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Cost–benefit analysis of the leisure value of urban greening in the new Chinese city of Zhuhai

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Nature in cities is increasingly preserved or created to improve urban environmental quality. Green space provision is proceeding apace in many Chinese cities. Cost–benefit analysis of such projects is needed to justify the level of investment and the use of public funds. This paper assessed the use pattern of urban green spaces in the new Zhuhai city in south China, and employed the contingent valuation method to estimate the non-market leisure value of an ambitious new urban greening project. A questionnaire survey of 850 randomly chosen households was conducted. Some 65.7% of respondents used public green spaces for leisure frequently and young residents aged 20–30 were less frequent users. The new greening project was strongly supported for its leisure and ecological values. The logit regression model indicated that household income and bid amount would affect individual willingness-to-pay (WTP). The mean WTP was RMB161.84 per household per year, translated into an aggregate leisure value of RMB12.3 million per year. The net present value is projected to be RMB-32.94 million and the discounted benefit–cost ratio is 0.88 when other benefits were not included. The findings confirmed community support and verified the application of cost–benefit analysis in projects related to non-market public goods, and the applicability of contingent valuation method in the Chinese context. The study could serve as the basis to launch other cost–benefits analysis of nature conservation projects which need urgent attention in view of the rapid pace of urbanization in China to contribute to sustainable city goals.

Keywords: Urban greening, cost–benefit analysis, contingent valuation, leisure value, Zhuhai

Introduction

Cost–benefit analysis (CBA) has been successfully applied in developed countries to environmental issues and policies, including the use and conservation of natural resources (Prest and Turvey, 1965; Price, 2000). The findings could inform economically efficient choices and contribute to social well-being (Mitchell and Carson, 1989). The valuation of environmental assets could link human and natural systems to ensure ecologically sustainable development (Howarth and Farber, 2002). Maximum economic efficiency could be achieved by identifying, quantifying, and comparing marginal benefits with marginal costs (Ahmed and Gotoh, 2006).

Environmental goods, such as leisure opportunities, amenities, and ecosystem services, are not normally traded in the market. Methods have been developed to assess the monetary value of such non-market and non-productive functions. The contingent valuation method (CVM) could place a value on commodities with a large non-use value (Goulder and Kennedy, 1997; Loomis et al., 2000). Contingent on a hypothetical market, people were asked to state their willingness-to-pay (WTP) to enjoy specific services, or their willingness to endure welfare loss from a reduced provision of services (Mitchell and Carson, 1989; Garrod et al., 1996). CVM was devised by the resource economist Siegfried von Ciriacy-Wantrup in 1947 (Portney, 1994). It was firstly applied by Davis

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(1963) to elicit the value of recreational opportunities. During the 1980s and 1990s, CVM was widely employed to valuate ecosystem services in western countries. A blue-ribbon study by NOAA indicated that CVM could yield reliable estimates (Arrow et al., 1993) to support policy making (e.g., Cropper and Alberini, 1998; Yoo and Chae, 2001; Jetter and Paine, 2004).

CBA has been used for projects involving natural resources to ensure efficient use and conservation (Arrow et al., 1993). In the previous planned-economy era in China, all activities were controlled by the government at different levels. CBA was then considered to be unnecessary due to ignorance or neglect of environmental concerns. Cheng (1983) produced a pioneering study, but thereafter the progressive shift to the market economy did not trigger new CBA evaluations. The last two decades witnessed rapid urbanization in China, raising awareness of residents and policy makers on the importance of green spaces to environmental quality. Nature in cities provides many benefits: amenity, leisure, recreation, abating pollution and mitigating the heat island effect (Miller, 1997). These benefits could sustain urban ecosystems (Whitford et al., 2001), and enhance the quality of urban life (Saz-Salazar del and Menéndez, 2007). Nevertheless, municipal governments in developing countries tend to focus on economic growth with limited investment in public green spaces. CBA could yield evidence and support to reverse the trend.

Urban green spaces provide desirable landscapes to fulfill leisure needs (Miller, 1997), often regarded as their most important service (Dwyer et al., 1992; Page et al., 1994; Tyrväinen and Väänänen, 1998; Lorenzo et al., 2000). The monetary value of the leisure function could be estimated by two approaches, namely stated preference methods (contingent valuation method) and revealed preference methods (travel cost method and hedonic pricing method) (Peterson and Loomis, 2000; Price, 2002; Dalenberg et al., 2004; Loomis, 2006). The maintenance of urban nature requires public funds (Perkins and Heynen, 2004) that could be compared with the aggregate leisure value.

Conservative estimate of the leisure value of urban forests in parks and recreation areas in the USA exceeds $2 billion per year (based on travel cost method by Dwyer et al., 1992). The analysis of street and park trees in California yielded benefit–cost ratios at 1.85:1 in Modesto and 1.52:1 in Santa Monica (McPherson and Simpson, 2002). The Finnish national parks demonstrated leisure benefits (€32 million per year) exceeding the annual maintenance expenditures by a large margin (about €13 million) (Huhtala, 2004). Other studies furnished key CBA data for urban greening projects (McPherson, 1994; Pepper et al., 2005), and facilitated natural resource management based on consumer satisfaction (Peterson and Loomis, 2000; Huhtala, 2004). A recent CVM study in Guangzhou, China, found average WTP for recreation-amenity services at RMB18.04/person/month (Jim and Chen, 2006). Similar CBA studies (e.g., Xu et al., 2003) are still scant in China.

CVM has seldom been applied in China to assess the value of nature both within and outside cities. This study attempted to explore its applicability to the valuation of the leisure value of a new green-space project, in a new city, in the context of nature in cities, in a country with a different socio-economic and political regime from other countries. Zhuhai, a new city in south China, has an ambitious plan to further augment its green-space stock, involving substantial public funds. Other Chinese cities are earnestly investing in new green spaces. The associated public policy deserves to be evaluated for acceptability and cost–benefit to the community. We attempted a CBA to assess the proposed urban greening project in Zhuhai with four objectives: (a) to identify Zhuhai residents' leisure use of urban public green spaces; (b) to estimate the non-market leisure value of urban public green spaces through CVM; (c) to explore the factors influencing residents' WTP for the urban greening project; and (d) to suggest new research directions to justify investments related to natural resources in Chinese cities.

Study area and methods

Study area

Zhuhai is a major city of Guangdong Province in south China, situated at the west side of the Pearl River Estuary, at 21°48′–22°27′N and 113°03′–114°19′E (*Figure 1*). Macau is situated to its immediate south, and Hong Kong is on the east side of the Estuary. Its subtropical monsoon climate offers abundant rainfall of 1770 mm per annum, with 90% falling in May to October. The long hot summer has average temperature of 22.3 °C. January and February are cool and dry with average temperature of 14 °C. Beginning as a small fishing village, it was elevated to a county in 1953 and a city in 1979. Associated with China's open and reform policy, it was designated in 1980 as one of its first special economic zones, leading to rapid development into a sizeable industrial city. Zhuhai's population reached 1,415,700 in 2005, of which 896,000 were officially registered residents, and 519,700 were migrants from other parts of China.

This study focused on Zhuhai's central built-up area of 91.85 km^2 with 108,000 households and 370,000 residents (Guangdong Census Office, 2002). In 2004, the average GDP in Zhuhai was RMB64,960 per capita per annum (Zhuhai Statistics Bureau, 2005). In comparison, Guangzhou was RMB56,300, Shenzhen RMB57,300, Guangdong provincial average RMB26,287, and national average RMB10,502 (National Bureau of Statistics of China, 2005). The average income of Zhuhai urban residents was RMB17,702 per capita per annum (Zhuhai Statistics Bureau, 2005), which was lower than Shenzhen's (RMB27,596) but higher than Guangzhou's (RMB16,884) (National Bureau of Statistics of China, 2005). RMB stands for the Chinese currency *Renminbi* with an exchange rate of US$1.00 = RMB7.367 at the time of the survey in June-July 2006.

The city enjoys a garden-like environment due to a pleasant maritime ambience, mountain backdrop, and diversified natural resources. Zhuhai's hierarchical public green space system has 1014 ha, composed of 6 urban parks at the municipal level (about 650 ha), 7 urban parks at the district level (about 158 ha), 26 neighborhood gardens (157 ha), community gardens (47 ha), and a theme