Existence Value of Grasslands on the Qinghai-Tibet Plateau: A Case Study of Maqu (Post-print)

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Abstract

Research on the existence value of grasslands serves as a powerful tool for strengthening environmental protection awareness and provides a decision-making basis for formulating resource utilization strategies. Employing the Willingness to Pay (WTP) technique within the Contingent Valuation Method (CVM), this study systematically investigated the existence value of the Maqu grassland on the eastern edge of the Qinghai-Tibet Plateau. The results demonstrate that in 2005, the average WTP of pastoral households was 339 yuan/year, with a total existence value of $0.03\$ \times 108 yuan/year; income exhibited a significant positive correlation with WTP. Based on this relationship, i$ yuan/year in 2016, representing an increase of approximately 20%, which is comparable to the income growth of local residents. These findings indicate that, compared to the protection costs of the Maqu grassland, its existence value is extremely significant and should be incorporated into cost-benefit analysis; furthermore, existence value possesses dynamic characteristics and should be continuously evaluated in accordance with income changes to reflect its true value, thereby ensuring that policymakers make correct decisions.

Full Text

Preamble

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The Existence Value of Qinghai-Tibetan Plateau Grasslands: A Case Study of Maqu Grassland

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Abstract

Existence value, as a form of non-use value, represents the sense of loss people experience when something disappears. Investigating the existence value of grasslands serves as a powerful tool for strengthening environmental protection awareness and developing resource utilization strategies. The Contingent Valuation Method (CVM), a survey-based approach, reveals consumer preferences for public goods and services and infers respondents' willingness to pay (WTP) for environmental quality improvements. After decades of development, CVM has emerged as the principal means for measuring existence value. Although questioned regarding its validity and reliability in decision-making processes, it has become a dominant technique for valuing non-market environmental costs and benefits since the 1990s.

This study systematically examined the existence value of Maqu grassland on the eastern Qinghai-Tibetan Plateau using CVM' s WTP technique. Results showed that in 2005, the average household WTP was 339 Yuan per annum, with a total existence value of 0.03$\times$10^{8}$ Yuan per annum. WTP was positively correlated with income. From 2005 to 2016, local residents' income increased by approximately 20%, with average WTP reaching 407 Yuan per annum in 2016 and total WTP amounting to 0.033$\times$10^{8}$ Yuan per annum. Compared with other studies, Maqu grassland' s existence value was smaller, primarily due to the limited population base. However, when considering the grassland' s contributions to global biodiversity conservation and its water conservation function for the Yellow River, this existence value would increase substantially, reaching up to 636$\times$10^{8}$ Yuan per annum in 2005 and 763$\times$10^{8}$ Yuan per annum in 2016. These results indicate that Maqu grassland's existence value is extremely significant and should be incorporated into cost-benefit analyses. Furthermore, existence value is dynamic and requires continuous evaluation according to income changes to reflect its true value and ensure policymakers make correct decisions.

Keywords: Maqu grassland; contingent valuation method; existence value; willingness to pay; spillover effect

1. Introduction

The Qinghai-Tibetan Plateau represents an important ecological function service area [1-2], a dominant region for carbon budget balance [4], a germplasm resource conservation base [5], and the origin of unique cultural arts [6]. Lo-

cated on the plateau' s eastern edge, Maqu features alpine stone peaks above 4000m, with other slopes and floodplains covered by natural grasslands with abundant water and lush vegetation, accounting for 84.26% of total land area. These grasslands constitute one of the most productive, biodiverse, and intact grassland ecosystems on the entire Qinghai-Tibetan Plateau—known as "Asia' s premier pasture." The complex topography provides excellent habitat for numerous species, including the black-necked crane and other wildlife resources that maintain global species diversity, genetic diversity, and ecosystem diversity—forming essential germplasm resources and fundamental research content for China' s major strategic needs.

However, driven by climate change and human disturbance, Maqu grassland has experienced severe degradation [9], posing serious challenges to local biodiversity conservation. With approximately species going extinct globally each day, maintaining biodiversity requires not only protecting species themselves but also their habitats—ensuring grasslands' perpetual existence [10]. Existence value represents the maximum monetary amount individuals are willing to pay for a resource' s continued existence, independent of its current or future use, arising from satisfaction derived from knowing environmental features will persist indefinitely, regardless of whether others benefit [11-13].

While scholars have studied existence values for specific species (peregrine falcons, sturgeon [14], wolves [10], giant pandas [15], Siberian tigers [16], Asian elephants [17]) and ecosystems (forests [18], oceans [19], wetlands [20-22], farmland [23-24], urban lake wetlands [25], farm landscapes [26], parks [27], cultural heritage [28], and nature reserves [29]), no studies have reported on grassland ecosystem existence value—disproportionate to its status as a key biodiversity conservation area and detrimental to grassland protection and restoration. This research investigates Maqu grassland' s existence value to provide decision-making support for sustainable grassland resource utilization and perpetual existence, offering case support for grassland existence value studies in China and globally.

2. Contingent Valuation Method

Contingent Valuation Method (CVM) is widely used by economists to evaluate non-market environmental goods. Grounded in traditional rational actor economic models, it assumes consumers have clear demand preferences for public goods and that social welfare equals the sum of individual welfare [30-31]. Initially applied in 1958 by the US National Park Service for Delaware River Basin outdoor recreation studies, the technique became a recommended valuation method by the US Water Resources Council after decades of continuous development. CVM has gained popularity in the United States, been adopted by European countries, and used in developing nations, with numerous European studies emerging subsequently.

This method creates or simulates markets through surveys to directly elicit pas-

sive use or non-use values. Respondents can either state their maximum WTP for a product through open-ended questions or indicate whether they would pay a specified amount for environmental quality improvement through voting questions. This flexibility makes CVM applicable to various use values, non-use values, and public goods policy evaluations, providing substantial information for investment decision-makers and biodiversity threat area management [32-34]. CVM has become the most widely applied public goods valuation method both domestically and internationally [17,28,34], utilizing formats including open-ended questions, payment cards, and dichotomous choice questions.

3. Maqu Grassland Existence Value Survey

The questionnaire comprised two main sections: (1) introducing to local herders the importance of grassland protection and restoration for biodiversity conservation and Yellow River flow stability, and inquiring about their conservation willingness; and (2) using a payment card bidding format to survey maximum funds herders would pay for grassland protection. Face-to-face household interviews were employed.

The payment card approach was selected because locals were unfamiliar with market pricing behavior in constructed markets and had generally low education levels, making direct expression of WTP difficult in questionnaires. After analyzing various elicitation methods, an anchored payment card (APC) was chosen as the guide tool to avoid starting point bias and establish a bidding value selection set [31]. Bidding values and intervals were obtained through two rounds of open-ended pre-test questionnaires—one among Lanzhou University faculty and students, and another in Maqu County' s periphery [35-36]. Face-to-face household interviews ensured high response rates and maintained respondent engagement [37-38].

During the survey, grassland protection purposes were categorized as: (a) continued use by future generations (bequest/legacy value), (b) grassland perpetual existence, and (c) other organisms' survival (biodiversity maintenance). For Tibetan herders with strong religious beliefs, all options were selected and merged into an existence purpose because: (1) all non-use value forms are premised on existence value, including bequest and biodiversity values; and (2) existing studies show existence value dominates other non-use value forms, accounting for the largest proportion of maximum WTP [34-35]. Zong Xue et al. [15] also considered non-use value primarily as existence value. Specific survey procedures are detailed in Cao Jianjun et al. [35].

4. Maqu Grassland Existence Value Estimation

When estimating Maqu grassland' s existence value, calculations were performed at three scales: local, regional, and national. At the local scale (Maqu County boundary), existence value equaled average WTP multiplied by total local households. At regional and national scales, the benefit area was divided into core,

radiation, and peripheral zones, with WTP proportions and amounts for each zone referencing Gao Qin et al. [40]. Each zone' s existence value was calculated similarly (average WTP × corresponding households), with total value being the sum of all three zones. Based on the significant positive correlation between WTP and income, and assuming income growth rates consistent with WTP growth rates, dynamic WTP values could be estimated from income changes.

5. Results and Analysis

5.1 Local-Scale Existence Value of Maqu Grassland

A total of valid questionnaires were completed. Women accounted for only 6.9% of the sample, primarily because many women were unwilling or unavailable for interviews. The surveyed population' s socioeconomic characteristics are shown in Table 1 . The proportion of primary school education and illiteracy reached 49.3%, indicating generally low education levels. Households with incomes below 10,000 Yuan were essentially break-even, with surpluses only appearing above 25,000 Yuan. Income variance was 493.5, indicating large economic disparities among herders.

Single-factor ANOVA and chi-square tests showed that gender and education level had no significant effect on WTP amounts, and no linear relationship existed between independent variables. Least squares regression analysis yielded an optimal regression equation with a determination coefficient $R^2 = 0.272$ ($P = 0.005$), indicating that independent variables could not effectively predict local residents' WTP.

In payment card bidding, the 100 Yuan frequency was highest (14.2%), followed by 300 Yuan (10.4%), 500 Yuan (6.9%), 1000 Yuan (6.6%), and 1500 Yuan (7.4%). Regarding payment methods, 42.7% chose donation, 34.7% chose grassland management fees, 19.2% chose labor-in-lieu-of-capital, and 3.4% chose other methods. The 2.5% zero-payment households all cited economic difficulties.

Maqu currently has households. In 2015, per capita net income was Yuan, with average household WTP of 339 Yuan per annum in 2004 and total existence value of 0.03$×10^{8}$ Yuan per annum. In 2016, average WTP was 407 Yuan per annum, with total existence value of 0.033$×10^{8}$ Yuan per annum. Based on income growth and the positive WTP-income correlation, the 20% income increase from 2005-2016 corresponded to a similar WTP increase.

In-depth interviews with herder households revealed that in 2016, local herders' living costs were relatively high, far exceeding 5-10% of total household income (some reaching 50%). Under basic survival pressures, herders could not allocate large income portions to pure existence value, despite special feelings toward grasslands. Therefore, 2016 data should be excluded as outlier bids. Such high WTP primarily reflects grassland degradation threatening herders' livelihoods, making WTP more reflective of use value than pure existence value. CVM

should only apply to relatively intact, non-degraded environmental resources [43].

5.2 Regional and National-Scale Existence Value

Maqu grassland is critically important for biodiversity conservation and Yellow River water conservation. Considering these ecological benefit spillover effects, its existence value increases substantially. According to Chambers & Whitehead [10], although distant populations may have lower WTP, values remain positive across large areas. Following this approach, the upper Yellow River basin can be designated as the core area, the middle-lower reaches as the radiation zone, and other national regions as the peripheral zone.

Gao Qin et al. [40] surveyed WTP in core, radiation, and peripheral zones of the Sanjiang Plain, finding payment proportions of 72%, 62%, and 42% respectively, with radiation and peripheral zone WTP at 60% and 40% of core zone levels. Applying this to Maqu: the Yellow River basin (3.2$\times$10^{6}$ households) serves as core area, Yellow River middle-lower reaches (4.3$\times$10^{6}$ households) as radiation zone, and other regions (1.1$\times$10^{6}$ households) as periphery. With minimal household number changes over 10 years, total existence values were 636$\times$10^{8}$ Yuan per annum in 2005 and 763$\times$10^{8}$ Yuan per annum in 2016—values comparable to Maqu residents' income growth (Table 3).

6. Discussion

6.1 Willingness to Pay vs. Actual Payment

Carson et al. [37] noted that respondents' WTP typically exceeds actual payment. To mitigate this, surveys emphasized: "Your selection is crucial for government decision-making and potential future fundraising; please consider income constraints." This proved effective, as economic difficulty itself represents an income constraint. The 76.4% selecting fee payment and donation methods indicates herders prefer cash payments over labor-in-lieu-of-capital, consistent with local conditions where men rarely participate in labor due to historical and traditional factors.

6.2 Dynamic Assessment of Existence Value

In nearly all studies, WTP correlates positively with income [14,21,41], and this study is no exception. This relationship enables dynamic assessment of Maqu grassland' s existence value based on income changes without repeated large-scale studies. The non-significant relationship between WTP and education/gender aligns with existing research, as existence value is primarily psychologically driven rather than economically determined [33].

6.3 Existence Value Calculation

Calculations for core, radiation, and peripheral zones simply referenced others' research and homogenized urban and rural residents, potentially affecting reliability. Improved assessments should stratify surveys across stakeholder groups including government officials and biodiversity conservation organizations [42].

7. Conclusion

At the local scale, Maqu grassland' s existence values were 0.03$×10^{8}$ Yuan per annum in 2005 and 0.033$×10^{8}$ Yuan per annum in 2016. At regional and national scales, values reached 636$×10^{8}$ and 763$×10^{8}$ Yuan per annum respectively. The small local-scale value reflects Maqu' s small population base, not residents' undervaluation of existence value. Regional and national-scale values demonstrate significant spillover effects, establishing lower and upper bounds for existence value.

Maqu grassland' s existence value is significantly positively correlated with income, exhibiting scale dependency and dynamic changeability. Continuous evaluation according to income changes is essential for developing and implementing grassland protection strategies and conducting cost-benefit analyses. However, when environmental resources are severely degraded, WTP reflects use value rather than pure existence value. In this sense, CVM applies only to relatively intact resources, as existence value represents the foundational form of non-use values.

References

[1] Valuation of ecological assets on the Qinghai-Tibetan Plateau. *Journal of Natural Resources*, 2003, 18(2): 189-196.
[2] Remote sensing estimation and dynamic changes of ecosystem service value on the Qinghai-Tibetan Plateau. *Geography and Geo-Information Science*, 2009, 25(3): 81-84.
[3] Protection and construction of national ecological security barriers on the Qinghai-Tibetan Plateau.
[4] Research progress on carbon budget of grassland ecosystems on the Qinghai-Tibetan Plateau.
[5] Service functions of Qinghai-Tibetan Plateau grassland ecosystems. *Grassland and Turf*, 2007, 25(9): 26-28.
[6] Overview of ecosystem services. *Biodiversity*, 2004, 4: 3-11.
[7] Progress and prospects. *Advances in Earth Science*, 2013, 21(6): 651-657.
[8] Minimum sample area for plant diversity measurement in alpine grasslands of the Qinghai-Tibetan Plateau. *Scientia Geographica Sinica*, 2012, 67(1): 3-12.
[9] Cao J J, Yeh E T, Holden N M, Yang Y Y, and Guo Z D. The effects of enclosures and land-use contracts on rangeland degradation on the Qinghai-Tibetan Plateau. *Journal of Arid Environments*, 2013, 97: 3-8.
[10] Chambers C M, Whitehead J C. A contingent valuation estimate of the

benefits of wolves in Minnesota. *Environmental and Resource Economics*, 2003, 26(2): 249-267.
[11] Proctor D J. Environmental values and popular conflict over management: A comparative analysis of public comments on the Clinton Forest Plan. *Environmental Management*, 1998, 22(3): 347-358.
[12] Fausold C J, Lilieholm R J. The economic value of open space: A review and synthesis. *Environmental Management*, 1999, 23(3): 307-320.
[13] Evaluating existence value of recreational farmland: A case study of Wuhan Peace Farm. *China Land Science*, 2009, 23(6): 66-71.
[14] Kotchen M J, Reiling S D. Environmental attitudes, motivations, and contingent valuation of non-use values: A case study involving endangered species. *Ecological Economics*, 2000, 32(1): 93-107.
[15] Existence value assessment of giant pandas based on contingent valuation method. *Acta Ecologica Sinica*, 2008, 28(5): 2090-2098.
[16] Economic value assessment of Northeast Tiger protection: A case study of Harbin residents' WTP. *Journal of Northeast Forestry University*, 2007, 35(5): 81-83.
[17] Existence value assessment of Chinese Asian elephants based on contingent valuation method. *Journal of Northeast Forestry University*, 2012, 40(3): 108-112.
[18] Pearce D W. The economic value of forest ecosystems. *Ecosystem Health*, 2001, 7(4): 284-296.
[19] Preliminary study on intrinsic value assessment of marine ecosystems: A case study of Xiamen Bay. *Journal of Applied Oceanography*, 2014, 33(4): 585-593.
[20] Monetary valuation of Zhalong Wetland. *Journal of Natural Resources*, 2002, 17(4): 451-456.
[21] Existence value assessment of Zhangye North Suburb Wetland using CVM. *Journal of Arid Land Resources and Environment*, 2011, 25(5): 140-147.
[22] Trend analysis of biodiversity conservation value in Sanjiang Plain wetland ecosystems. *Acta Ecologica Sinica*, 2015, 35(4): 935-943.
[23] Application of contingent valuation method to non-market value assessment of cultivated land resources in Xi' an. *Journal of Arid Land Resources and Environment*, 2011, 25(3): 28-32.
[24] Non-market value assessment of cultivated land in the Three Gorges ecologically fragile area. *Acta Geographica Sinica*, 2011, 66(4): 562-575.
[25] Non-use value evaluation of typical urban lake wetland resources in Wuhan. *Acta Ecologica Sinica*, 2010, 30(12): 3261-3269.
[26] Estimation of recreational and existence values of leisure landscapes in Wuhan Shiliuhong Farm.
[27] Study on non-use value of Beijing Zizhuyuan Park based on contingent valuation method. *Economic Research Guide*, 2011, 5: 257-258.
[28] Research on cultural heritage value assessment using CVM: A case study of Yungang Grottoes. *Landscape Architecture Survey and Analysis*, 2008, 28(3): 1201-1210.
[29] Common M, Reid I, Blamey R. Do existence values for cost-benefit analysis

exist? *Environmental and Resource Economics*, 1997, 9(2): 225-238.
[30] Noonan D S. Contingent valuation and cultural resources: A meta-analytic review of the literature. *Journal of Cultural Economics*, 2003, 27(3/4): 159-176.
[31] Cuena E C, Gallego A G, Georgantzis N, and Grande G S. An experimental validation of hypothetical WTP for a recyclable product. *Environmental and Resource Economics*, 2004, 27(3): 313-335.
[32] Shechter M, Reiser B, Zaitsev N. Measuring passive use value-pledges, donations and CV responses in connection with an important natural resource. *Environmental and Resource Economics*, 1998, 12(4): 457-478.
[33] Wierstra E, Geurts P, Van der Vegh A. Validity of CVM related to the type of environmental good; an empirical test. *Integrated Assessment*, 2001, 2(1): 1-16.
[34] Analysis of ecological service compensation standards in Min River Basin. *Journal of Yunnan Agricultural University*, 2015, 9(3): 28-33.
[35] Cao J J, Holden N M, Qin Y Y, Song X Y. Potential use of willingness to accept (WTA) to compensate herders in Maqu County, China, for reduced stocking. *Rangeland Ecology & Management*, 2012, 65(5): 533-537.
[36] Contingent valuation of Maqu grassland ecosystem restoration costs. *Acta Ecologica Sinica*, 2008, 28(4): 1872-1880.
[37] Carson R T, Flores N E, Meade N F. Contingent valuation: Controversies and evidence. *Environmental and Resource Economics*, 2001, 19(2): 173-210.
[38] Paulo A L D, Nunes, Jeroen C J M, Van den Bergh. Can people value protection against invasive marine species? Evidence from a joint TC-CV survey in the Netherlands. *Environmental and Resource Economics*, 2004, 28(4): 517-532.
[39] Langford I H, Kontogianni A, Skourtos M S, Georgiou S, Bateman I J. Multivariate mixed models for open-ended contingent valuation data willingness to pay for conservation of Monk Seals. *Environmental and Resource Economics*, 1998, 12(4): 443-456.
[40] Spatial differentiation of non-use value WTP based on residents' ecological cognition: A case study of Sanjiang Plain wetlands. *Acta Ecologica Sinica*, 2014, 34(7): 1851-1859.
[41] Tarrant M A, Cordell H K. Amenity values of public and private forests: Examining the value-attitude relationship. *Environmental Management*, 2002, 30(5): 692-703.
[42] Millennium Ecosystem Assessment and China' s countermeasures. *Bulletin of Soil and Water Conservation*, 2003, 23(1): 7-11.
[43] Hanemann. The economic theory of WTP and WTA. In: Bateman I J and Willis K G. Valuing environmental preferences-theory and practice of the contingent valuation method in the US, EU, and developing countries. Oxford University Press, Great Britain: Edward Elgar Press, 1999: 43-93.

Note: Figure translations are in progress. See original paper for figures.