Available online at www.sciencedirect.com
ScienceDirect
Landscape and Urban Planning 81 (2007) 155–166
LANDSCAPE AND URBAN PLANNING
This article is also available online at:
www.elsevier.com/locate/landurbplan

Effect of urban landscapes on land prices in two Japanese cities

Xiaolu Gao[a,*], Yasushi Asami[b,1]

[a] Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, 11A Datun Road, Chaoyang District, Beijing 100101, China
[b] Center for Spatial Information Science, University of Tokyo, Kashiwanoha 5-1-5, Kashiwa, Chiba 277-8568, Japan

Received 17 August 2006; received in revised form 15 November 2006; accepted 28 November 2006
Available online 9 January 2007

Abstract

To support decision-making in landscape management and planning policies in urban built-up areas, a formal framework is needed to evaluate urban landscapes objectively and clarify the economic values of landscape amenity. This paper proposes a framework to address this issue. The framework consists of three parts: conducting a standardized landscape survey, extracting critical evaluation factors with a principal component analysis, and then identifying the effect of these factors on land prices with hedonic pricing models. Data from the cities of Tokyo and Kitakyushu were used, which are typical of large metropolitan areas and medium-sized cities in Japan. In each city, some 200–300 transacted vacant sites, designated for residential development, were chosen as samples. The results of principal component analysis and hedonic regression analysis suggested that, in either city, the compatibility of the buildings and the greenery of the neighborhood were distinctively perceived; these factors significantly influenced land prices, and the marginal effects were similar for both cities. The results empirically proved the stableness of the proposed framework and suggested the possibility of generalizing the framework in urban built-up areas. In addition, some important policy implications were provided by the analysis. The outcomes indicate that programs should be provided to motivate residents to preserve or create landscape amenity cooperatively, and justify planning policies to encourage neighborhood-based cooperation for landscape improvement. With the impact of landscape amelioration or damage being elucidated, it also makes it possible to adjust benefits among concerned people, and may help public landscape management sectors optimize their budget plans.

Keywords: Urban landscape quality; Urban greenery; Compatibility of buildings; Land price; Hedonic pricing method

1. Introduction

Among residents of urban built-up areas, there is a growing concern for landscape amenity for the purpose of aesthetic enjoyment, recreation opportunities and healthy environments (McLeod, 1984; Adams and Leedy, 1987; Tyrvainen and Miettinen, 2000). Good planning and management of urban landscapes not only bestows pride on citizens and the government but also enhances a city's capability for competition and for community development (de Haas et al., 1999; Jim, 2004; Nishimura, 2005). Consequently, many planning policies related to urban landscapes have been adopted such as regulations on land use and the appearance of buildings, control of views, designation of historical sites and conservation areas, and limitations on advertisements (Department of the Environment, 1990; Murtagh, 1997; Miyawaki, 2000; Wada and Toriumi, 2000).

In Japan, for example, 'Landscape Laws' were enacted in 2004 to enhance the administration of urban landscapes, which provided a legal basis for protecting people's rights to landscape amenity (Itoh, 2006). In the laws, human judgments of the comprehensive quality of landscapes were legitimized through a so-called 'landscape certification' program. That is, the valuations of normal people could be used as criteria in lawsuits.

No doubt, the implementation of such policies requires a high level of objectivity and measurability in the assessment. However, in practice, the evaluations of urban landscapes, especially in built-up areas, are often a mixture of personal views, and there is not yet a formal framework to resolve this problem. Therefore, an objective methodology for evaluating urban landscapes in built-up areas would be beneficial. Specifically, it is necessary to develop a formal procedure for

* Corresponding author. Tel.: +86 10 6488 9075.
E-mail addresses: gaoxl@igsnrr.ac.cn (X. Gao), asami@csis.u-tokyo.ac.jp (Y. Asami).
[1] Tel.: +81 4 7136 4300; fax: +81 4 7136 4300.

0169-2046/$ – see front matter
doi:10.1016/j.landurbplan.2006.11.007

landscape evaluation, and to clarify the impact of landscape ameliorations and damages, so that judgments of landscape can be shared, regulations on urban landscapes can be justified in spite of limited development rights, and the benefits can be adjusted among people. This is an important issue not only for the above-mentioned laws, but also for other policies related to the planning and administration of urban landscapes.

So far, quite a few frameworks for evaluating landscapes in urban contexts have been proposed. For example, Lichfield (1988), Carter and Bramley (2002), Coeterier (2002), and İpekoğlu (2006) analyzed the values of historical sites and traditional dwellings with respect to physical space and compositions; Gómez-Sal et al. (2003) proposed that landscapes should be evaluated from ecological, productive, economic, social and cultural perspectives, and they defined some scenarios based on this idea, compared with which landscape planning and management projects could be evaluated. Nasar (1988) used perceptual indices to identify the cognitive dimensions of residential street scenes in American cities, which rendered three prominent ones, i.e., diversity (in contrast to plain and dull scenes), openness and naturalness (in contrast to closed space and scarce vegetation), and fittingness and clarity (in contrast to unfitting and ambiguous building configurations). Prato (2000) applied a multiple attribute decision-making model to select management plans of sites or landscapes based on biophysical features, financial and economic conditions, and decision-makers' preferences for the attributes of plans, etc., and evaluated the sustainability of the plans at the landscape scale. Groat (1984) investigated people's aesthetic judgments of contextual design in American cities, to seek good ways to organize new development with existing environmental settings. Furthermore, the roles of nature and green space in urban areas were intensively examined, as reported by Burgess et al. (1988), Mazzotti and Morgenstern (1997), and Jim (1999, 2004).

To investigate the value of urban landscapes, two kinds of analytical approaches have most often been used. One is a psychological approach such as semantic differential techniques in terms of human perceptions used by García-Mira et al. (1997), Green (1999) and Hass and Imamoglu (2000), and psychological experiments by Fukahori and Kubota (2003). The other is an economic (monetary) evaluation approach such as contingent valuation methods in Willis and Garrod (1993) and Tyrvainen and Vaananen (1998), and hedonic pricing methods in McLeod (1984), Tyrvainen (1997), and Tyrvainen and Miettinen (2000). In particular, hedonic pricing methods have been applied in recent works to comprehend the benefits of landscape improvement through analysis of an agency market. For example, Geoghegan et al. (1997) and Kong et al. (in press) incorporated ecological indices of landscapes in hedonic pricing models such as the richness and fragmentation of land-use patches, with the aid of geographical information systems (GIS).

Urban landscape amenities have been interpreted from a rich variety of perspectives, and with varied methods. The existing literature showed that spatial order, greenery, etc., have been subjects of common interest; however, a formal framework integrating the analysis of the cognitional judgments of urban landscapes and that of their economic impacts has not been established. The research reported here attempts to bridge this gap.

There are two objectives of this research. The first is to analyze the evaluation structure of urban landscapes and to investigate empirically whether markets for land reflect the values of landscape amenity. This requires a framework for objectively describing the amenity of urban space, as well as an analytical framework to associate the perceptions of physical environments with economic values. The second objective is to generalize the evaluation method. Since the perceptions of urban landscapes are highly likely to differ by cities, districts, and individuals with different preferences, to what degree a methodology is valid and applicable is a critical issue.

Tokyo and Kitakyushu were selected as investigation targets. They represent a large metropolitan area and a medium-sized city, respectively. The two cities have well-managed data on planning and urban environments, most of which are integrated with GIS.

2. Methodology

A three-step approach was developed. First, a scheme was designed to represent the physical characteristics of urban landscapes qualitatively, but objectively. Based on the scheme, data were collected via surveys of sample sites and their surrounding areas. Secondly, critical factors of landscape evaluation were extracted by employing a principal component analysis. Finally, a hedonic approach was adopted to examine if the principal components of urban landscapes were significant determinants of land prices.

2.1. Samples and data

In Tokyo, the sample sites were drawn from the 1996 to 1997 issues of Weekly Housing Information, which provided information on a large number of houses and land for sale (approximately 10,000 properties every month). The sample sites were limited to vacant land properties having been transacted, and the study area to nine of 23 wards in western Tokyo (Suginami, Nerima, Shinjuku, Shibuya, Nakano, Setagaya, Meguro, Ota, and Shinagawa). The study area was outside of the Yamanote line, the main railway line surrounding the central part of Tokyo. In this area, real estate transactions were active, so there could be enough sites to choose for sampling. Generally speaking, the nine wards had no prominent difference in terms of the intensity of land use, real property value, and general landscape and environmental qualities.

Furthermore, the sample sites were confined to land use zones designated for residential development, including 'low-story residential zones' (exclusively used for low-story housing and small-scale daily services), 'medium-high residential zones' (allowed for medium and high-rise residential development and limited commercial use) and 'residential zones' (mainly used for residential use, and an area was designated as such if there were already many mixed types of land use).

There were 687 properties satisfying the above criteria in the Weekly Housing Information database. Some of them were successfully located on residential maps so that detailed data on the environments and landscapes of the surrounding areas could be collected by survey. Finally, the number of samples with complete data was 272.

The largest site was 423.5 m^2 and the smallest 34.1 m^2, with an average of 132.5 m^2. This size distribution resembles that of detached residential lots in Tokyo (an average of 128 m^2 for newly acquired detached housing lots in 1998). Therefore, it was assumed that the chosen sites belonged to the same market of detached housing lots. As a matter of fact, detached housing constitutes a large share of the housing market in Japanese cities (about 40% in Tokyo and more in medium-sized cities).

Among the sample sites, 203 were in low-story residential zones, 37 in medium-high residential zones and 32 in residential zones. Presumably, the landscape characteristics should be different across different land use zones, being subject to allowed non-residential use, designated floor-to-area ratio, etc. However, the actual use of a specific lot is largely confined by its size. That is, small sites are almost always used for detached housing. This was confirmed by a survey showing that the entire sample sites except for undeveloped ones had been developed for two or three story detached housing. This fact supported the same-market assumption about the sample sites.

Additionally, the extent of the study area in terms of distance to the center of the city was moderate. The sample sites were distributed along 13 railway lines, and it took 7–34 min from the nearest railway station to reach the Yamanote line.

The sample in Kitakyushu was drawn from a database from an administrative survey of the purchases of 1333 properties transacted in the fiscal year of 2003. The criteria for drawing samples were similar to those for Tokyo. Only records of vacant land properties related to private sellers and buyers, designated for residential use, were selected. Properties traded rapidly (specified by the survey) were excluded. Those with extremely small (<40 m^2) or large sizes (>1000 m^2) were also excluded, because they could constitute a part of other parcels, or because non-residential development could increase. With these criteria, a sample of 181 vacant sites distributed across the whole city was obtained. The proportion of samples in low-story residential zones, medium-high residential zones and residential zones was approximately 2:1:2. More sites within residential zones were selected in Kitakyushu than in Tokyo, but this was not regarded as a problem, provided that the attribute of designated land use zones could be controlled in the analysis.

Among the sample sites, the largest was 876 m^2 and the smallest 45.66 m^2, with an average of 260.8 m^2. This size distribution was close to that of detached housing lots in Kitakyushu (an average of 242 m^2 for newly acquired detached housing lots in 2003), so they were also assumed to be developed for detached houses.

The databases for the two samples were carefully constructed. First, both included the prices of property at the sample sites. As a matter of fact, it was difficult to obtain the real prices of properties in Japan. Therefore, for the Tokyo sample, the final list prices (final prices recorded before transaction) of each site given by Weekly Housing Information were used; for the Kitakyushu sample, the prices obtained from questionnaires in the administrative survey were used. These were assumed to be close to the real prices, though errors were possible. Second, the data sets include detailed information on sample lots, including their sizes, shapes, the width and direction of the roads in front of the sites (to be called 'front road'), accessibility to public transportation, the environmental attributes of the neighborhoods, and the indices of 'chome' (the Japanese name for a city block, which usually constitutes the smallest unit of a census) including building density, gross floor-to-area ratio, population density, and the proportion of wood-structure buildings. For the Tokyo sample, a part of the data came from Gao et al. (2006). For Kitakyushu, data provided by the municipal government, including the ratings on 18 indices of living environments for 1488 chomes, were utilized in addition to those obtained from the administrative survey. See Appendix A, for a list of the data.

2.2. Landscape survey

In this survey, the proposal of Arai (2001) was used for reference, i.e., to evaluate urban landscapes in built-up areas from three aspects: neighborhood scene, street scene and the practice of local-based planning (e.g., public involvement in local affairs and the implementation of 'district planning'). Specifically, emphasis was placed on the scenes of neighborhoods and streets for the clarity of data collection (by observation). An 11-factor evaluation system was designed as shown in Table 1. The factors beginning with 'A' are indicators of neighborhoods and those with 'B' are indicators of streets. Every factor consists of several items, with each rated by points −1, 0, +1, +2, etc. They add up to the ratings of the 11 factors.

A detailed guideline was made to ensure the objectivity of survey results. The evaluations were based on neighborhood areas within 20–25 m from the borders of each sample site. Detailed criteria were provided for rating each factor, including both verbal descriptions and pictures for reference. For example, the criteria for the evaluation of the continuity of external walls (A1) were as follows:

"This factor focuses on the enclosing walls or external walls of buildings beyond 1.5 m (above the eye-line) to see if they are 'well-aligned' along the street. Here, 'well-aligned' means that the differences in distance from the street do not exceed 0.5 m:

+1: Most walls and buildings are well-aligned. They account for more than 4/5 of the total length on each side of the street. (The left picture of Fig. 1 is given for example.)
0: More than half, but no more than 4/5, of walls and buildings are well-aligned along the street. (The middle of Fig. 1 is given for example.)
−1: There are many vacant sites, sites being used for parking, houses without gate-walls, or large buildings such as apartments or office buildings in the neighborhood. Consequently, no more than 1/2 of walls are well-aligned along the street. (The right of Fig. 1 is given for example.)"

A 1-hour training was delivered to surveyors, who came from local survey companies of each city and had no professional experience in architecture or urban design.

Table 1
Factors for evaluating urban landscapes

Factors	Items	Point
A1: Continuity of external walls (+1, 0, −1)	Walls are well-aligned along streets to a high degree	+1
	Walls are well-aligned along streets to an average degree	0
	Walls along streets are not continuous	−1
A2: Conformity of colors and materials (+1, 0, −1)	Colors and materials of buildings are in harmony to a high degree	+1
	Colors and materials of buildings are in harmony to an average degree	0
	Colors and materials of buildings are not in harmony	−1
A3: Compatibility of building styles (+1, 0, −1)	Building styles share common features to a high degree	+1
	Building styles share some kind of common features	0
	Building styles have little in common	−1
A4: Beauty of skylines formed by buildings (+3, +2, +1, 0, −1)	Building heights are orderly and under control	+1
	Roof shapes are similar	+1
	Rhythms of skylines are beautiful	+1
	Silhouette of buildings distinctively lacks order	−1
A5: Openness and scale of buildings (+1, 0, −1, −2)	Spaces formed by buildings are open and comfortable	+1
	Street spaces are narrow and compressed	−1
	Open spaces are dull and without change	−1
A6: Visually aesthetic and continuous greenery (+2, +1, 0)	Greenery in the district forms a network	+1
	Greenery is visually continuous	+1
B1: Greenery of walls and trees (+1, 0, −1)	Walls along roads are continuously greened	+1
	Walls along roads are greened to an average level	0
	Walls along roads are mostly concrete blocks	−1
B2: Greenery of open pedestrian spaces (+2, +1, 0, −1)	There are well-greened parks and playgrounds	+1
	There are abundant trees along the streets	+1
	Land is deserted and garbage is scattered throughout it	−1
B3: Favorable pedestrian space (+1, 0, −1, −2, −3)	Streetscape is rich and pleasant	+1
	Street scenes are chaotic with garbage bins, bicycles	−1
	Advertisements are in disorder	−1
	Illegal parking hinders pedestrian use	−1
B4: Friendly outdoor space (+1, 0, −1)	Street spaces are friendly and sociable	+1
	Streets spaces are isolated, without living atmosphere	−1
B5: Decorations and street furniture (+2, +1, 0)	There is street furniture, sculptures, waterscapes, etc.	+1
	There is well-designed lighting, etc.	+1

The site surveys were conducted for the Tokyo sample in May 2004 and for the Kitakyushu sample in March–April 2005. The surveyors were instructed to work on each site for 15–20 min, and finish about 10 sites each day. For each sample site, two surveyors implemented the evaluation. The second was asked to confirm the points given by the first. In cases in which they did not agree with each other, the scores given by each were recorded. In addition, they were asked to take six or seven pictures from different angles and a 15-s video for each sample site. These were later used to justify whether the evaluation results were biased and in cases in which different opinions were reported, which surveyor's rating was more appropriate.

+1 point   0 points   -1 point

Fig. 1. Pictures for reference in landscape survey (A1: continuity of external walls).

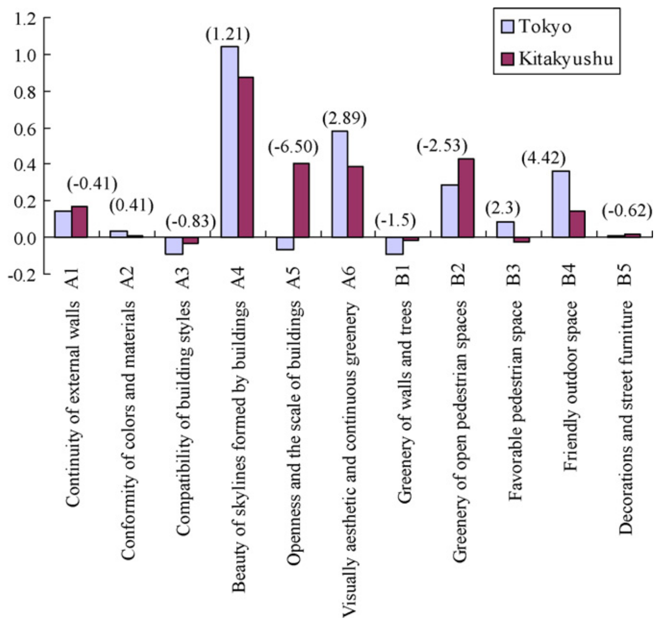

Fig. 2. Comparison of the survey results in the two cities (brackets are *t*-values of the difference between the values for each city).

In fact, 94% of the points given by the surveyors were unanimous and reasonable, and in this point no significant difference was detected between the two cities. In one of the 15 groups of the Tokyo surveyors, one member tended to rate most of the 11 factors lower than his colleague. This tendency was identified by viewing the pictures and videos.

According to the results, the databases of urban landscapes in Tokyo and Kitakyushu were established. Fig. 2 compares means of the 11 indices in the two cities.

The results revealed that they were similar for factors A1 (continuity of external walls), A2 (conformity of colors and materials), A3 (compatibility of building styles), A4 (beauty of skylines formed by buildings), B1 (greenery of walls and trees) and B5 (decorations and street furniture), while significantly different in factors A5 (openness and scale of buildings), A6 (visually aesthetic and continuous greenery), B2 (greenery of open pedestrian spaces), B3 (favorable pedestrian space), and B4 (friendly outdoor space). This result agreed with the fact that, in large metropolitan areas, building densities were generally higher but open spaces and greenery were less. The largest difference between the two cities was in A5 (openness and scale of buildings). A reasonable explanation was that more sites in Kitakyushu were located in newly developed areas with more vacant land.

2.3. *Principal component analysis of landscape data*

It was found that the ratings of the 11 landscape indices were inter-correlated. In order to analyze the evaluation structure better, the correlation problem has to be addressed. Therefore, a principal component analysis was performed.

For the Tokyo data, the 11 factors were first grouped based on the intensity of their correlations. With a graphical modeling method, they were classified into four categories:

(1) A1 (continuity of external walls), A2 (conformity of colors and materials), A3 (compatibility of building styles), and A4 (beauty of skylines formed by buildings);
(2) B1 (greenery of walls and trees), B2 (greenery of open pedestrian spaces), and A6 (visually aesthetic and continuous greenery);
(3) B3 (favorable pedestrian space), B4 (friendly outdoor space), and A5 (openness and scale of buildings);
(4) B5 (decorations and street furniture).

Based on the respective meanings of the indices, it was noted that the four categories were related to the compatibility of buildings, greenery of neighborhoods, sense of familiarity, and the effort to preserve or create unique characteristics of neighborhood. Then, principal component analysis was conducted within each category. This procedure yielded a principal component with an eigenvalue larger than 1 for three of the above categories. The fourth, however, was omitted because the eigenvalue that showed the contribution of B5 (decorations and street furniture) to the whole set of data was very small (0.17). The extracted principal components accounted for 72.8%, 66.6% and 58.2% of the classified variables, respectively.

It will be shown in a later section that the landscape factors were significant in the hedonic models. Actually, the significant variables derived from the classified categories as described above retained more information from the original data of the 11 factors than the case without classification (44.7% versus 41.4%). This had been the reason we chose to classify the variables prior to principal component analysis.

In parallel, three principal components with eigenvalues larger than 1 were extracted with the Kitakyushu data. Table 2 gives the details of the results.

In both samples, the three principal components explained about 40%, 12%, and 9% of the total variances. They equally kept 62% of the total information of each dataset. Eigenvectors in the lower part of Table 2 revealed that the structures of the first and second components were alike in Tokyo and Kitakyushu. Specifically, the first one strongly correlated to factors representing the compatibility of buildings, including A1 (continuity of external walls), A2 (conformity of colors and materials), A3 (compatibility of building styles), and A4 (beauty of skylines formed by buildings); thus it was considered to be a scale for compatibility. In the same way, the second one was deemed to be a scale for greenery. The third principal component of the Tokyo sample, with strong association to B3 (favorable pedestrian space), B4 (friendly outdoor space) and A5 (openness and scale of buildings), was regarded as a scale for familiarity. That of the Kitakyushu sample, being strongly associated with B5 (decorations and street furniture), was termed decoration.

The results revealed the distinctiveness of compatibility and greenery in the perception of urban landscapes. On this point, the results were very close in Tokyo and Kitakyushu. In Tokyo, the recognition of familiarity was stronger. This probably indicated that the desires of the inhabitants of large metropolitan areas for amiable environments were adversely affected by intensified incompatible land use and heavy traffic. In contrast, the recognition of decoration in Kitakyushu might have reflected the

Table 2
Principal components of landscape factors

	Tokyo			Kitakyushu		
Principal Component	1	2	3	1	2	3
Eigenvalue	4.436	1.313	1.035	4.317	1.4369	1.016
Percent (%)	40.33	11.93	9.41	39.24	13.06	9.23
Cum. Percent (%)	40.33	52.26	61.68	39.24	52.31	61.54
Evaluation scale	Compatibility	Greenery	Familiarity	Compatibility	Greenery	Decoration
A1 Continuity of external walls	0.336	-0.208	-0.306	0.372	-0.234	-0.004
A2 Conformity of colors and materials	0.370	-0.298	-0.155	0.392	-0.269	-0.068
A3 Compatibility of building styles	0.381	-0.158	-0.204	0.388	-0.221	-0.028
A4 Beauty of skylines formed by buildings	0.383	-0.206	-0.207	0.397	-0.235	0.079
A5 Openness and scale of buildings	0.231	-0.073	0.361	0.280	0.056	-0.002
A6 Visually aesthetic and continuous greenery	0.305	0.476	-0.097	0.220	0.608	-0.055
B1 Greenery of walls and trees	0.249	0.491	-0.197	0.322	0.289	0.032
B2 Greenery of open pedestrian spaces	0.275	0.487	0.037	0.226	0.548	0.144
B3 Favorable pedestrian space	0.280	-0.086	0.479	0.246	0.084	-0.203
B4 Friendly outdoor space	0.287	-0.221	0.383	0.236	-0.056	-0.079
B5 Decorations and street furniture	0.119	0.187	0.492	0.048	-0.051	0.957

endeavors of the local government and communities to preserve and create local characteristics.

2.4. Hedonic analysis of landscape factors in Tokyo

Hedonic analysis was then performed on the datasets of Tokyo and Kitakyushu. In hedonic pricing models of land prices, the principal components of urban landscapes were used as independent variables to see if they had significant impacts on land prices.

For the Tokyo sample, the following linear regression function was employed:

$$\text{unitP} = \text{intercept} + \sum_i \alpha_i X_i + \sum_j b_j \left(\frac{X_j}{S}\right) \tag{1}$$

where unitP is a vector of the per-square-meter price of land, X_i (for $i = 1$ to m) is a vector of the ith independent variable, S is a vector of lot size, and a_i and b_j are regression coefficients to be estimated. The terms X_i and X_i/S were included in the model together, assuming that the influence of some variables might differ by lot size S.

Statistical tests showed that unitP was normally distributed. The raw data of independent variables were transformed to suitable forms via postulating and validating respective assumptions. For example, the width of the front road, w_1, was replaced by $\ln(w_1)$, considering that as w_1 increases, its marginal influence on unitP should decay. The width of a second front road, w_2 ($w_2 = 0$ if a second front road did not exist), was replaced by $\ln(w_2 - 1)$ if $w_2 \geq 2.0$ m, and 0 otherwise. In this way, the new variable was continuous no matter whether a second front road existed. These transformations improved the fitting of the regression model.

The specification in Eq. (1) was tested against a variety of alternative functions including a linear model for unitP regressing on X_i (excluding X_i/S), a log-linear regression model on X_i, and so on. Comparisons of R^2, AIC and the prediction errors showed that the specification in Eq. (1) was satisfactory. The average level of prediction errors, estimated with a cross-validation method proposed by Gao et al. (2002), was 10.4%.

As a result of incremental stepwise regression, a model with 19 variables was established (Table 3). It explained 68.7% of the total variations of land prices. The correlations of the 19 significant variables were tolerable except for that between FAR_1 and FAR_2 (−0.915). This was understandable since they were derived from the same variable, which is described later in this paper. Statistical tests were performed with random errors imposed on correlative terms, and with some terms randomly removed from the independent variable list. As a result, the estimates of the model were statistically stable. This suggested that collinearity had not caused serious problems.

It was found that the determinants of land price included railway lines (indicated by line-Seibu, line-Keio, and line-Tokyutoyoko), accessibility to multiple railway lines (indicated by multiple line) and time to the nearest train station (indicated by t-station). For example, properties along Tokyutoyoko line, being famous for wealthy residents and high-class houses, are 75.6 thousand Yen/m^2 (approximately 657.4 US$/$m^2$ with 1000 Yen = 8.696 US$. The same exchange rate is used hereafter) more expensive than standard residential areas along the JR Chuo line (based on which the dummy variables of railway lines were generated).

Significant variables also included attributes of lots, including the frontage (indicated by frontage/S), lot shape (indicated by irregular shape) and the floor-to-area ratio (FAR) regulated by planning controls (indicated by FAR_1, FAR_2, and FAR_3). UnitP was affected positively by larger frontages and negatively by irregular shapes. The variables FAR_1, FAR_2 and FAR_3 were derived from the 'effective FAR' of each lot, i.e., maximum FAR under all planning controls on lots and onsite buildings. With less than 10% parts being dropped, the effective FAR variable was obtained. It was a categorical variable in the range of 60–270%. Then, regression analysis rendered three related

Table 3
Regression model for unitP in Tokyo

Number	Variable	Definition	Coefficient		Standard error	t	P-Value
			In thousand Yen/m^2	In US$/m^2			
	Intercept		688.4	5986.1	0.0413	16.68	<0.0001
1	Line-Seibu[a]	Along Seibu railway lines, 1; otherwise, 0	−129.4	−1125.2	0.0153	−8.45	<0.0001
2	Line-Keio[a]	Along Keio railway lines, 1; otherwise, 0	−41.3	359.1	0.0134	−3.09	0.0022
3	Line-Tokyutoyoko[a]	Along Tokyutoyoko railway lines, 1; otherwise, 0	75.6	657.4	0.0158	4.8	<0.0001
4	Multiple line	The nearest station connects at least two railway lines, 1; otherwise, 0	35.7	310.4	0.0121	2.95	0.0035
5	FAR_1	If effective FAR[b] is below 100%, 1; inclusively between 110% and 270%, −1; otherwise, 0	−61.2	−532.2	0.0123	−4.96	<0.0001
6	FAR_2	If effective FAR[b] is below 210%, 1; beyond 220%, −1	−111.7	−971.3	0.0234	−4.78	<0.0001
7	FAR_3	If effective FAR[b] is inclusively between 110% and 160%, 1; inclusively between 170% and 210%, −1; otherwise, 0	18.4	160.0	0.0087	2.12	0.0353
8	t-Station	Time to the nearest train station (min)	−9.8	−85.2	0.0013	−7.45	<0.0001
9	Irregular shape	With an irregular shape and $S \geq 70$, $\ln(S-70)$; otherwise, 0[c]	−25.1	−218.3	0.0038	−6.63	<0.0001
10	Frontage/S	Frontage facing main front road (m)/S	590.2	5132.2	0.2095	2.82	0.0052
11	$\ln(w_1)$	ln(width of main front road (m))	44.8	389.6	0.0170	2.64	0.0088
12	$\ln(w_2-1)$	If the width of the second front road $w_2 \geq 2.0$ m, $\ln(w_2-1)$; otherwise, 0	49.7	432.2	0.0137	3.62	0.0004
13	Cul-de-sac	Front road is of dead-end type, 1; otherwise, 0	−46.1	−400.9	0.0127	−3.64	0.0003
14	Chome-elevation/S	Average elevation of chome (m)	108.4	942.6	0.0351	3.09	0.0022
15	Chome-popden	Population density of chome (person/ha)	−0.3	−2.6	0.0001	−2.65	0.0087
16	Chome-BCR < 40%/S	If building coverage ratio of detached houses in chome is less than 40%, 1/S; otherwise, 0	−3892.4	−33,847	1.4227	−2.74	0.0067
17	Obnoxious	With obnoxious facility in neighborhood, 1; otherwise, 0	−115.0	−1000	0.0287	−4.00	<0.0001
18	Compatibility	First principal component of landscape	7.2	62.6	0.0033	2.17	0.0310
19	Greenery	Second principal component of landscape	8.0	69.6	0.0040	1.99	0.0477

R^2, 0.687; Adj. R^2, 0.663; sample size, 272.

[a] Dummy variables for railway lines were based on the JR Chuo line.

[b] Effective FAR was the maximum floor-to-area ratio under all planning controls on lots and onsite buildings, with less than 10% parts being dropped.

[c] By this definition, it was assumed that the impact of irregular shapes diminishes as S increases. Seventy square meters is an experience value below which it is difficult to develop an irregular lot. The smallest sample site with an irregular shape is 72 m^2.

variables, FAR_1, FAR_2, and FAR_3. They split effective FAR into four intervals, below 100%, 110–160%, 170–210%, and over 220%. By computing their estimates, it was revealed that land prices were lowest with effective FAR below 100%, possibly due to limited development capacity, as land lots are generally small in Tokyo. Comparatively, land prices were 140.8 thousand Yen/m^2 (1224.3 US$/m^2) higher with effective FAR of 110–160% and 104 thousand Yen/m^2 (904.3 US$/m^2) higher with that of 170–210%. These results indicated that 110–160% were reasonable FAR levels for detached housing in Tokyo. That land prices were slightly lower with effective FAR between 170% and 210% might be the consequence of difficulties in controlling land use and landscape features if maximum FARs were regulated as such. In addition, land prices associated with effective FAR over 220% (almost falling in residential zones) were 345.8 thousand Yen/m^2 (3007 US$/m^2) higher. A greater possibility of commercial land use might explain this effect.

Attributes of front roads were significant, including their widths (indicated by $\ln(w_1)$ and $\ln(w_2-1)$) and road types (indicated by cul-de-sac). Their effects were also reasonable. Land prices increased by $\ln(w_1)$ and $\ln(w_2-1)$, and decreased by cul-de-sac, which corresponds to inconvenient traffic circulation and more difficulty in escaping if fires occur in densely built-up areas.

Significant variables related to neighborhood involved the average elevation of the district (indicated by chome-elevation/S), population density (indicated by chome-popden), building coverage ratio (indicated by chome-BCR < 40%), and the presence of obnoxious facilities (indicated by obnoxious). The negative effects of population density and presence of obnoxious facilities were reasonable. That land prices differed by elevation could be explained by the conviction that higher places provide better views and protection from flooding. Actually, it is traditional in Japanese cities for high-ranking residences to be placed in high locations. In general, detached housing areas have high building coverage ratios (BCR) in Tokyo. The study area of this research is typical among them. More than half of sample districts (chome) were between 45–50%, and less than 40% ones were no more than 10%. It was noted that the latter, instead of indicating more open space within individual lots, were rather the result of undeveloped lots or land temporarily used for parking. In this sense, the negative effect of chome-BCR < 40% was reasonable.

The above results should provide much useful information for the planning and design of detached housing areas. However, detailed discussions have been omitted to leave space for the investigation of landscape variables, which are the focus of this research.

The first and second principal components of urban landscapes, indicated by compatibility and greenery, were significant at 0.05 levels in the model of Table 3. Specifically, land prices increased by 7.2 thousand Yen/m^2 (62.6 US\$/m^2) if the level of compatibility increased by one point, and by 8.0 thousand Yen/m^2 (69.6 US\$/m^2) if that of greenery increased by one point. The signs of compatibility and greenery indicate that the effects of landscape factors on land prices are positive, because all of them are positively associated with compatibility and greenery as shown by the signs of eigenvectors in Table 2.

2.5. Hedonic analysis of landscape factors in Kitakyushu

A modeling procedure similar to the one described above was followed using the Kitakyushu data. As a result, a log-linear regression model for per-square-meter land price, unitP, was established:

$$\ln(\text{unitP}) = \text{intercept} + \sum_i a_i X_i \qquad (2)$$

where X_i (for $i = 1$ to m) is a vector of the ith independent variable, and a_i is the regression coefficient.

By stepwise regression, a model with 20 variables was obtained (Table 4). This model explained 66.1% of the variance of ln(unitP). Validation tests showed that the specification was satisfactory (it was significantly better than linear regression models); there were no serious multicollinearity problems and the estimates of the model were stable.

The signs and the estimates of the variables were consistent with expectations. In this model, two principal components of landscape factors, compatibility and greenery were significant at 0.01 and 0.05 levels, respectively. This result re-confirmed the economic values of urban landscape amenities. Their elastic coefficients showed that land prices could increase by 3.05% if compatibility was one point higher and by 3.35% if greenery was one point higher.

Table 4
Regression model for ln(unitP) in Kitakyushu

Number	Variable	Definition	Impact on ln(unitP)	Standard error	*t*	*P*-Value	Elastic coefficient (impact on unit price)
	Intercept		10.9033	0.1411	77.29	<0.0001	
1	Away from main road	Away from main road, 1; otherwise, 1	−0.1589	0.0415	−3.83	0.0002	0.853
2	Away from commercial area	Away from commercial area, 1; otherwise, −1	−0.1481	0.0556	−2.66	0.0085	0.862
3	Road direction	In north, northeast or south, 1; in east, 0; otherwise, −1	−0.0361	0.0177	−2.04	0.0428	0.965
4	Without sidewalk	Without sidewalk, 1; otherwise, 0	−0.0472	0.0213	−2.21	0.0283	0.954
5	Road circulation	Not bad, 1; otherwise, −1	0.1499	0.0382	3.93	0.0001	1.162
6	Line-not Chikuho[a]	Not along Chikuho line, 1; otherwise, −1	0.0611	0.0320	1.91	0.0578	1.063
7	Line-not Hitahikosan[a]	Not along Hitahikosan line, 1; otherwise, −1	−0.0870	0.0437	−1.99	0.0481	0.917
8	Line-not monorail[a]	Not along monorail, 1; otherwise, −1	−0.1265	0.0305	−4.15	<0.0001	0.881
9	t-Bus stop	Time to the nearest bus stop	−0.0003	0.0001	−3.21	0.0016	1.000
10	Solid land base	Solid land base, 1; otherwise, −1	0.1838	0.0791	2.32	0.0214	1.202
11	Regulated FAR	Floor-to-area ratio designated by planning	0.0012	0.0003	3.86	0.0002	1.001
12	Regular shape	Regular shape, 1; otherwise, −1[b]	0.1126	0.0225	5.01	<0.0001	1.119
13	Distance-shopping	Within 200–500 m to the nearest shopping center, 1; otherwise, −1	−0.0501	0.0180	−2.79	0.0059	0.951
14	Chome-fire disaster	In high degree of danger due to densely built wood-structure buildings, 1; otherwise, −1	−0.0429	0.0174	−2.47	0.0145	0.958
15	Chome-public transportation	Inconvenient public transportation, 1; average, 0; good, −1	−0.1433	0.0367	−3.91	0.0001	0.866
16	Chome-home care	Too few or too many home care facilities, 1; average, −1	−0.0700	0.0217	−3.22	0.0015	0.932
17	Chome-daily facility	Insufficient daily facilities, 1; average or above, −1	−0.1461	0.0367	−3.98	0.0001	0.864
18	Chome-popden	Population density in chome (person/ha)	0.0027	0.0006	4.72	<0.0001	1.003
19	Compatibility	First principal component of landscape	0.0305	0.0084	3.64	0.0004	1.031
20	Greenery	Second principal component of landscape	0.0335	0.0153	2.19	0.0296	1.034

R^2, 0.661; Adj. R^2, 0.618; sample size, 181.

[a] Dummy variables for railway lines were based on the JR Kagoshima line.

[b] This form is different from the irregular shape variable in the Tokyo model (see Table 3) because the impact of irregular shape is less sensitive to the size of lots, probably due to larger lot size in Kitakyushu.

3. Discussion of the evaluations in the two cities

The results with regard to compatibility and greenery provide useful implications for urban landscape management and planning policy. First, the significant positive effects of urban landscapes on land prices were proved, and they are not trivial in dimension. The average land price levels of the Tokyo and Kitakyushu samples were 602.4 and 73.2 thousand Yen/m^2 (5 238.3 and 636.5 US$/m^2). This means compatibility or greenery marginally accounts for 1–1.5% of the total prices in Tokyo, and more than 3% in Kitakyushu. In absolute values, the impacts of compatibility and greenery were 7.2 and 8.0 thousand Yen/m^2 (62.6 and 69.6 US$/m^2) in Tokyo, and 2.23 and 2.45 thousand Yen/m^2 (21.3 and 22.1 US$/m^2) at the average land price level in Kitakyushu. These results were reasonable for both cities. In terms of the amount, the influence of landscape amenity on land price should not be ignored.

Second, the empirical results in Tokyo and Kitakyushu demonstrated a high level of robustness, thus suggesting that subjectivity had been kept to an acceptable level. Consequently, the proposed method can be generalized.

The evaluation structures of urban landscapes were identical in the two cities. In either case, compatibility and greenery were the main attributes in urban landscapes. Although the assessments of the 11 factors being investigated were different (as shown in Fig. 2), the levels of compatibility and greenery in the two cities were not ($t = -0.25$ and $t = 0.099$, respectively).

Additionally, the estimated hedonic prices of compatibility and greenery were comparable in scale, though the marginal effects in Tokyo were higher with respect to absolute values, and those in Kitakyushu were slightly higher with respect to percentages.

Since, Tokyo and Kitakyushu are typical examples of Japanese cities, the proposed method could be generalized to other areas, i.e., it could be used as a formal framework for judging the loss and benefit of landscape changes in practice.

Third, the results of hedonic pricing analysis indicate effective strategies for improving urban landscapes in built-up areas. Because principal components are linear combinations of the product of eigenvectors and standardized landscape factors, the estimates for compatibility and greenery in the 11 dimensions can be broken down. Thereby, the marginal effects of the 11 landscape factors on land price were computed (Table 5). For instance, by a one-point increase in the continuity of external walls (A1), land prices can rise by 0.72% in Tokyo and 0.43% in Kitakyushu. The effects associated with greenery-related factors are even larger; for example, in well-greened areas in Tokyo, land price was 10.35 thousand Yen/m^2 (90 US$/m^2) higher than that of other areas (shown by the results of B1); in Kitakyushu, the marginal effect of the same factor was 3.08 thousand Yen/m^2 (26.8 US$/m^2), which is also the largest among considered factors.

In Tokyo, the benefits of keeping the continuity of external walls (A1), conformity of colors and materials (A2), and

Table 5
Comparison of the results for Tokyo and Kitakyushu[a]

	Tokyo		Kitakyushu	
	Marginal effect on unit price (in thousand Yen/m^2/in US$/m^2)	Elastic coefficient (impact on average unit price)	Average marginal effect on unit price (in thousand Yen/m^2/in US$/m^2)	Elastic coefficient (impact on unit price)
A1: Continuity of external walls (1, 0, −1)	+4.31/37.5	+0.0072	+0.32/2.8	+0.0043
A2: Conformity of colors and materials (1, 0, −1)	+4.71/41.0	+0.0078	+0.35/3.0	+0.0048
A3: Compatibility of building styles (1, 0, −1)	+5.27/45.8	+0.0087	+0.49/4.3	+0.0067
A4: Beauty of skylines formed by buildings (3, 2, 1, 0, −1)	+2.52/21.9	+0.0042	+0.19/1.7	+0.0026
A5: Openness and scale of buildings (1, 0, −1, −2)	[b]		+0.64/5.6	+0.0088
A6: Visually aesthetic and continuous greenery (2, 1, 0)	+5.81/50.5	+0.0096	+2.82/24.5	+0.0385
B1: Greenery of walls and trees (1, 0)	+10.35/90.0	+0.0172	+3.08/26.8	+0.0421
B2: Greenery of open pedestrian spaces (2, 1, 0, −1)	+7.52/65.4	+0.0125	+2.85/24.8	+0.0389
B3: Favorable pedestrian space (1, 0, −1, −2, −3)	[b]		+2.76/24.0	+0.0377
B4: Friendly outdoor space (1, 0, −1)	[b]		+0.20/1.7	+0.0027
B5: Decorations and street furniture (2, 1, 0)	[b]		0.49/4.8	+0.0067

[a] Exchange rate 1000 Yen = 8.696 US$ was used for the computation.
[b] Means non-significant.

compatibility of building styles (A3) are prominent, suggesting the effectiveness of regulating the position, colors and materials, and styles of buildings in neighborhoods. Also, the greenery of walls and trees (B1), open pedestrian spaces (B2), and visual quality of greenery (A6) brings the largest benefits among the 11 factors. Accordingly, taking actions to improve landscape amenity in these aspects will be efficient. Similar indications were found from the analysis of Kitakyushu, whilst the effectiveness of providing favorable pedestrian spaces as suggested by B3 should also be emphasized.

Finally, and most important, the analysis suggests the importance of collaborations at neighborhood levels for the improvement of landscape quality. This point is of critical importance in the management and planning of urban landscapes.

In built-up areas, compatibility and greenery depended on the qualities of building groups and neighborhoods rather than those of individual buildings. Therefore, to improve landscape qualities, the joint efforts of neighborhood members were necessary. In this sense, regulations that merely focus on individual sites or on the land use of large-scale districts are not sufficient; instead, policies encouraging and inducing cooperation at the neighborhood level are more effective.

This necessitates adequate involvement of residents in local environmental affairs, as well as effective support from the side of local authorities or non-profit organizations. Nowadays, the importance of this point is increasingly recognized. In some wards of Tokyo, for example, municipal governments have enacted policies to encourage residents to green the walls and fences along streets by providing subsidies or reducing property taxes, and to send personnel to help residents make covenants concerning the features of buildings and greenery. Meanwhile, there have been successful examples where neighboring residents initiated and made agreements by themselves.

The motives of such neighborhood-based efforts are empirically proven in the analysis reported here. Accordingly, activities and policies leading to collaboration, such as 'district planning' made by the local government and 'building and landscape covenant' made by residents should be further enhanced in the future.

4. Concluding remarks

The above analyses showed that the proposed method is effective for evaluating urban landscape amenities, i.e., standardized survey, principal component analysis and hedonic analysis. They also suggested that strategy for landscape administration and planning should generally emphasize the compatibility of buildings and greenery of neighborhoods.

The analyses of the economic values of urban landscape amenities indicate that programs should be provided to motivate residents to preserve or create landscape amenity cooperatively, and justify planning policies that encourage neighborhood-based cooperation. With the impact of landscape amelioration or damage being elucidated, it also makes it possible to determine how benefits are adjusted among concerned people, and may help public landscape management sectors optimize their budget plans.

Although the analysis was confined to the residential areas in two Japanese cities, the implications may be extended beyond these specific areas. As a matter of fact, the significant effects of compatibility of buildings and that of greenery in urban built-up areas agrees with the outcomes reported by many other researchers, such as Groat (1984), who proved a high level of consistency in the preference judgments of the compatibility of buildings in American cities; Burgess et al. (1988), Mazzotti and Morgenstern (1997), and Jim (1999, 2004), who elaborated the values of green space in urban areas. This, from another viewpoint, corroborates the effectiveness of the proposed framework for landscape evaluation. Comparisons of the evaluation structures and the economic impacts of urban landscapes across cities with more land use types and broader demographic and socioeconomic differences will be a subject of our future research.

Acknowledgements

The authors gratefully acknowledge the members of the Evaluation of Residential Environments Research Team for their support in data collection and valuable comments. Two anonymous referees and the editor also provided valuable comments for improving this paper. This research was supported by the Grant-in-aid for Scientific Research from the Japan Society for the Promotion of Science, Ministry of Land, Transportation and Construction of Japan, the Center for Spatial Information Science at the University of Tokyo, National Science Foundation of China No. 40671063, the Institute of Geographical Sciences and Natural Resources Research at the Chinese Academy of Sciences, and the Ministry of Education, China.

Appendix A. Details on the data for Tokyo and Kitakyushu samples

Tokyo (valid sample size: 272)[a]	Kitakyushu city (valid sample size: 181)
Railway lines[b]	Railway lines[c]
Time to the nearest railway station	Time to the nearest railway station and bus stop[d]
Time to Yamanote line[e]	Configuration of lot (size; frontage; irregular or not)
Configurations of lot (size; frontage; irregular or not)	Number of front roads; directions
Number of front roads; direction(s)	Quality of front road (width; dead-end or not; pavement, slope; public or private)
Quality of front road (width; dead-end or not; pavement, slope; public or private)	Adjacent land use (farm, factory, parking lots)
Adjacent land use (farm, factory, parking lots)	Obnoxious facilities in neighborhood
Distance to park, school, hospital, shopping center, etc.	Intensity of land use mixture in neighborhood
Available sunshine duration	Distance to park, school, hospital, shopping center, etc.
Noise and vibrations in neighborhood	Land use zone
Obnoxious facilities in neighborhood (e.g., waste treatment, cemetery)	Designated floor-to-area ratio and building coverage ratio
Intensity of land use mixture in neighborhood	Evaluation of chome on the density of wood-structure buildings

Appendix A (*Continued*)

Tokyo (valid sample size: 272)[a]	Kitakyushu city (valid sample size: 181)
Land use zone	Evaluation of chome on emergency roads in fire disasters
Effective floor-to-area ratio of lots	Evaluation of chome on dangers of natural disasters
Beauty area designated by planning	Evaluation of chome on hazard
Economic rank of chome (taxes in chome)	Evaluation of chome on criminal-prevention
Implementation of 'district plan'	Evaluation of chome on pollution and noise
Criminal occurrence in the past years	Evaluation of chome on public transportation
Average elevation of chome	Evaluation of chome on accessibility to artery roads
Population density in chome	Evaluation of chome on welfare facilities
Density of road in chome	Evaluation of chome on medical facilities
Proportion of vacant land in chome	Evaluation of chome on daily facilities
Coverage ratio of detached houses in chome	Evaluation of chome on education facilities
Proportion of wooden structure buildings	Evaluation of chome on commercial facilities
Proportion of buildings constructed before 1970	Evaluation of chome on parks and public space
	Evaluation of chome on coverage of greenery
	Evaluation of chome on open space
	Evaluation of chome on planning regulations in terms of landscape beauty
	Evaluation of chome on sustainability of environment
	Evaluation of chome on balance of population

[a] See Gao et al. (2006), for more details on the Tokyo data.
[b] There are 13 railway lines across the study area. According to the average land price levels along the lines, they were classified into five variables: the JR Chuo line, Seibu lines, Keio line, Tokyutoyoko line, and others.
[c] Including the JR Kagoshima line, Chikuho line, Hitahikosan line, and a monorail line.
[d] Local bus service plays an important role in Kitakyushu, so these data were also included.
[e] Railway line surrounding central Tokyo areas.

References

Adams, L.W., Leedy, D.L. (Eds.), 1987. Integrating Man and Nature in the Metropolitan Environment. National Institute for Urban Wildlife, Columbia, MD.

Arai, Y., 2001. Evaluation indices of residential environments. In: Asami, Y. (Ed.), Evaluation of Residential Environment. University of Tokyo Press, Tokyo (appendix 52, in Japanese).

Burgess, J., Harrison, C.M., Limb, M., 1988. People, parks and the urban green: a study of popular meanings and value for open spaces in the city. Urban Stud. 25, 455–473.

Carter, R.W., Bramley, R., 2002. Defining heritage values and significance for improved resource management: an application to Australian tourism. Int. J. Herit. Stud. 8 (3), 175–199.

Coeterier, J.F., 2002. Lay people's evaluation of historic sites. Landsc. Urban Plann. 59 (2), 111–123.

de Haas, W., Kranendonk, R., Pleijte, M., 1999. Valuable man-made landscapes (VMLs) in the Netherlands: a policy evaluation. Landsc. Urban Plann. 46, 133–141.

Department of the Environment, 1990. Guidance on the Protection of Strategic Views for London. Department of the Environment Consultation Letter, UK.

Fukahori, K., Kubota, Y., 2003. The role of design elements on the cost-effectiveness of streetscape improvement. Landsc. Urban Plann. 63 (2), 75–91.

Gao, X., Asami, Y., Chung, C.F., 2002. An empirical evaluation of hedonic regression models, paper presented at ISPRS/SDH/CIG Joint International Symposium on Geospatial Theory Processing and Applications, Ottawa, Canada, July 2002.

Gao, X., Asami, Y., Katsumata, W., 2006. Evaluating land use restrictions concerning the floor-area-ratio of lots. Environ. Plann. C 24, 515–532.

García-Mira, R., Arce, C., Sabucedo, J.M., 1997. Perceived quality of neighborhoods in a city in northwest Spaan individual differences scaling approach. J. Environ. Psychol. 17, 243–252.

Geoghegan, J., Wainger, L.A., Bockstael, N.E., 1997. Spatial landscape indices in a hedonic framework: an ecological economics analysis using GIS. Ecol. Econ. 23, 251–264.

Gómez-Sal, A., Belmontes, J.A., Nicolau, J.M., 2003. Assessing landscape values: a proposal for a multidimensional conceptual model. Ecol. Model. 168 (3), 319–341.

Green, R., 1999. Meaning and form in community perception of town character. J. Environ. Psychol. 19, 311–329.

Groat, L., 1984. Public opinion of contextual fit. Archit.: Am. Inst. Archit. J. 73, 72–75.

Hass, Imamoglu, Ç., 2000. Complexity, liking and familiarity: architecture and non-architecture Turkish students' assessments of traditional and modern house facades. J. Environ. Psychol. 20, 5–16.

İpekoğlu, B., 2006. An architectural evaluation method for conservation of traditional dwellings. Build. Environ. 41 (3), 386–394.

Itoh, S., 2006. From Landscape Regulations to Landscape Laws: A Policy Reform Originated from Autonomy. Mokutakusha, Tokyo (in Japanese).

Jim, C.Y., 1999. A planning strategy to augment the diversity and biomass of roadside trees in urban Hong Kong. Landsc. Urban Plann. 44, 13–32.

Jim, C.Y., 2004. Green-space preservation and allocation for sustainable greening of compact cities. Cities 21 (4), 311–320.

Kong, F., Yin, H., Nakagoshi, N., in press. Using GIS and landscape metrics in the hedonic price modeling of the amenity value of urban green space: a case study in Jinan City, China. Landsc. Urban Plann.

Lichfield, N., 1988. Economics in Urban Conservation. Cambridge University Press, Cambridge.

Mazzotti, F.J., Morgenstern, C.S., 1997. A scientific framework for managing urban natural areas. Landsc. Urban Plann. 38, 171–181.

McLeod, P.B., 1984. The demand for local amenity: a hedonic price analysis. Environ. Plann. A 16, 389–400.

Miyawaki, K., 2000. Planning of landscape and historical urban areas based on Legge Galasso, Italy. In: Nishimura, Y. (Ed.), Landscape Planning in Urban Areas: Approaches and Applications of Landscape Controls in Europe and the United States. Gakugei Press, Tokyo, pp. 68–90 (in Japanese).

Murtagh, W.J., 1997. Keeping Time: The History and Theory of Preservation in America, Revised ed. John Wiley & Sons Inc.

Nasar, J.L., 1988. Perception and evaluation of residential street scenes. In: Nasar, J.L. (Ed.), Environmental Aesthetics: Theory, Research & Applications. Cambridge University Press, New York.

Nishimura, Y., 2005. Urban landscapes and community development, new frontiers in architecture: urban and regional design. Pap. Archit. Inst. Jpn. 3, 64–66 (in Japanese).

Prato, T., 2000. Multiple attribute evaluation of landscape management. J. Environ. Manage. 60 (4), 325–337.

Tyrvainen, L., 1997. The amenity value of the urban forest: an application of the hedonic pricing method. Landsc. Urban Plann. 37, 211–222.

Tyrvainen, L., Miettinen, A., 2000. Property prices and urban forest amenities. J. Environ. Econ. Manage. 39, 205–223.

Tyrvainen, L., Vaananen, H., 1998. The economic value of urban forest amenities: an application of the contingent valuation method. Landsc. Urban Plann. 43, 105–118.

Wada, Y., Toriumi, M., 2000. Conservation of historical environments and landscape planning in France. In: Nishimura, Y. (Ed.), Landscape Planning in Urban Areas: Approaches and Applications of Landscape Controls in Europe and the United States. Gakugei Press, Tokyo, pp. 39–65 (in Japanese).

Willis, K.G., Garrod, G.D., 1993. Valuing landscape: a contingent valuation approach. J. Environ. Manage. 37 (1), 1–22.

Xiaolu Gao PhD, Professor of the Lab of Urban and Rural Development, Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences. She has a BE degree in architecture and a ME degree in urban planning and design from Tsinghua University, and a PhD in urban engineering from University of Tokyo (in 2001). Research interests include quantitative analysis of planning policies, land use and environments, and the application of GIS and spatial information analysis in urban planning.

Yasushi Asami PhD, Professor and Vice-Director of the Center for Spatial Information Science (CSIS), University of Tokyo. He has a BA and ME in urban engineering from University of Tokyo, and a PhD in regional science from University of Pennsylvania (in 1987). He has a wide research interests, including housing and environmental design, spatial information analysis, urban housing theory, analysis of human behavior and psychology, morphological analysis, etc.