and deterioration, diminishing their capacity to deliver vital ecosystem services crucial for communities (Scholtz and Twidwell, 2022). These risks are compounded by the natural challenges of arid and semi-arid ecosystems where grasslands thrive, such as unpredictable rainfall, intense evaporation, nutrient-deficient soils, and fluctuations in productivity (Zhao et al., 2020). Therefore, implementing conservation programs for grasslands becomes imperative to enhance ecosystem resilience.

The advancement of Payment for Ecosystem Services programs holds promise in enhancing the economic and environmental sustainability of peasant organizations. However, it needs a shift towards prioritizing the supply side over the demand of ecosystem services. This entails active involvement from land users, ensuring they grasp the added ecological and economic benefits these programs offer, along with the developmental prospects they present (Bengtsson et al., 2019).

This manuscript presents a review study that integrates two research, conducted by the authors, in the Andean region of Peru: *Huaraz* City, *Ancash* region, in 2014, and *Cerro de Pasco* City, *Pasco* region, in 2011. Its objective is to comparatively evaluate urban residents' perceptions regard-

ing the economic value and indirect benefits of grasslands, along with their Willingness to Pay (WTP) for ecosystem conservation. WTP refers to the amount respondents are willing to pay to establish a monetary fund for the care and improvement of ecosystems.

Materials and methods

The total economic value of the environment comprises use and non-use values. Use value refers to the environmental goods or services that individuals can benefit from, in a consumptive or non-consumptive way, present or future. Non-use value means the desire that people have to preserve the environment, even if they do not directly use its services or functions. In terms of the economic valuation of ecosystem goods and services from natural resources, there are many studies that, practically all, start from the theory of indirect utility and consumer and/or producer surpluses (Ignatyeva et al., 2022). Concerning the provision of ecosystem services, the contingent valuation (CV) method has been used mostly because it has the advantage of "capturing" or estimating the economic value of use and non-use. CV is precisely the method used in both studies.

Sites information

This manuscript presents two economic valuation studies in two places in the Peruvian Andes: the first was developed in 2014, at *Huaraz*, the capital city of *Ancash*, demonstrating the maximum willingness to pay for an ecosystem conservation program in the city. *Huaraz* City (9.5278° S 77.5278° W) is located in the western zone of the Andes Mountains and is known for its beautiful mountain setting, which includes the *Cordillera Blanca*, a famous tourist destination (figure 1). The second case focuses on the assessment of urban residents of *Pasco* City (10.6675°S 76.2567°W), the capital city of *Pasco* region, this study was carried out in 2011. Unlike *Huaraz*, the city of *Pasco* is surrounded by grasslands, with a high presence of mining and livestock. Finally, comparisons are made between both studies.

Econometric procedure

The estimation of indirect utility models requires the use of an econometric equation from the family of so-called probabilistic econometric models, which use a discrete (dichotomous) dependent variable, based on a variety of determining factors (A_i and income, age, among others) and regression analysis to obtain the probability of "success" of a given event (in this case the success that individuals pay the indicated tariff).

The functional forms used in this study correspond to a Logistic Regression Model (LOGIT model), whose dependent variable expresses the probability of payment (P_i) of a certain randomly indicated tariff (*bid*), as follows:

$$P_i = E(Y = \frac{1}{X_s}) = \frac{1}{1+e^{-Li}} = \frac{e^{Li}}{1+e^{Li}} \quad (1)$$

where:

$L_i = \alpha + \beta X$, and represent a change of the utility function. Likewise, X is a matrix that includes the tariff associated with the WTP (A_i or $\ln A_i$) and can be expanded to include a set of additional explanatory variables (environmental or socioeconomic). P_i represents the probability that an individual will pay the randomly indicated tariff in the interview (*bid*) (Greene, 2018).

Gujarati and Porter (2009) determine the following LOGIT equation (2):

$$\ln\left(\frac{P_i}{1-P_i}\right) = L_i = \alpha + \beta X \quad (2)$$

where:

α is the intercept of the function.

β is a vector of coefficients, representing semi-elasticities (relative changes in the odds probabilities ratio due to absolute changes in the corresponding regressor variables).

The specific form of $(\alpha + \beta X)$ depends on the chosen model:

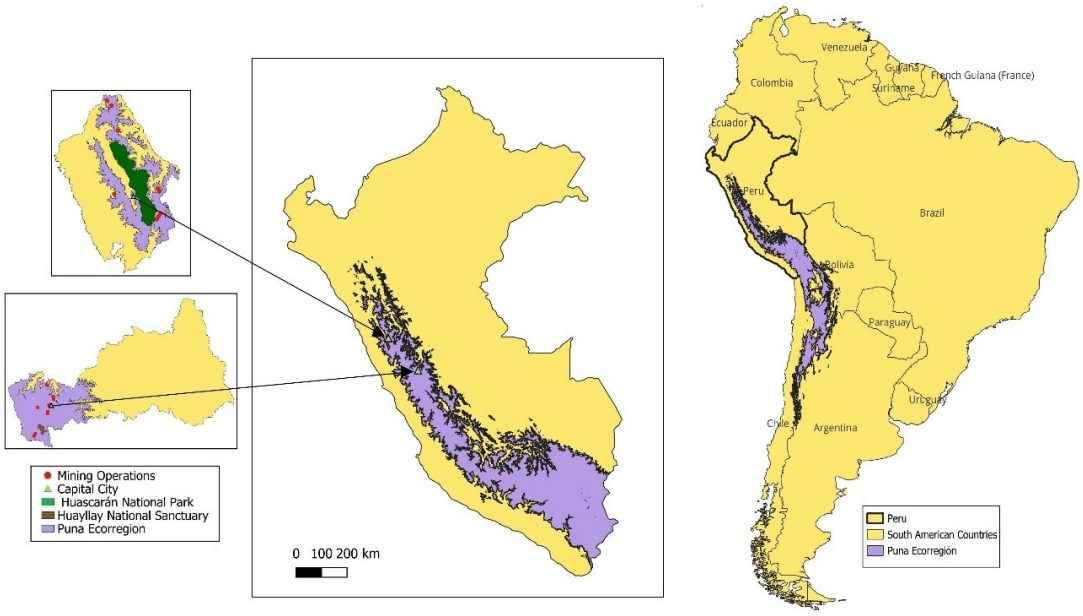

Figure 1. Puna ecoregion of South America and geographical location of the study areas.

The linear proposal by Hanemann (1984) or the logarithmic proposal by Bishop and Heberlein (1979). The estimation of indicators was done according to the maximum likelihood method.

Functional forms of Willingness to Pay (WTP)

Econometric estimations from a LOGIT probabilistic model have been utilized to calculate welfare measures for service demanders. Specifically, the mean and median were employed to derive the Willingness to Pay (WTP) as outlined by Schmidt and Bijmolt (2020). The regression specification was based on functional forms of economic utility, among which those proposed by Hanemann (1984) and by Bishop and Bishop and Heberlein (1979) stand out, offering alternative methods for estimating the WTP (Vasquez et al., 2007); see Table 1.

The Welfare measures were calculated in base on the mean or median value, which in turn depends on the estimation of the parameters of each functional form, as shown in Table 1. Welfare measures were obtained according to Vasquez et al. (2007).

Results

Valuation of ecosystem services wetlands in *Huaraz*

In 2014, the population of the city of *Huaraz* was of 24,783 households and the population surveys were conducted according to recommendations of Villena and Lafuente (2013). Two interviews were conducted in this *Ancash* case: an "open-ended" interview with 200 respondents, as a pilot small study to determine the payment vectors; a second "closed-ended" interview with 270 respondents, which included a dichotomous question, of acceptance, or rejection, of the payment proposed. The respondents for both surveys ("open-ended" and "closed-ended") were randomly selected in high-traffic public places in the city.

The distinction between the open-ended and closed-ended questionnaires lies in the fact that the former was used to estimate the value of the WTP and calculate the sample size per WTP, while the latter was applied to statistically representative sample size, including socioeconomic items. The closed-ended survey was divided into three parts: The first of people's perceptions of the surrounding wetlands; the second to determine their "willingness to pay" for improvement of the wetland under study; and the third corresponded to socioeconomic aspects of the people interviewed. The most significant variables are shown in the first column of Table 2.

The optimal payment vector contains a set of tariffs that are correlated with the dichotomous variable which expresses willingness to pay. Each interviewee citizen was presented with one of the tariffs (or *bid*) from the payment vector and was asked their WTP for that *bid* (which was distributed and randomly applied). Tariffs were estimated using the DWEABS method "Distribution with Equal Area *Bid* Selection", originally designed by Cooper (1993), and widely used in contingent valuation (CV) studies (Plataniaa and Rizzo, 2018). The descriptive statistics of the used variables to estimate the different regression functions is presented in Table 2.

Based on information from the closed-ended survey, four functional forms were estimated to establish the determinants of WTP (Table 3). As per the best indicator of "goodness of fit" (Akaike and Chi-square statistic and also the McFadden R^2 in Table 3) as well as the statistical significance of the estimators, functional form 3 turned out to be the most appropriate. According to function 3, the probability of success in payment as a function of the proposed tariff (*bid*) is -0.205, expressing that if the tariff were reduced by one monetary unit, the probability in favor of the WTP for the wetland conservation project would increase by 1%. In fact, in all equations, a negative relationship was found between an increase in tariffs and the probability in favor of a positive WTP response.

Also in functional form 3, men would be willing to pay a higher tariff than women up to 56%; likewise, the probability of a higher tariff payment for wetland conservation would be higher in residents who know the wetlands (67%) and also higher in residents who indicated a greater importance for the conservation of the ecosystem (195%). Table 4 shows welfare measures for each functional form.

A value of $ 0.82 was used, as a measure from the best-fitting equation and also as a "conservative" measure for the calculation of the collected values for conservation of the wetlands (year 2014); recommendations from other studies suggest the use of "conservative" measures for estimation of welfare for the population (Finkelstein and Hendren, 2020). Considering that the population of *Huaraz* was approximately 24,783 families (INEI, 2020) and the sample was representative, it would be possible to apply a massive and "flat" tariff of $ 0.82 for the domestic electricity service (Alarcón et al., 2018). This would result in a total monthly collection of $ 20,322, which makes a total annual value of $ 243,865. Under the assumption that the Government and other entities could co-finance the costs of an improvement program, in equivalent amounts, then the annual contribu-

Table 1. Functional forms used to estimate the determinants of the Willingness to Pay (WTP).

Methods	LOGIT functional forms
1. Hanemann	$(\Delta v)_j = \alpha - \beta_1 A_i + \varepsilon_j$
2. Bishop-Heberlein	$(\Delta v)_j = \alpha - \beta_1 \ln(A_i) + \varepsilon_j$
3. Hanemann extended	$(\Delta v)_j = \alpha - \beta_1 A_i + \beta X + \varepsilon_j$
4. Bishop-Heberlein extended	$(\Delta v)_j = \alpha - \beta_1 \ln(A_i) + \beta X + \varepsilon_j$

$Y = \Delta v$ is the dichotomous dependent variable (yes/no), regarding a suggested payment (*bid*), represented by $A_i \cdot X$ represents a matrix with a set of socioeconomic and environmental variables included in the function. Source: own elaboration.

Table 2. *Huaraz*: Statistics of socioeconomic variables and perceptions of respondents.

Variable	Units	Average	SD*	Minimum	Maximum
Bid #	$/month	2.84	1.99	0.09	6.38
Low monthly family income	$/month	202.14	45.58	71.63	354.61
Middle monthly family income	$/month	443.91	49.07	356.38	530.51
High monthly family income	$/month	1198.02	178.50	587.59	1765.25
Visit you the wetlands?	Visits/year	2.54	11.58	0.0	180
Are wetlands important to you? (a)	Yes/No	0.59	0.49	0.0	1.00
Sex (b)	Female/Male	0.46	0.50	0.0	1.00
know about environmental services?	Yes/No	0.22	0.41	0.0	1.00

It was considered an exchange rate of 2.82 soles (local currency) per one $ (average value for 2014).
*SD = standard deviation. (a) No = 0, Yes = 1. (b) Female = 0, Male = 1.

tion could reach the annual amount of $ 487,729.

Valuation of ecosystem services of rangelands in *Pasco*, Peru

To determine the economic value of the high-altitude rangelands of *Pasco*, Peru, the contingent valuation method was used, in accordance with the procedure described in Materials and methods. The Puna of *Pasco* region is a combination of mainly grasslands and wetlands, with an area of 507,956 ha. In 2011, two surveys were conducted to determine the economic value of the grasslands: one open-ended pilot survey applied to 30 randomly selected residents; then a closed-ended survey applied to 105 residents. The first survey was used for estimation of the *bid*, and to prepare and apply a second closed-ended survey for getting final information. In both cases, the residents were heads of household and direct beneficiaries of the ecosystems (Barrantes and Flores, 2013).

The "open" survey had eight questions to learn about the perceptions of the residents, regarding the grasslands, as well as a ninth open question where they were asked about the possibility of their monthly WTP, charged as part of their electricity tariff, to implement a Grassland Conservation and Improvement (GCI) program in the region. During the survey, the citizens interviewed were explained that the implementation of the GCI program would help the survival of the ecosystem. With this information, a vector of seven *bid* amounts was estimated in $ 0.4, 1.8, 3.7, 7.3, 9.1, 11.0, and 14.6, used to carry out the "closed-ended" survey.

In the final survey, 15 residents were assigned to each *bid*. The form had 15 questions with dichotomous answers (Yes and No); eight were the same perception questions about the grasslands, six were of a social nature (marital status, age, sex, educational level, family members, among others) and the last one was of economic nature. In this last question, they were asked to answer whether they accepted or rejected the monthly payment (*bid*) in the electricity tariff, for the implementation of the GCI program. The results of

Table 3. Estimation of alternative coefficients from LOGIT functions at *Ancash*
(Dependent variable: P_i, the probability that an individual pays the randomly indicated tariff).

Explanatory variables	Function 1	Function 2	Function 3	Function 4
Intercept	0.594**	1.417**	−1.178**	−0.278
Tariff (*bid*)	−0.199**	−1.304**	−0.205**	−1.453**
Middle monthly income	-	-	−0.005	0.099
High monthly income	-	-	0.422	0.418
Number of visits per year	-	-	0.109	0.099
Importance of the wetlands	-	-	1.953**	2.118**
Sex	-	-	−0.565*	−0.595*
Know environmental services?	-	-	0.679*	0.656*
R^2 McFadden	0.1297	0.1682	0.3093	0.3455
R^2 account	75.65	75.7	81.55	82.65
Akaike	298.8	285.70	251.92	239.66
Chi square	43.9**	56.97**	104.74**	117.01**
Sample size (*n*)	271	271	271	271

The four functional forms are those shown in Table 1.
margin of error of 10%; **margin of error of 5% or less.

Table 4. Measures valuation of environmental services of wetlands at Huaraz (in $).

Indicator	Median (Me.)	Average (Av.)
Function 1, LOGIT Lineal ($.)	1.06	1.06
Function 2, LOGIT Log ($.)	1.05	3.78
Function 3, LOGIT Lineal extended ($.)	0.82	0.82
Function 4, LOGIT Log extended ($.)	1.28	3.33
Total monthly DAP amount (000 $)	20.3	–
Total annual DAP amount (000 $)	243.9	–

the survey indicate that 25% of the respondents agreed to pay the amount of the assigned *bid*.

Descriptive statistics of the variables that have been used to estimate the different regression functions in *Pasco* is presented in Table 5.

The four functional forms indicated in Table 1 were used to evaluate the determinants of WTP, using a LOGIT regression model (according to equation (2) of the material and method section). It was found that the functional form 4 was the best for estimating the WTP, as it had unbiased and highly significant estimators, with appropriate goodness-of-fit indicators (according to Akaike and Chi square statistics, and also the McFadden R^2) (Table 6).

It is worth noting that function 4 includes four socioeconomic variables and three perception variables. The coefficient of the *bid* is negative and highly significant, which is consistent with the theory that states that the higher the payment tariff (*bid*), the lower the probability that people will be willing to pay (Villena and Lafuente, 2013). In addition, the coefficients of the intercept, average monthly household income, are positive and significant, being key indicators for the estimation of WTP. Concerning the WTP, people with an average monthly household income are the ones who would tend to pay a higher WTP. As regards to the perception variables, the residents who consider that the grasslands are under threat of disappearing, which was close to the level of significance, are the ones who would tend to pay a higher WTP.

The estimation of the well-being measures is shown in Table 7. Taking into account that Peru is a developing country, and that people need greater awareness of the benefits, people in *Pasco* produce in terms of environmental services of the high-altitude grassland ecosystem, a conservative measure of welfare of function 3 was chosen: the median, which was $ 1.51/household/month. This means that around 10,138 households in the *Pasco* city would be paying $ 183,701 annually, or $ 0.36/ha to implement a Grassland Conservation and Improvement (GCI) program in the grasslands of the region.

Discussion

Economic ecosystem valuation theory suggests that it is important to assess the perceptions of the population in order to formulate, implement, and monitor a program for protection and restoration of natural grasslands (Ning et al., 2019). This study compares the perceptions of residents of the Andean cities of *Huaraz* and *Pasco*, both regional capitals, but with different environmental settings. The population of *Huaraz* develops activities in an ecological context dominated by the touristic Huascaran National Park; the main economic activities are tourism, commerce, and transportation, in order of importance; mining and livestock are secondary. While *Pasco* is a city surrounded by a livestock and mining environment, where the latter activity contributes more than household incomes than livestock, and where the presence of protected natural areas is scarce. In the two Andean cities taken as cases in this study, the perceptions of the urban population regarding the impor-

Table 5. *Pasco*: statistics of socioeconomic variables and perceptions of respondents.

Variable	Units	Average	SD	Minimum	Maximum
Bid	$/month	6.83	4.80	0.36	14.60
Low monthly family income	$/month	136.04	29.03	74.82	182.48
Middle monthly family income	$/month	365.05	88.16	184.67	541.97
High monthly family income	$/month	862.68	151.48	642.70	985.04
Visit you the wetlands? (a)	Yes/No	0.91	0.28	0	1
Age	Years	36.07	10.46	20	65
Members of the family number	5.81	2.86	1	16	
Think grasslands are threatened? (a)	Yes/No	0.53	0.50	0	1
know about environmental services? (a)	Yes/No	0.01	0.10	0	1

Note: SD = standard deviation. (a) No = 0, Yes = 1.

*It was considered an exchange rate of 2.74 soles (local currency) per one $ (average value for the 2011).

Table 6. Estimation of alternative coefficients from LOGIT functions of *Pasco*.
(Dependent Variable: P_i, probability that an individual pay the randomly indicated tariff).

Explanatory variables	Function 1	Function 2	Function 3	Function 4
Intercept	0.382	1.695**	1.659	3.821**
bid	−0.102**	−1.305**	−0.123**	−1.596**
Middle monthly income	-	-	1.016*	1.139*
High monthly income	-	-	1.106	1.654
Age	-	-	−0.017	−0.026
Member of family	-	-	−0.119	−0.123
Visit the grasslands	-	-	−0.472	−1.048
Threatened grasslands	-	-	0.421	0.9616
Know about Environmental Services? -	-	−15.557	−14.756	
R^2 McFadden	0.1986	0.3331	0.2494	0.397
R^2 account	89.52	89.52	85.71	89.52
Akaike Criteria	98.19	82.39	106.22	88.86
Chi square	23.34**	39.15**	29.31**	46.68**
Sample size (n)	105	105	105	105

Note: *margin of error of 10%; **margin of error of 5% or less.

tance of implementing a GCI program were evaluated. For the first scenario, the interviews were focused on the conservation of the surrounding high Andean wetlands, characterized by the combination of wetlands, grasslands, and remnants of native forests (INAIGEM, 2023), considered key due to their role in water supply and disaster prevention associated with the increasing melting of glaciers due to climate change. Meanwhile, in the second scenario (*Pasco*), sampling was carried out in an area almost exclusively of grasslands: 508,000 ha, which represents more than 70% of the total area (MINAM, 2019).

A survey was conducted to determine WTP for grassland and wetland ecosystem services, consisting of eight dichotomous questions. Both populations responded similarly to one question but diverged on seven others (Table 8). In particular, *Pasco* residents overwhelmingly recognized the importance of high Andean grasslands/wetlands, likely due to their direct dependence on these ecosystems for communal agriculture and also because of the additional income they receive from mining companies. In contrast, only about half of *Huaraz* residents considered these ecosystems important (despite being aware of the threat of glacial avalanches), probably explained by a less prominent role of livestock in their livelihood, compared to the economy of *Pasco* focused on agriculture and mining.

A more comprehensive comparative analysis reveals dissimilar opinions between the two cities regarding the ecological-economic value of environmental services and the risks facing the grasslands; in one case, mining contamination and, in the other, disasters derived from the growing glacial melt, which would be giving different answers to the same questions; for example, regarding whether they consider the grasslands and wetlands to be important and under threat, the answers are, in average, different.

The models used to estimate the WTP, based on the perceptions and realities present in each case, yield relatively low but dissimilar values between the two cities of these two cases. It is important to mention that the original values of WTP, reported previously, of $ 1.51 for *Pasco* in 2011 and $ 0.82 for *Huaraz* in 2014, were adjusted by using the inflation and exchange rates in those two periods (with base in the year 2014). After its conversion to "real" monetary values, in *Pasco*, a WTP of $ 1.60/family/month was found, while in *Huaraz* this value reached the amount of $ 0.82;

Table 7. Measures valuation of environmental services of grassland at *Pasco* (in $).

Indicator	Median (Me.)	Average (Av.)
Function 1, LOGIT Lineal ($.)	1.37	1.37
Function 2, LOGIT Log ($.)	1.34	4.79
Function 3, LOGIT Lineal extended ($.)	1.67	1.67
Function 4, LOGIT Log extended ($.)	**1.51**	3.21
Total monthly DAP amount (000 $)	15.31	–
Total annual DAP amount (000 $)	183.7	–

Table 8. Perceptions of urban residents of the high andean grasslands/wetlands.

Question	*Pasco* ($n = 105$)		*Huaraz* ($n = 271$)		Chi Squared
	Yes%	No%	Yes%	No%	
1. Do you engage in outdoor activities?	96.2	3.8	70.1	29.9	27.948**
2. Are you familiar with high-altitude grasslands/wetlands?	64.8	35.2	53.5	46.5	3.460
3. Do you consider high-altitude grasslands/wetlands to be important?	99.0	1.0	58.7	41.3	56.784**
4. Are you familiar with what a GCIP/B is?	4.8	95.2	15.5	84.5	7.024**
5. Have you visited high-altitude grasslands/ wetlands?	91.4	8.6	69.4	39.6	18.744**
6. Are you familiar with what an environmental service is?	1.0	99.0	21.8	78.2	22.930**
7. Do you consider high-altitude grasslands/ wetlands to be under threat?	53.3	46.7	80.1	19.9	25.879**
8.Do you consider the protection of high-altitude grasslands/wetlands to be important?	98.1	1.9	91.1	8.9	4.653*

Notes: *margin of error of 10%; **margin of error of 5% or less.

responses that could well be attributed to the influence of different environments and the benefits of the services that the population receives from ecosystems, revealing the importance of the role that they (the ecosystems) could be playing, in addition to the presence of different environments, the nature of the threats and the associated economic activities.

Conclusion

Rangeland degradation is a widespread phenomenon in the Andes, consequently building a fund to support legal, social and conservation policies and actions to fight against the deterioration of this important regional ecosystem is a crucial task (Flores, 2016). The inhabitants of *Huaraz* would contribute a lower individual monetary value ($ 0.82/family/month) due to their status as indirect beneficiaries of the ecosystem services provided by their wetlands, although they expressed interest in their conservation. Conversely, the residents of *Pasco* would contribute a higher monetary value ($ 1.60/family/month) because they are direct beneficiaries of the ecosystem, living in and benefiting from the products and services provided by the region's grasslands; even though they also expressed great importance for the ecosystem. The potential monetary fund collected annually in *Huaraz* turned out to be $ 243,864 and the collection in *Pasco* reached $ 194,649. This is important to highlight because despite being populations with relatively low income, they are demonstrating that they have experienced and are aware of the health problems of their pastures, associated with frequent natural disasters, overgrazing, mining pollution and reduction in water availability.

In light of the above, it is feasible to recommend promoting greater education regarding the importance of ecosystem services among citizens in the *Pasco* region and other similar cities with a livestock and intensive mining nature, where inhabitants directly depend on the products and services associated with their natural resources. This recommendation could eventually extend to *Huaraz* and other regions where beneficiaries are indirect or may play an important role in maintaining the ecosystem health and its capacity to supply important ecosystem services. Other than the important issue of education, a pending issue to resolve would be the management of the monetary fund that could be generated and the role that public institutions, producers and contributors should play regarding the management and use of the fund, for the effective fulfillment of ecosystem conservation and the environmental services derived from it.

Authors contributions
Authors have contributed equally in preparing and writing the manuscript.

Availability of data and materials
The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Conflict of interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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