Case Study

Impact of Urban Green Space on Residential Housing Prices: Case Study in Shenzhen

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Abstract: Public resources such as transportation, hospitals, parks, and schools are important factors in housing prices. However, studies on property value have mainly concentrated on transportation, and few studies have focused on the effect that green space has on property values. Researchers have mainly focused on specific parks within different communities rather than parks (on a larger scale) to study the average impact of green space on housing prices. Therefore, the objective of this research is to quantify the effect of public resources on property value, especially green space, using the hedonic pricing method (HPM). This paper focuses on 71 parks within Shenzhen to make results universal. Transaction price data and the structural attributes of 6,473 dwelling units were collected. This paper looks at HPM from three dimensions: structural attributes, location variables, and environmental variables. The results showed that (1) proximity to a central business district (CBD) produced the greatest effect on housing prices, followed by distance to park, distance to school, distance to arterial road, and distance to subway; (2) proximity to a park noticeably contributes to housing prices at 0.041%, and housing prices decline at a rate of 20,920 CNY (US\$3,356)/km depending on distance to the nearest park; and (3) the average influence radius of Shenzhen parks was 1.73 km, and the 71 parks could promote an increase in value across 412.14 km^2 of land. This research will be helpful in residential housing purchase decision-making, for reasonable estate development layouts (for developers), and for governments (in terms of increasing environmental tax to promote green space preservation). **DOI: 10.1061/(ASCE)UP.1943-5444.0000241.** © *2014 American Society of Civil Engineers.*

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Introduction

Public resources such as transportation, parks, hospitals, schools, and lakes can be convenient for residents and can play an important role in the housing market (Chin and Foong 2006; Li and Wang 2010), especially in terms of green space, which can provide multiple benefits, including aesthetic enjoyment, recreational opportunities, and ecological services (Cho et al. 2006; Gómez et al. 2010; Maimaitiyiming et al. 2014). Urban green space has significant cultural and ecological value. It also benefits human health by providing a location for outdoor exercise and for releasing pollutants (Maller et al. 2006; Sander and Polasky 2009). Thus, renters and homebuyers are willing to pay more for houses adjacent to urban landscapes. However, the amenity values provided by green space are usually difficult to assess and quantify because they are intangible and cannot be easily priced, especially in the residential housing market (Jim and Chen 2006; Liu and Hite 2013).

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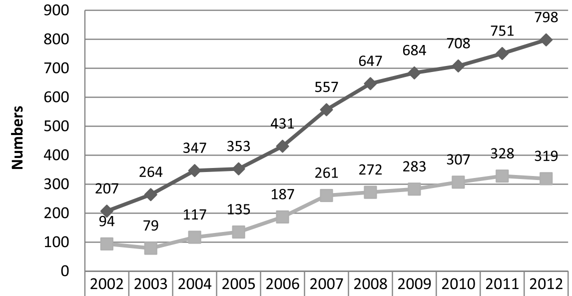
Fortunately, the hedonic pricing method (HPM), which is widely used by domestic and foreign researchers in empirical studies, can help people quantify the value-added effect of green space on residential housing prices. The HPM has been applied to several empirical studies on the residential housing market. However, its main focus is on urban transportation (Wei et al. 2014; Dziauddin et al. 2013; Pan 2013), according to the China National Knowledge Infrastructure (CNKI). In contrast, few studies have focused on urban green space, based on a search using the keywords "rail transportation," "hedonic pricing method," and "urban landscape." It shows that research from 2002 to 2012 focused more on transportation than on urban landscapes (Fig. 1).

The earliest study on the impact of landscapes (parks, wetlands, lakes, rivers, and urban forests) on the housing market was an external benefit analysis of three urban water parks in California (Darling 1973). Previous landscape studies have played an active role in promoting residential housing and have had a positive impact on property values and urban shapes and structures (Yin and Xu 2009). For example, Doss and Taff (1996) discovered that different wetlands have different influences on housing prices and that maritime areas and swamps may add a premium of \$99 and \$145 to residential property values, respectively (Doss and Taff 1996). Mahan found that housing prices in Portland had a negative correlation to distance from wetlands and a positive correlation to wetland areas (Mahan et al. 2000). Tyrväinen found that in Finland the price of residential housing rose by 5.9% as the distance from urban forests increased by 1 km (Tyrväinen and Miettinen 2000). Luttik found that water and open green space can increase profits of residential property values in the Netherlands by 8–10% and 6–12%, respectively (Luttik 2000). Wolf found that development costs were 5.5% greater for lots where trees were conserved (Wolf 2007). There are also negative landscape factors that affect housing prices, such as garbage, urban villages, and noise. Baranzini and Schaerer (2011) discovered that having visible manufacturing factories can reduce the prices of



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Rail transportation	207	264	347	353	431	557	647	684	708	751	798
urban landscape	94	79	117	135	187	261	272	283	307	328	319

Fig. 1. Number of residential pricing research studies 2002–2012 in CNKI

residential housing (Baranzini and Schaerer 2011). Ham studied the negative impact of the Birmingham landfill on housing prices (Ham et al. 2013). However, the approach used mainly depended on experience, judgment, and number of samples. In the case of small samples, the results may be imprecise because of the limitations of data collection and quantification.

More research is currently being done on the effect that different landscapes have on housing prices using HPM, but these studies are mainly focused on a specific landscape such as a park, not on the overall effect of parks on a larger scale. For example, Wu found that the amenity value of Nanjing Mo Chou Lake can reach as high as 13% for residential prices (Wu et al. 2008). Zhong found that within a 700-m range from Nan Hu Lake, a marginal decrease of 100 m in the distance from house to lake leads to a 5.65% price increase (Zhong et al. 2009). Using HPM and multiple regression analysis, Shi and Zhang found that the maximum impact radius of Huang Xing Park was 1.59 km and the strongest influence location was 0.29 km (Shi and Zhang 2010). Jim and Chen (2010) concluded that residential gardens were the most attractive landscapes (an average increase of 17.2% in housing price) and that a view of Shenzhen Bay can attract a premium of 125,612 CNY (US$20,153) (Jim and Chen 2010). Wen discovered that housing prices decline by 0.226% as the distance to West Lake increases by 1%, whereas housing prices fall by 0.036% as the distance to the nearest park increases by 1% with an average spatial extent of 5.62 km (Wen et al. 2012; Wen and Li 2012). Through the samples of Nanjing Mo Chou Lake, Shenzhen Bay, and Huang Xing Park, this shows that previous studies have mainly focused on a specific landscape such as a park and that studies on all parks on a larger scale are rare.

Cities need green infrastructure (parks, gardens, forests) for sustainable development (Chiesura 2004). Green spaces are very valuable—socially, ecologically, and economically. In particular, the new debates on climate issues demonstrate this fact. It can also provide a theoretical basis and support for the planning and legislation of urban spaces (Qiu et al. 2011; Gómez et al. 2010). Therefore, city governments, urban planners, and developers must pay more attention to urban green infrastructure planning. It is on one hand a question of direct profit for developers and residents. On the other hand, it is important for health and social reasons. Thus, it is necessary to quantify the effect radius and zone of urban green space on property values.

Previous research on housing prices mainly focused on transportation rather than the urban landscape (Pan 2013; Dziauddin et al. 2013). In addition, previous studies have usually focused on a specific landscape (such as a typical park) on a small scale while overlooking the overall effect of parks on a larger scale. Therefore, the researchers chose Shenzhen as the study area and analyzed the effects of 71 parks to help readers better understand the average effect, which can serve as practical support for green space conservation.

In this study, the specific objectives include (1) quantifying the effect of public resources on property values and (2) calculating the effect radius and zone of 71 Shenzhen parks, which is helpful in making residential decisions, providing a new method for government to impose environmental taxes to promote green space conservation and to decide on reasonable estate development layouts for developers.

This paper is organized as follows: "Materials and Methods" describes the study area, the hedonic pricing method, and the data. "Results and Discussion" analyzes variable sign and calculates the marginal price of public resources, effect radius, and zone of Shenzhen's parks. Finally, some conclusions are drawn and some suggestions provided.

Materials and Methods

Study Area

Shenzhen is situated in the central coastal area of southern Guangdong Province and has a total land area of 2,050 km^2 (Zhou et al. 2010). Shenzhen has experienced a rapid rate of urbanization since the mid-1980s, and the number of permanent residents increased from 8.46 million in 2005 to 10.55 million in 2012. The eastern and northern part of Shenzhen has many hills, which are less densely populated. In contrast, the southern part of Shenzhen is mostly flat with few hills, and thus the population density is very high.

Unlike Beijing, Shenzhen is a compact city with multiple centers, in the form of cluster development. The central government of China designed Shenzhen as a special economic zone in 1979 (Sui and Zeng 2001). Shenzhen has six administrative districts and four new functional regions. The per capita gross domestic product of Shenzhen was 122,779 CNY (US$19,720) in 2012, and the average house price was 25,573 CNY $(\text{US}\$4{,}107)/\text{m}^2$ in March 2014.

Hedonic Pricing Method

There have been few studies that factor environmental variables into residential pricing. The HPM provides an appropriate approach to quantifying the external benefits that contribute to transaction prices. This method assumes that a heterogeneous commodity is defined by many different attributes, and its value is based on a combination of characteristics (Brasington and Hite 2008). Buying a house is like purchasing a basket of "characteristics." In general, it can be expressed as

$$P = y(a_1X_1, a_2X_2, a_3X_3, \ldots, a_nX_n) + u_n \qquad (1)$$

where P stands for the commodity price and X_1, X_2, and X_3 are its attributes. The value a_n is the estimated coefficient, and u_n is the error term. This method has been widely applied to calculating the premium of environmental factors on residential value, namely environmental externalities, including air quality, bays, wetlands, and local amenities. Previous empirical research studies mainly have three types of HPM: linear, semilogarithmic, and double logarithmic forms (Table 1) (Wang and Qin 2009).

In linear equations, a_i stands for the residential price variation of changes in a unit house's attributes, whereas a_i represents the percentage of residential price variations that correspond to the united attribute changes in the semilog model. In addition, a_i is the percentage of residential price variation when 1% of attributes changes

Table 1. Three Forms of the Hedonic Pricing Method

HPM type	Formula
Linear model	$P = a_0 + \sum a_i x_j + u_i$
Semilog model	$\ln P = a_0 + \sum a_i x_j + u_i$
Double-log model	$\ln P = a_0 + \sum (a_i \ln x_j) + u_i$

in the double-log model. After the processing of the three models in the Statistical Package for Social Sciences (SPSS 19.0), it turns out that a double-log model is the best model with the highest R^2 (Table 2). The adjusted R^2 is 0.827, indicating that there is a strong linear relationship between the dependent and independent variables. This can explain 82.7% of the variations in apartment sale price. All of the variables are statistically significant.

Data Description

Data on the transaction price of 6,494 dwelling units from October to November 2012 were collected from Shenzhen Real Estate Trading Center and the SOFANG website (SOFANG 1999). The authors ignored the time influence on price because the time span was short. The authors also excluded villas, apartments, and financed housing units to enhance comparability because the units were mostly multistory, high-rise buildings. Finally, the authors acquired 6,473 residential samples after data preprocessing, and the authors did field research in November 2012 to modify the relevant information (building condition, surroundings, living facilities, and so on) to make the data more accurate and complete. It is important to note that the residential samples were mainly distributed in the southern part of Shenzhen. First, Dapeng Peninsula, in the east of Shenzhen, is a mountainous region with dense forest coverage (above 76%) and poor transportation systems (Liu et al. 2010); thus few people live there, and the study area didn't include this area. Second, northern Shenzhen is mainly industrial, and many urban villages located there are not up on the market; as a result, there are few samples in this region. Therefore, the distribution of the Shenzhen residential sample is as shown in Fig. 2.

The authors regard the total price of the secondary housing market as the dependent variable in HPM, for it can reflect purchasing ability (Wang and Huang 2007). Sixteen explanatory variables were selected in three different dimensions: structural attributes, location variables, and neighborhood environment variables (Wen and Jia 2004). The authors selected eight structural attributes, including area, age, orientation, fitment, floor height, floors, property fees, and number of bathrooms. The location variables used were DIS-subway (distance to subway), DIS-central business district (CBD), and DIS-arterial road. Meanwhile, DIS-school, DIS-park, green rate, and coastal park are selected as neighborhood environment variables. In addition, research has found that air pollutants have a negative association with property value (Yusuf and Resosudarmo 2009). To make the model more complete and accurate, the authors introduced a variable of "particulate matter 2.5 (PM2.5)" to stand for air quality. The authors acquired it through a geographic information system (GIS) interpolation based on 18 monitoring stations from the Shenzhen Habitat Environment Network. The definitions and quantification of explanatory variables are as listed in Table 3.

Table 2. Regression Results of Hedonic Pricing Method

Model	R	R^2	Adjust-R^2	Standard error	F	Significant F	Durbin-Watson
Linear model	0.768	0.590	0.589	156.7036498	515.498	0.000	0.742
Semilog model	0.879	0.773	0.772	0.302730926	1219.569	0.000	1.402
Double-log model	0.910	0.828	0.827	0.262223653	1692.241	0.000	1.572

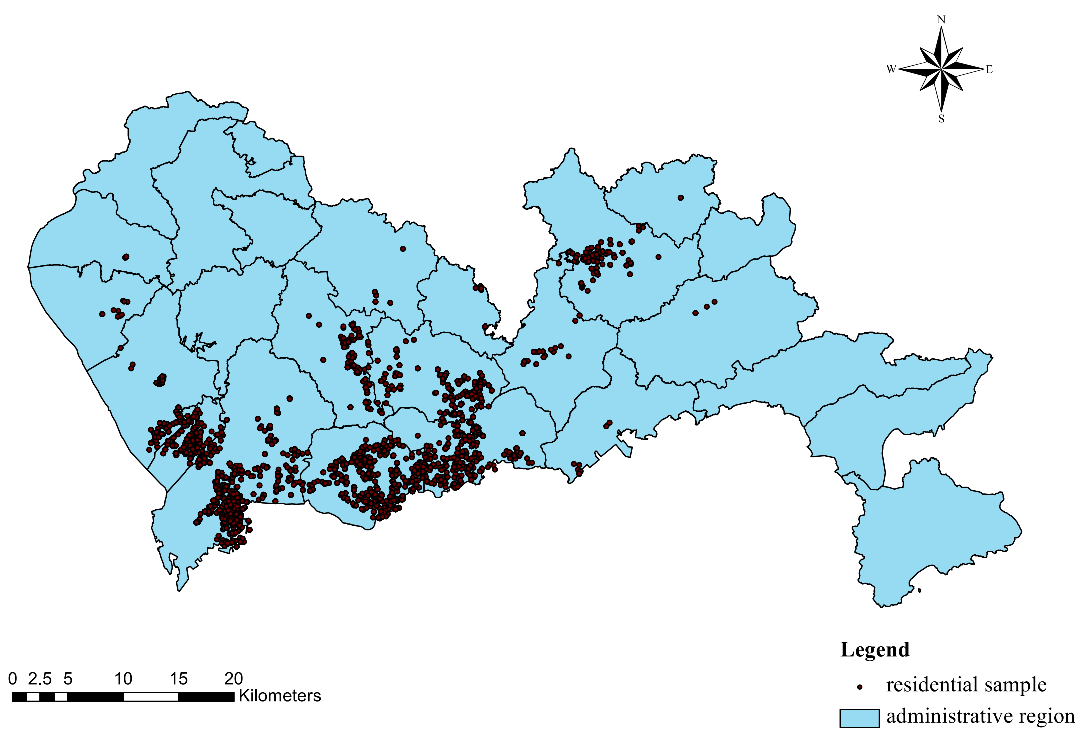


Fig. 2. Study area and geographic distribution of sample properties (data from SOFANG 1999)

Table 3. Description and Quantification of Explanatory Variables

Characteristic types	Variables	Definition	Sign
Structural and housing variables	X_1: area	Floor area of apartment (m^2)	+
	X_2: age	Time of residential use (years)	−
	X_3: orientation	(if south, southeast, southwest, and south-north; 1.0 otherwise)	+
	X_4: fitment	Blank (1), simple (2), middle (3), refined (4), luxury (5)	+
	X_5: floor height	Floor on which the apartment is situated (floor)	−
	X_6: floors	Total floors of the apartment (floor)	Unknown
	X_7: property fees	Property fees of unit area (yuan)	+
	X_8: bathroom	Number of bathrooms	+
Location variables	X_9: DIS-subway	Distance to nearest subway (m)	−
	X_{10}: DIS-CBD	Distance to nearest CBD (m)	−
	X_{11}: DIS-arterial road	Distance to main road (m)	−
Neighborhood environment variables	X_{12}: DIS-school	Distance to nearest school (m)	−
	X_{13}: DIS-park	Distance to nearest park (m)	−
	X_{14}: green rate	Ratio of green space area of residential area (%)	+
	X_{15}: air quality	Average value of PM2.5 over two months (ug/m^3)	−
	X_{16}: coastal parks	Dummy variable, if coastal park; 1.0 otherwise	+

Results and Discussion

Sign Analysis of Property Attributes

According to the analysis results of the double-log model (Table 4), the sign of the variables is in accordance with the assumptions, except for the floor height: the residential property value increases by 0.11% as the floor height increases by 1%, which is different from the expected results and foreign research (Poudyal et al. 2009). A possible explanation for this is that Shenzhen is a compact city with several skyscrapers, and householders have better landscape views and lots of sunlight on higher floors (Jim and Chen 2006). The significance level of "floors" is larger than 10%, so this variable was not included in the model. In the structure characteristic variables, results show that "housing area" is the most relevant variable in terms of price, followed by "property fees," which have a 0.226% premium on residential property values. Meanwhile, the price will decline by 0.08% if the used years increase by 1%, and the variables of orientation, fitment, and bathrooms all have a positive effect on property value. In the location variables, DIS-CBD has a significant effect on housing price and can add 0.186% extra value to the housing price with a distance decrease of 1%, followed by DIS-arterial road and DIS-subway. In neighborhood environment variables, the housing price declines by 0.228 and 0.041%, respectively, with the value of PM2.5 and as the distance from the nearest park increases by 1%. However, the most significant variable is coastal parks, which can bring an extra 0.327% of value to property.

Price Elasticity and Marginal Price of Public Resources

Public resources are relatively significant in terms of residential price according to the double-log model. The order of importance is DIS-CBD, DIS-park, DIS-school, DIS-arterial road, and DIS-subway (Table 5). The authors infer that residents are the most sensitive to CBD and parks to meet their preferences for comfort and convenience.

The authors calculated the marginal price of variables based on total residential price and the average value of characteristic variables. That is, the authors calculated the premium price with the increase of each additional unit. The average residential price is 2,209,000 CNY (US$354,590) based on a statistical description, and the marginal price of logarithmic variables is based on their

Table 4. Regression Variables Based on Semilog Model

	Coefficient[a]						
	Nonstandard coefficient		Standard coefficient			Collinearity statistics	
Model	B	Standard error	Trial version	t	Significant	Tolerance	VIF
Constant	3.015	0.231	—	13.029	0.000	—	—
Area	1.161	0.012	0.743	95.695	0.000	0.453	2.209
Orientation	0.050	0.009	0.029	5.274	0.000	0.913	1.095
Fitment	0.035	0.003	0.054	10.217	0.000	0.964	1.037
Green rate	0.077	0.008	0.048	8.856	0.000	0.941	1.063
Property fee	0.226	0.009	0.171	23.505	0.000	0.519	1.927
Age	−0.080	0.008	−0.066	−10.427	0.000	0.683	1.465
Bathrooms	0.058	0.012	0.037	4.849	0.000	0.467	2.139
Floors	0.008	0.008	0.000	0.004	0.997	0.411	2.430
Floor height	0.011	0.005	0.019	2.760	0.040	0.576	1.738
DIS-park	−0.041	0.005	−0.035	−5.541	0.000	0.682	1.467
DIS-school	−0.038	0.005	−0.063	−10.370	0.000	0.745	1.342
DIS-subway	−0.031	0.005	−0.029	−4.935	0.000	0.769	1.301
DIS-arterial road	−0.035	0.003	−0.066	−11.437	0.000	0.831	1.203
DIS-CBD	−0.186	0.006	−0.240	−33.202	0.000	0.524	1.908
Air quality	−0.228	0.056	−0.022	−4.100	0.000	0.975	1.026
Coastal parks	0.327	0.22	0.082	15.079	0.000	0.915	1.092

Note: B = coefficient; t = t-ratio (the significance of independent variables); VIF = variance inflation factor (there is no multicollinearity when $0 < \text{VIF} < 10$).
[a]Dependent variable.

Table 5. Price Elasticity of Urban Public Resources

Variable	Coefficient	Price elasticity (%)	Importance ranking
DIS-subway	−0.031	3.05	5
DIS-park	−0.041	4.02	2
DIS-school	−0.038	3.73	3
DIS-CBD	−0.186	16.97	1
DIS-arterial road	−0.035	3.44	4

elasticity coefficient, whereas for dummy variables it is based on the semielasticity coefficient. The results (Table 6) indicate the following:

1. Additional square meters of house area attracted a premium of 25,700 CNY (US$4,125), and residential prices fell by 19,640 CNY (US$3,152) with each additional year. The residential price increased by 2,430 CNY (US$389) with additional floor height because residents tend to have better landscape visibility on higher floors.
2. There is a significant negative correlation between the distance variables of public resources and residential price. The DIS-CBD caused the greatest change, with a 0.186% decline in house prices, and the standard residential price fell by 34,580 CNY (US$5,548)/km. The marginal prices of DIS-arterial road, DIS-school, and DIS-subway are 69,040 CNY (US$11,076), 62,800 CNY (US$10,075), and 61,930 CNY (US$9,936). Parks attract a premium of 0.041% and make the standard house price increase by 20,920 CNY (US$3,356).
3. A coastal park can create a premium of 852,830 CNY (US $136,828) for property value, and Jim and Chen (2010) found that Shenzhen Bay's visibility can increase housing prices by 12,561 CNY (US$2,015). The reason for this is that coastal parks are typically adjacent to the sea. For example, mangroves are a powerful temptation for bird lovers and plant researchers as well as marine enthusiasts. Therefore, because coastal parks combine the double attribute of waterfronts and parks, there is an obvious premium for housing prices in these areas.

Effect Radius and Zone

According to the study, the parks can attract a premium of 0.041%, causing house prices to fall by 20,920 CNY (US$3,356) per kilometer. However, according to elasticity theory, such an effect will gradually decrease as the distance to park increases. Thus, it is necessary for residents to know how far the effect can reach by employing a binary model using the *SPSS* software. The authors used 6,473 transaction samples and 71 parks of Shenzhen (Fig. 3). The distribution of parks was as follows.

Table 6. Marginal Price of Urban Public Resources

Variable	Regression coefficient (%)	Elastic coefficient (%)	Semielastic coefficient	Marginal price
ln(DIS-subway)	−0.031	−0.031		−61,930CNY(US$9,936)/km
ln(DIS-arterial road)	−0.035	−0.035		−69,040CNY(US$11,076)/km
ln(DIS-school)	−0.038	−0.038		−62,800CNY(US$10,075)/km
ln(DIS-park)	−0.041	−0.041		−20,920CNY(US$3,356)/km
ln(DIS-CBD)	−0.186	−0.186	0.386	−34,580CNY(US$5,548)/km
Coastal parks	0.327			852,830CNY(US$136,828)

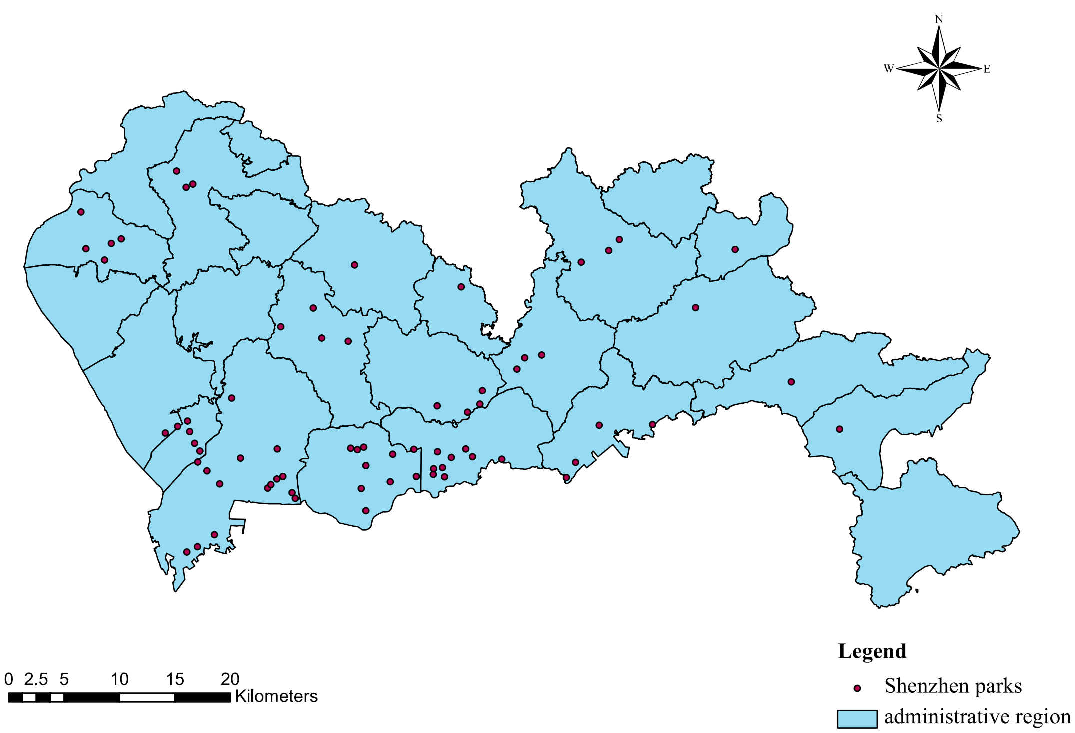


Fig. 3. Distribution of 71 parks in Shenzhen (data from SOFANG 1999)

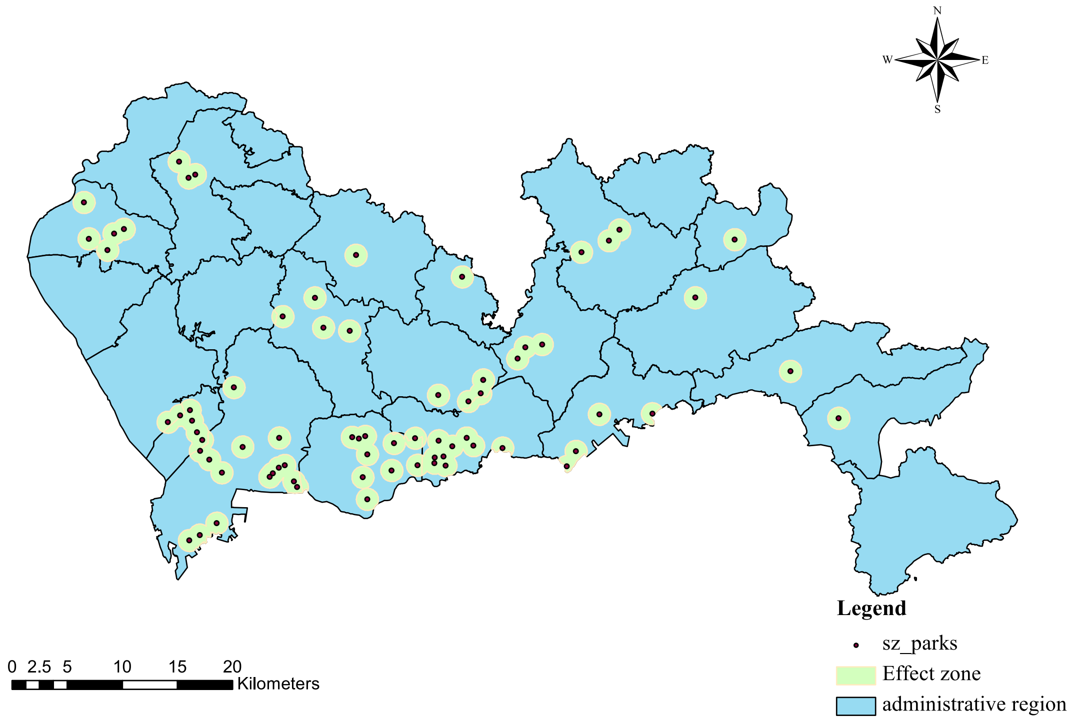


Fig. 4. Effect area of parks using GIS buffering (data from SOFANG 1999)

The authors assume that housing price is Y yuan and the distance to parks is X meters. The equation can be expressed as

$$Y = 0.007X^2 - 24.222X + 52131.232 \quad (2)$$

The results show that the average effect radius of parks in Shenzhen can reach 1.73 km according to ecology threshold theory, with $F = 9.686$ and its significance = $0.000 < 0.05$ (Ma 1995). The effect range varies in different cities because diverse conditions are found in different study areas. Previous research has demonstrated that the maximum radius of Huang Xing Park in Shanghai could reach 1.59 km (Shi and Zhang 2010). Wolf found that residential properties located 1 km away from parks may have a significant premium (Wolf 2007). By contrast, 1.73 km is relatively larger than previous studies, and a reason for this is that the 71 parks are typical and adjacent; therefore, the average effect radius is larger. However, to a certain extent, this is in accordance with foreign research with the effect radius ranging from 1 to 2 km (Rosen 1974).

According to the literature review, one can measure the premium effect of green space on housing prices through the sampling survey method, the traveling cost method, and hedonic estimation (Smith et al. 2002). Researchers have calculated the effect zone by combining hedonic estimation and GIS (Xie and Zhang 2012; Zhang and Xie 2012). The authors regard the effect radius ($r = 1.73$ km) as the buffering range with a buffering tool of spatial analysis in GIS; then the authors calculate the valid area of the buffering region (the authors fused the overlay buffering zone to make sure that the overlapped region was calculated only once and ignored park area). The total effect zone of 71 parks is as shown in Fig. 4.

The formula can be defined as follows:

$$A = \sum_{i=1}^{n} \mathrm{buffer}(r) \quad (3)$$

where A = effect zone of 71 parks in Shenzhen (ha); and r = average effect radius of parks, which is equal to 1.73 km here. In addition, the subscript i stands for each urban green space. According to the GIS calculation, the authors found that the overall effect zone is 412.14 km^2, accounting for 20.1% of the area of Shenzhen.

Conclusion and Suggestions

This study provides a further step in quantifying the overall benefits of green space on property value based on GIS and HPM. It can be concluded that, first, urban public resources have a statistically significant effect on housing price, and the order of importance is DIS-CBD, DIS-park, DIS-school, DIS-arterial road, and DIS-subway. The most significant factor is DIS-CBD, even though Jim's study (Chen and Jim 2010) on Shenzhen special zones showed that CBD was not significant. The probable explanation is that Shenzhen is a compact city with many sub-CBDs in the special zone; thus it is significant on the city scale. Second, proximity to parks has a powerful and significant effect on residential property value, of which the average effect can reach 1.73 km. The overall effect zone is 412.14 km^2; that is, parks can promote an increase in housing prices within the scope of 412.14 km^2. However, the effect may diminish and can become constant as the distance increases. There is a 0.041% premium as the distance increases by 1%; that is, the standard residential price decreases 20,920 CNY (US$3,356) as the distance increases by 1 km.

This paper can provide effective suggestions for residents, developers, and local governments in several ways. First, residents may be able to better understand the factors that influence property value and learn more about the importance of public resources; they can choose a house that is 1.73 km from the nearest park to save money when buying a new house because the property value drops as the distance from the nearest park increases. Second, housing developers can define reasonable layouts according to the price spillover effect. For example, if there are two residential properties that are 0.4 and 0.8 km from an urban green space, respectively, then the premium can be based on Eq. (1). If the D-value of two lands is lower than the premium, the developer should choose the first land (0.4 km from green space) to achieve maximum profit. Third, the government can impose an "environmental tax" in the effect zone based on the effect radius, which can contribute to green space conservation. The average green space maintenance costs are about 15 CNY (US$2.50)/$m^2$ in Shenzhen; the environmental tax can be used to pay for the maintenance costs to better preserve and manage green spaces. Besides, China has been collecting land-transferring fees for many years, resulting in high land-transferring cost and low holding cost (Li and Wang 2010); thus, the profit of projects invested in by the government may be exclusive to developers and land users. Therefore, the environmental tax on 412.14 km^2 can make the external effect rationally internalized and relieve pressure on governments.

It is worth noting that a park's shape and area also have a significant effect on neighborhood residential property values. For this reason, in the future, researchers should conduct more research from the perspective of landscape ecology, including the landscape quality, diversity, and fragmentation (Morancho 2003; Yin and Kong 2003; Kong et al. 2007). The authors believe that this study can provide effective information for real estate developers, government (in terms of decision-making on environmental tax), urban and landscape planners or architects, and green space conservationists and managers in Shenzhen and other cities in China.

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