

Assessing the aesthetic value of urban forests and associated individual differences: An example from the Loess Plateau, China

Mingxia Zhang¹, Dexiang Wang¹, Zhitao Wang², Xinping Zhang¹, Ganggang Zhang¹, Yong Xu¹

¹Northwest A&F University, Yangling 712100, China

²Qinghai Academy of Agriculture and Forestry, Xining 810016, China

Abstract. Urban forests have important aesthetic values contributing to the quality of urban life. The aesthetic difference in urban forests can cause negative or positive externalities, e.g., the loss or increase of non-priced benefits. Urban forestry planning, therefore, should systematically assess and commensurately measure the aesthetic value of urban forests, i.e., in monetary terms with material values. Here we present an empirical study for assessing the aesthetic value of urban forests using on-site survey data from 1,000 visitors in the loess hilly-gully area of Loess Plateau (Yan'an, northern Shaanxi, China). An assessment model is established by logistic regression and automated neural networks for measuring the objective and subjective influencing factors of aesthetic attitude and individual willingness to pay (WTP) recreation fees for consumption of the urban forest environment. The objective factors are directly linked to WTP and gains the largest weight in the system; The subjective factors exert strong influences on WTP; additionally, quality of urban virescence strongly affects the respondents' aesthetic attitudes, thus influencing their WTP. Our results are useful for assessing ecosystem service function in urban forests, thus contributing to the management and sustainable development of urban forests in the study area as well as other forests in similar settings.

Keywords: Loess Plateau, Yan'an, urban forests, automated neural networks

1 Introduction

Aesthetic is the center of everything that is considered valuable by human beings, and individual differences in aesthetic attitude affect the aesthetic value [1] [2]. In forest planning, aesthetic value is an important criterion for assessing the quality of urban forests. Being an aesthetic object, urban forests are a group of public goods whose aesthetic value refers to the individual willingness to pay (WTP) recreation fees for consumption of the pleasant urban forest environment [3] [4]. In social psychology, WTP is considered to be the behavioral intention that affects the attitude partially and helps to predict behavior [5] [6]. The aesthetic value of urban forests has an indeterminate price but lacks a market price [7]. Therefore, policy makers are required to carry out direct monetary assessment on the aesthetic value of urban forests, similar as the work for valuation of other ecosystem service functions. In this way, the aes-

thetic value of urban forests will gain comparability with economic factors [1].

Here we present a one-year empirical study on urban forests at the revolutionary site of Yan'an, which represent vast forest areas on the Loess Plateau. The aesthetic value of urban forests was assessed by using CVM and the influencing factors of individual WTP and aesthetic differences were identified by logistic regression analysis and automated neural networks. The results will provide reference data for assessing the quality of urban forest ecosystem service function, further contributing to the management and sustainable development of urban forests.

2 Material and Methods

Site survey data were collected from urban forests in Yan'an, northern Shaanxi Province, China, part of the loess hilly-gully area of Loess Plateau. The loess hilly-gully area of Loess Plateau is a typical hilly region of loess ridges and hills, where land surface is highly fragmented and soil erosion widely occurs. This area is deeply cut by gullies with steep slopes. This topography has limited the expansion of townships, so that the urban area is relatively small and large-area suburban landscaping has become one of the main tasks for constructing an urban ecological network.

The sampling date (2-3 d per week), time, and site were chosen using a hierarchical random sampling design. The sampling time was chosen at 2 h after sunrise or 1.5 h before sunset, according to the recreation time of most respondents. The sampling sites included seven representative zones of Yan'an urban forests: Baota Mountain, Qingliang Mountain, Fenghuang Mountain, Wangjiaping, Zaoyuan, Yangjialing, and the urban periphery of Yan'an University. An attempt was made to interview every visitor, and each person can only complete one questionnaire. A total of 1,000 visitors were surveyed, of which 947 completed the questionnaire. Here we select a binary logistic regression model for qualitative variables as Logistic regression and Automated neural networks method.

Here we select a binary logistic regression model for qualitative variables. We use neural networks method to analysis data for influencing variables.

3 Analysis on influencing factors

As shown in Fig. 1, Fig. 2, Fig. 3 and Fig. 4, the objective factors (tourists eigen, means of traveling, place of residence, monthly income) are directly linked to WTP. This result indicates that the older the age of visitors, the high the possibility of unwilling to pay. Visitors from closer areas are more unwilling to pay. Travel tool selection has no significant influence on WTP, despite it reflects the travel distance or personal preference. This result demonstrates that monthly income has a direct and significant influence on WTP. Respondents with high monthly income are more likely to pay.

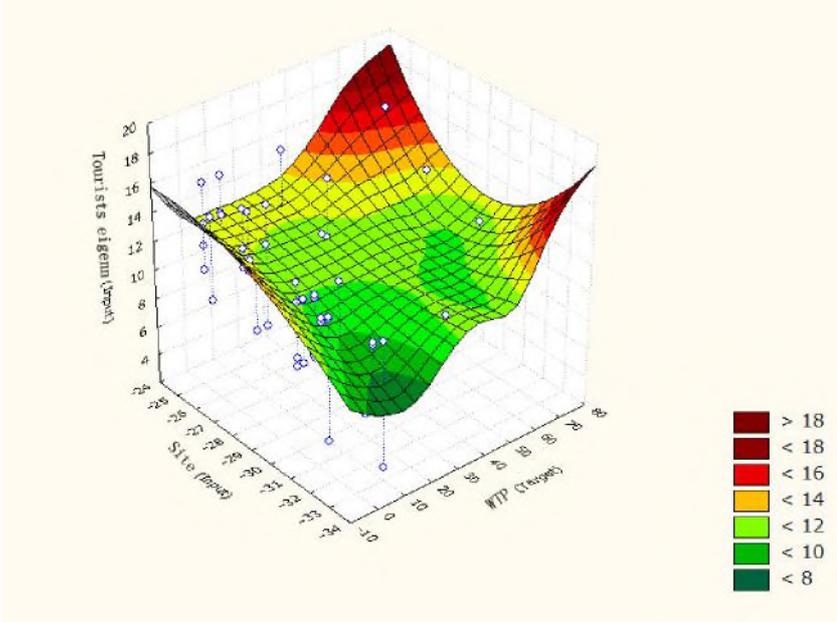


Fig. 1. The tourists eigen of Yan'an urban forest

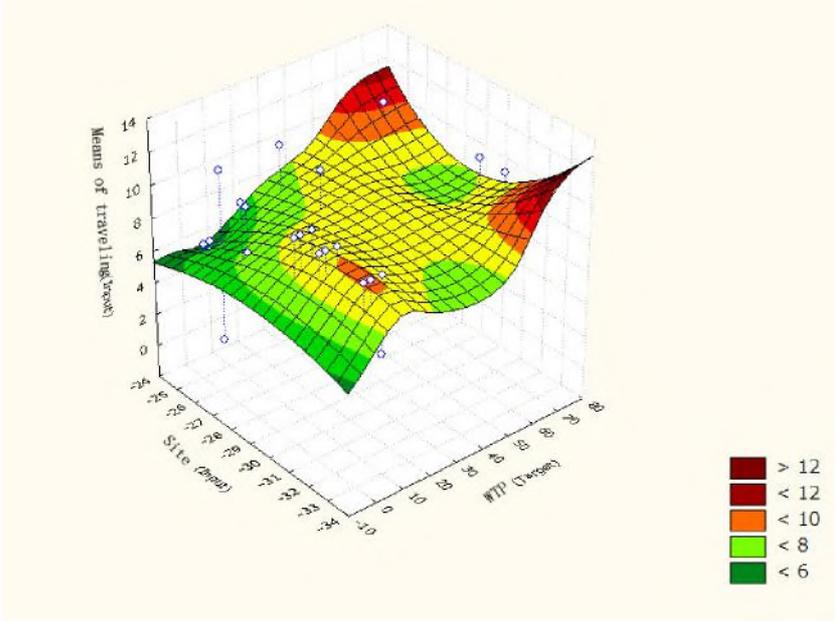


Fig. 2. The means of traveling of Yan'an urban forest

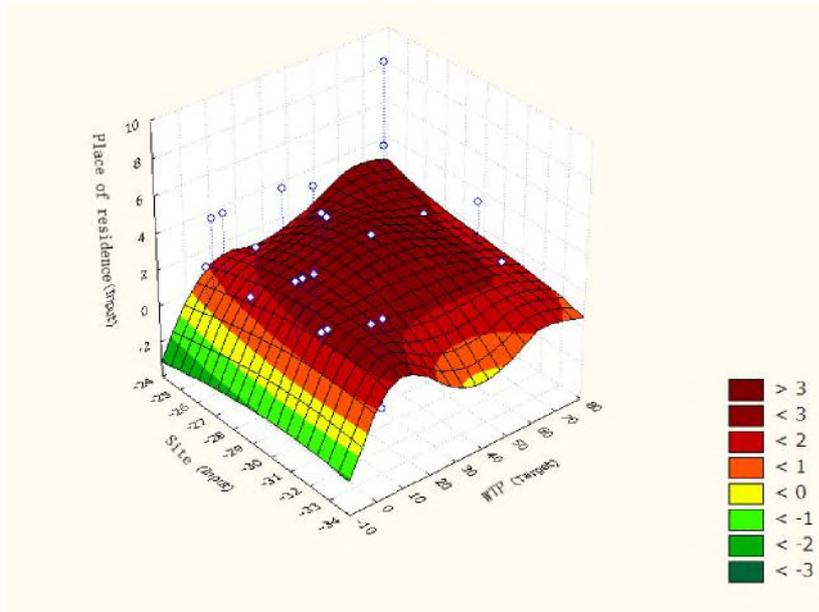


Fig. 3. The place of residence of tourists of Yan'an urban forest

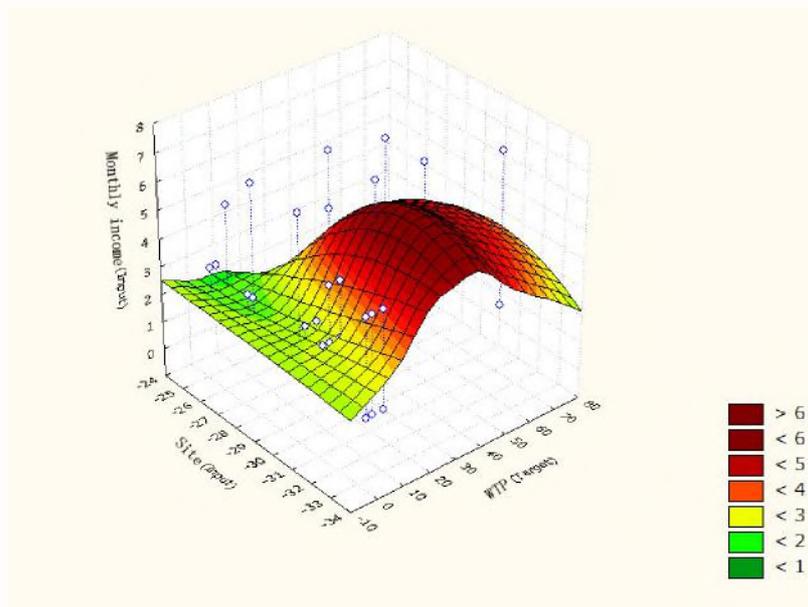


Fig. 4. The monthly income of tourists of Yan'an urban forest

The subjective factors (purpose demand, the urban environment impression, sensory evaluation) exert strong influences on WTP.

According to Fig. 5, among different purposes of the visit to urban forests, enjoy-the-beautiful-scenery gains the largest regression coefficient. That is, the purpose of visit has a significant influence on WTP.

Through Fig. 6, it can be observed that the urban environment impression influence of the respondents' experience, quality of urban greening shows the greatest influence. Thus, green quality directly affects the visitors' experiences, and the better the green quality, the lower the possibility of negative attitude toward paying for urban forest recreation environment.

Seeing Fig. 7, among different reasons for visiting urban forests, work-related reason gains the largest regression coefficient. This shows that various reasons for visiting urban forests result in significant changes in the respondents' WTP.

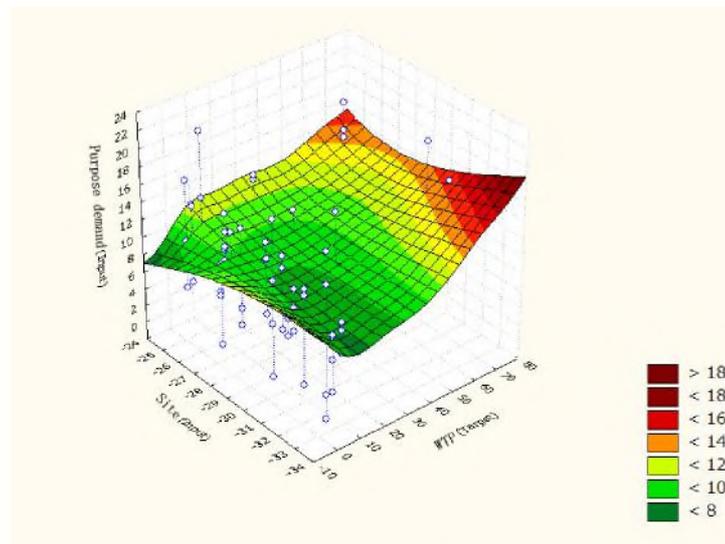


Fig. 5. The purpose demand of Yan'an urban forest

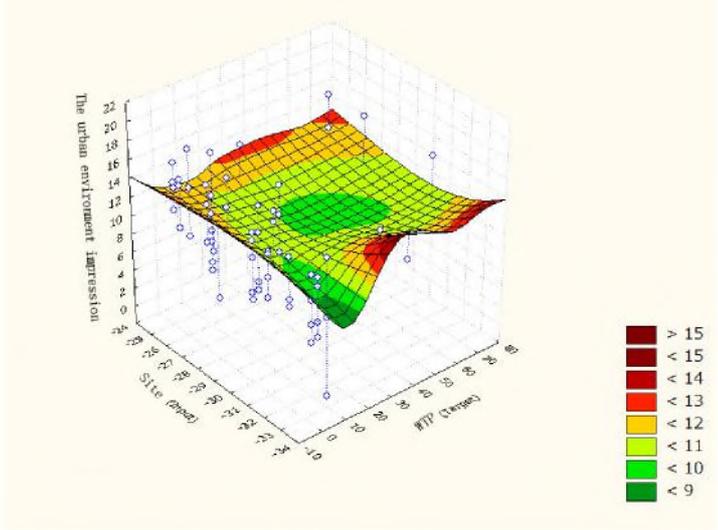


Fig. 6. The purpose demand of Yan'an urban forest

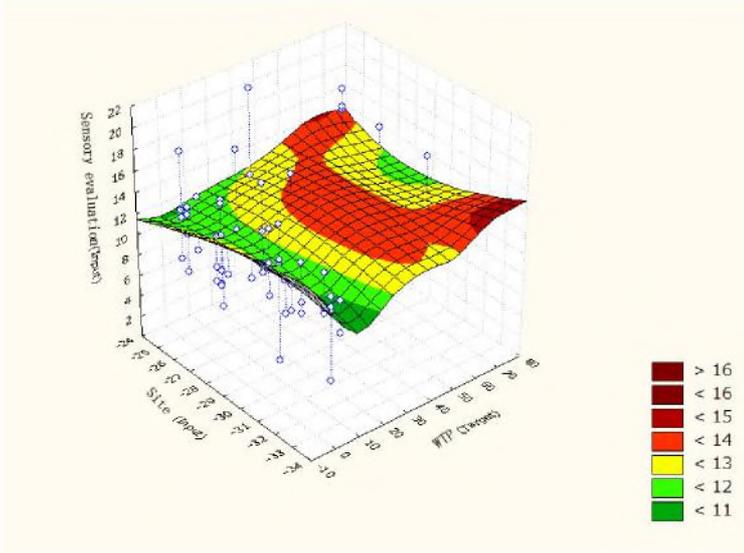


Fig. 7. The sensory evaluation of tourists of Yan'an urban forest

4 Conclusions

Our assessment results show that aesthetic differences in individual respondents are statistically significant in terms of objective (age and monthly income) and subjective

factors (visiting purpose, visiting reason, and personal sensation of urban virescence). Objective factors directly affect WTP and gain the greatest weight in the assessment system, whereas subjective factors as well have profound influences on WTP, consistent with previous findings. Specifically, negative aesthetic attitude is related to WTP declines while positive aesthetic attitude is related to WTP increases. Additionally, WTP shows a declining tendency with increasing age, and visitors with the purpose for scenery or work are more likely to pay.

Aesthetics of urban forests is not the ultimate goal, but is a consequence of urban forest construction. Urban forest construction from a single perspective of scenery is not advantageous, but a combination of cultural and historical factors can transform the aesthetic attitude. Extensive studies have shown that the aesthetic attitude can be changed through education and persuasive, targeted informative activities. In order to increase the visitors' WTP in the premise of complying with the charging policy, forest managers and policy makers can consider information transmission to visitors with negative aesthetic attitudes through education, namely, informing them of the reasons for charges and related policies. For future assessment and prediction of aesthetic attitude in other natural resource environment, the whole set of variables of measures should be included (objective factors: income, visiting frequency, age, and educational level; subjective factors: purpose, reason, and sensation).

Acknowledgments. This study was supported by the National Forestry Public Sector Research Project of Science and Technology Department, National Forestry Bureau of China (201104045). Prof. Dexiang Wang is the corresponding author.

References

1. F. Di, Z. P. Yang, X. L. Liu, J. R. Wu, Z. G. Ma, Estimation on aesthetic value of tourist landscapes in a natural heritage site: Kanas National Nature Reserve, Xinjiang, China. *Chinese Geogr Sci*, 20 (2010)
2. J. N. Martin, The lover of the beautiful and the good: Platonic foundations of aesthetic and moral value. *Synthese*, 165 (2008)
3. L. Tahvanainen, L. Tyrvaïnen, M. Ihalainen, N. Vuorela, O. Kolehmainen, Forest management and public perceptions - visual versus verbal information, *Landscape Urban Plan*, 53 (2001)
4. L. Tyrvaïnen, Economic valuation of urban forest benefits in Finland, *J Environ Manage*, 62 (2001)
5. C. C. Harris, B. L. Driver, W. J. McLaughlin, Improving the contingent valuation method: A psychological perspective, *J Environ Manage*, 17 (1989)
6. I. Ajzen, B. L. Driver, Contingent value measurement: on the nature and meaning of willingness to pay, *J Consum Psychol*, 1 (1992)
7. E. Heyman, Analysing recreational values and management effects in an urban forest with the visitor-employed photography method, *Urban for Urban Gree*, 11 (2012)