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Social benefits of urban green space

A conceptual framework of valuation and accessibility measurements

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Received 20 June 2010
Revised 11 April 2011
Accepted 29 September 2011

Abstract

Purpose – The purpose of this paper is to review the topic "urban green space" focusing on its social benefits and measure techniques in terms of monetary value and accessibility. It suggests potential research direction by using an integrated valuation and measurement framework, and concludes that urban green space valuation in the providers' perspective as well as accessibility analysis in the consumers' perspective are useful tools that provide significant measure techniques in urban green space planning.

Design/methodology/approach – The paper uses a systematic approach to build up a conceptual framework that quantifies social benefits of green space from provider and consumer perspectives. The literature review indicates some limitations of existing techniques of valuation and accessibility analyses, which entails an integrated model of measurements.

Findings – The paper explores social benefits of urban green space, which includes recreational opportunities, aesthetic enjoyments, adjusting psychological well-being and physical health, enhancing social ties, and providing educational opportunities. To analyze existing evaluation and measure techniques of urban green space, the paper points out that a single measurement only evaluates certain aspects of urban green space, which may not always be suitable to comprehensively assess social benefits from both providers' and consumers' perspectives. Considering this limitation, the paper offers an integrated model to measure urban green space that may deal with current limitations.

Originality/value – The originality of the study resides in designing an integrated model including valuation and measure techniques. It certainly offers an important avenue to evaluate social benefits of urban green space.

Keywords Town planning, Landscaping, Leisure activities, Urban green space, Social benefits, Valuation, Accessibility

Paper type Conceptual paper

1. Introduction

Most cities in the world are experiencing environmental challenges such as poor air quality, water pollution, street noises, and heat island effects, which undermine urban development process and environmental sustainability. In addition to these environmental problems, urban residents also complain against intensive work stress and less social communication among them both in individual and community level (Chen and Jim, 2008; Kweon *et al.*, 1998). As a result, the physical and psychological health of the urban citizens has been a major concern for maintaining urban

The authors would like to thank Dr Li Hui, Foo Ern Hui Serene, and anonymous reviewers for their valuable and insightful comments and suggestions.

Management of Environmental Quality: An International Journal
Vol. 23 No. 2, 2012
pp. 173-189

1477-7835
DOI 10.1108/14777831211204921

socioenvironmental quality. Prior researches indicate the presence of urban green space may largely mitigate such social problems in the urban context and provide attractive environment to residents (Kellert and Wilson, 1993; Ulrich *et al.*, 1991). Many researchers note that urban green space can inject cities with vitality in terms of ecological, social, and economic benefits (Givoni, 1991; Heidt and Neef, 2008; Tzoulas *et al.*, 2007). It can serve as air pollution purifier, microclimate ameliorator, noise reducer, and rainwater container. In addition, green space also boosts up economic value of space, reduces social gap in the community, and ensures socioenvironmental sustainability (Chen and Jim, 2008). Therefore, conserving urban green space in the city is an important strategy to maintain social sustainability.

The process of urbanization, with an ever growing population in the city, devours large amount of green spaces at the periphery of the city and also changes the internal green space pattern. This situation calls for an attention to maintain and regenerate urban green space. In addition, with citizens' expectations, provision of urban green space becomes an important agenda to ensure the quality of urban life.

Urban green space can be understood as an integrated area comprising natural, semi-natural, or artificial green land, providing manifold benefits to different groups of people within the city extent (Tzoulas *et al.*, 2007). It is further defined as "an open space situated within the city limits with a good vegetation cover planted deliberately or inherited from pre-urbanization vegetation and left by design or by default" (Jim and Chen, 2006b, p. 338). Urban green space includes urban forest as well as other green areas (Helms, 1998; Wu, 2008); for examples, public parks, sport fields, edges of roads, public or private gardens, and remnant patches of natural vegetation as well as individual street trees (Davies *et al.*, 2008). Some researchers also use the term "green infrastructure" to denote urban green space as a coherent planning entity (Ahem, 2007; Sandstrom, 2002).

The importance of the urban green space has obviously been realized (Givoni, 1991; Heidt and Neef, 2008; Tzoulas *et al.*, 2007). Nevertheless, the questions, how to measure the benefits obtained from green space and to what extent these benefits serve the urban citizens, are less documented in previous studies. There are two different ways to accomplish this task. First, evaluate benefits of green spaces in the monetary term, which comes from provider's perspective. More *et al.* (1988) point out that one of the most important reasons of the vulnerability of urban green space is: the value of green space is not directly expressed in a monetary term. As a result, the planners and policy makers can clearly understand the values of different land covers, and the decision-making process can be facilitated. Despite benefits of green space may not be fully measurable in a monetary term, this valuation process may at least provide more weights to green space when deciding the tradeoff between green land cover and others (Luttik, 2000). In another word, valuation gives an explicit way to explain the extent to which green space benefits people in a monetary term. Second, the benefits of green space can also be evaluated through accessibility analysis (Tyrväinen *et al.*, 2007). The accessibility analysis of green space represents a consumer perspective, indicating the distribution and structure of green space that may satisfy requirements of green spaces in a city.

This paper intends to introduce a hybrid model, which incorporates both consumer and provider's perspectives. The specific aims and objectives of this paper include: first, to provide an interdisciplinary literature review focussing on social benefits of urban green space and its measurements in terms of monetary valuation and accessibility analysis; and second, to build up a conceptual framework to quantify social benefits of green space from both providers' and consumers' perspectives.

The paper is organized in five sections. Section 2 introduces the social benefits of urban green space. Additionally, the interconnectedness of socioenvironmental benefits is also illustrated. In section 3, an overview of existing measure techniques of social benefits of urban green space is given. Section 4 proposes a measure framework focussing on both providers and consumers' perspectives. Section 5 concludes the paper and summarizes findings of this review.

2. Green space and people

Green space, an oasis in the city, renders great benefits to urban sustainable development from ecological, economic, and social equity aspects (Wheeler and Beatley, 2002). Hence, the following section illustrates the social benefits that can be directly obtained by the citizens from urban green spaces.

2.1 Social benefits of green space

Green space endows citizens with a series of benefits in both explicit and implicit ways. In the following section, several social benefits of green space are discussed.

2.1.1 Providing recreational opportunities. The urbanization process and the expanding built-up area cause an ever growing demand for off-road recreation and a strong desire for urban green space (Briffett, 2001), which plays an important role in providing attractive, vibrant, and amusing land. The pursuits for joy, excitement, and relaxation can be largely satisfied in an urban green space.

Different enjoyments can be obtained from different types of green spaces (Fleischer and Tsur, 2003). Neighborhood gardens provide residents' daily contact with nature; golf courses bring leisure relish; urban parks give a good place for picnic and recreation. Various characteristics of green space may function differently. Bjerke *et al.* (2006) examine the vegetation density as a factor that may lead to different preferences. The extent of naturalness is another issue which affects the attractiveness of green space (Kaplan, 1985; Strumse, 1994). In addition, the maintenance, safety, and diversity of the green space are also some major factors that influence urban green spaces as attractive amenities (Jorgensen *et al.*, 2002; Kuo *et al.*, 1998).

2.1.2 Rendering esthetic enjoyments. Urban green spaces provide distinct senses of colors, shapes, textures, and sounds, and these senses vary as a consequence of the change of seasons, weather, or even time of a day (Miller, 2007). Sense of beauty derived from the urban green space is associated with each individual. Lots of empirical studies indicate that urban green spaces provide great esthetic enjoyments to the residents (Jim and Chen, 2006b; Tyrväinen *et al.*, 2003). It serves as ornaments or decorations for individual tastes or public enjoyments (Smardon, 1988). Simply through visual contact with nature, individuals can obtain immense pleasure and gratification. Esthetic enjoyment is not always limited to visual experience. Immersed in some light scent emitted from certain vegetation is also a pleasant experience. Besides, sounds from the rustling leaves and whistling wind in the green space create a sense of peacefulness (Smardon, 1988). As the city becomes more and more dense, the elaborate and ingenious design of the urban green corridor can add some beautiful elements into each citizen's life (Todorova *et al.*, 2004).

2.1.3 Promoting physical health. Keeping urban open space is an important means that positively influences the physical health and well-being of the residents. Physical benefits can be derived through frequent contacts with green environments (Hill, 2002). For patients, a window view of green space will expedite the recuperation process comparing to a view of brick wall (Ulrich, 1984). In order to justify the cause and effect

relationship between green space and health, Vries *et al.* (2003) investigate causation mechanism between human health and green space, and find that green space can promote the heath conditions. Moreover, characteristics of green space urge people to participate more in outdoor activities (Sugiyama *et al.*, 2009). In addition, many preventive effects can be retrieved through physical activity in a favorable environment. The possibility that people suffer from diseases like cardiovascular problems, diabetes, and some types of cancer can be greatly reduced (Folsom *et al.*, 2000; Manson *et al.*, 2002; Sinner *et al.*, 2006). Moreover, blood pressure can be lowered in a natural setting (Hartig *et al.*, 2003). Tanaka *et al.* (1996) also find that the longevity of the elderly is positively correlated with the presence of green space.

2.1.4 Adjusting psychological well-being. Human health has been defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1948). Accordingly, aside from conducive to physical health, urban green space also has a number of psychological benefits (Orsega-Smith *et al.*, 2004; Teo, 1997). The concept of "biophila" suggests that human cannot be separated from nature, and contact with nature is the essence for the psychological well-being (see Kellert and Wilson, 1993). Moreover, different landscapes can generate varied psychological responses (Ulrich *et al.*, 1991). Preferable green space affords restorative experiences and emotional relief (Korpela and Hartig, 1996). Particularly, the positive emotion can replace a commensurate negative feeling when people approach green space (Korpela *et al.*, 2001). Mental fatigue and aggression can be controlled and reduced in a favorable environment (Kuo and Sullivan, 2001). Green space provides an effective way to escape from a worldly, overwhelmed, stressful world (Macnaghten and Urry, 2000). The horticultural therapy has been used to improve psychological status through gardening activities in a natural surrounding (Milligan *et al.*, 2004).

2.1.5 Enhancing social ties. Urban green space provides environment to facilitate social contact. Social interactions take place more frequently in a preferable environment than other places. On the one hand, high rise buildings separate residents, resulting in social disconnection; on the other hand, the crowded urban environment makes it difficult to contact with others, delimiting productive social communications (Coley *et al.*, 1997). Kweon *et al.* (1998) note that older people in an inner city with greater accessibility to green space have more social ties than others. Also, a sense of community can be created when frequently using the outdoor green space (Kearney, 2006).

2.1.6 Providing educational opportunities. Urban green space can be seen as a second classroom for children. Exposure to the green space creates a sense of diversity and stimulates ingenuity and imagination (Chen and Jim, 2008), which promotes performance of students in their classes. Green space also improves self-discipline, lower the rate of truancy and allow for even better scholar achievement (Taylor *et al.*, 2001; Taylor *et al.*, 2002). Moreover, it is an important site for scientific studies, including ecology, vegetation, and animal science.

Besides individual benefits, city as a whole also reaps the benefits of having large areas of green space for regional identity. In addition, having large area of urban green space is an appealing characteristic that draws attentions. For instance, the green ribbon project in Houston substantially strengthens the regional identity of Houston and promotes tourism (Lockwood, 1999). Jorgensen *et al.* (2007) find that specially designed woodlands have symbolic functions and serve to stand out place identity.

2.2 Interconnectedness of social benefits

The social benefits obtained from the urban green space are not mutually exclusive. Contact with neighborhood and engagement in social activities brings great psychological satisfaction and dissipates unhappiness (McAuley *et al.*, 2000). In addition, social ties can effectively reduce some adverse health problems, such as coronary disease and pregnancy complications (Lindheim and Syme, 1983). The esthetic relish, such as a sense of tranquility and peace from the green space can calm down people's rage and regulate emotion (Kellert and Wilson, 1993). Green space itself is a scientific deposit where people can play with natural environment and simultaneously gather knowledge about nature.

2.3 Consumption variability of green space

The previous section discusses the social benefits of urban green space and provides a model indicating their interconnectedness. This section articulates another interesting aspect of urban green space in terms of consumption variability, which varies with age range, professional, educational and cultural values, and socioeconomic status. There is a large body of literature, which focusses on different issues related to consumption variability.

2.3.1 Age range. The benefits obtained from green space in terms of different age range have drawn lots of attentions. Green space is particularly important to maintain and enhance the quality of life of older people (Sugiyama *et al.*, 2009). Sugiyama and Thompson (2007) present a conceptual framework of "environmental support" describing the benefits of green spaces particularly for the senior residents. Takano *et al.* (2002) find that the provision of greenery in the mega-city is not just a matter of preference. Instead, the walkable green space elongates the age of senior citizens regardless of their sex, marital status, and socioeconomic status. In addition, sleeping ability which troubles many old people can be largely improved (Sugiyama and Thompson, 2007). Moreover, green space is crucial for the physical and mental growth of the children. Many studies have shown that participation in physical activities is positively correlated with the proximity to green space (Timperio *et al.*, 2004). Nowadays, there is a growing trend that children are becoming more and more sedentary, and obesity problems among children are more apparent. As a result, the presence of green space contributes to the children's physical health (Davison and Lawson, 2006), as well as psychological health. Some studies suggest that children function better in a green setting. Taylor *et al.* (2001, p. 59) note that "the greener a child's play area, the less severe his or her attention deficit symptoms."

2.3.2 Professional, educational, and cultural differences. Another important aspect of consumption variability is the variability of vocations. It is assumed that people with different culture and educational status prefer diverse landscapes. Some empirical studies suggest that the recreational functions of green spaces are perceived differently according to different groups of people (Brush *et al.*, 2000; Lyons, 1983). Brush *et al.* (2000) find that the interactions between nature and people with different level of knowledge vary significantly. Moreover, Ribe (1989) states that the professional bias also affects the connection between people with nature. Dwyer and Hutchison (1990) add racial or cultural differences with respect to selecting recreational environment. For instance, they note, black and white households have distinct recreational environment preferences. The former is more likely to be attached with artificial environment whereas the latter group tends to be involved with nature (Dwyer and Hutchison, 1990).

2.3.3 Gender differences. There is a large body of literature devoted to investigating the health conditions for women. It is evident that all kinds of interaction with green spaces can effectively reduce the risk of coronary heart disease and stroke to women. In addition, the vulnerability of bone fracture can be diminished (Karlsson, 2004; Oguma and Shinoda-Tagawa, 2004). Krenichyn (2006) presents a thorough discussion about the benefits inherited from green space, particularly to women in terms of recreation, psycho-physiological health, and esthetic enjoyments. Moreover, the interactions between nature and women of different race, ethnicity, or age group also vary dramatically, which has drawn attention of many scholars (Gobster, 2002; Zenk *et al.*, 2009).

2.3.4 Socioeconomic status. Despite urban green space has been recognized as a public resource where residents of different socioeconomic status should have equal access, the reality is not always satisfactory. Tree shades, creeks, and amiable paths are more common around high socioeconomic neighborhoods (Crawford *et al.*, 2008). These positive features largely encourage the people of high socioeconomic status to be connected to nature.

3. The measurement of green space

The discussion in the previous sections focusses on social benefits of urban green space. Now the question is: how to measure these benefits? Various researches have tried to measure benefits provided by urban green space by quantitative approaches. The following sections explain two types of measures; first, valuation from providers' perspective; and second, accessibility analysis from consumers' perspective.

3.1 Valuation of green space

The benefits of green spaces can be directly evaluated through conventional commodity market value, such as the prices of the timber productions, or foods provided by vegetations. On the contrary, in terms of non-market values there are some important indirect measurements. Drawing upon indirect valuation techniques to measure the benefits of green space by Farber *et al.* (2002), this section discusses these techniques with regard to specific social benefits.

3.1.1 Different valuation techniques. Farber *et al.* (2002) present six major techniques; avoid cost (AC), replacement cost (RC), factor income (FI), travel cost (TC), hedonic pricing (HP), and contingent valuation (CV) to measure the benefits of green space. These techniques can be used to measure the ecological, environmental, and social value of green space. AC refers to the probable lost of property in the absent of the green space. RC refers the value of the green space that can be measured through some anthropological system, which is easy to calculate. FI considers the extra profits earned by the green space service. TC reflects the value of the green space by traveling fees. HP deals with the market-priced goods where a certain component of price contributes to the benefits of green space. CV captures a hypothetical transaction fee that people will be willing to pay for the benefits obtained from green space. Among these methods, the hedonic price model and CV are widely used to measure different aspects of the social value provided by green space.

3.1.2 Application of valuation techniques. The CV has widely been used to measure the social benefits of urban green space (Chen and Jim, 2008; Tyrväinen, 2001). Tyrväinen and Vaananen (1998) suggest that the usefulness of CV for green space can be used to justify different land use options. Jim and Chen (2006a) use the "willingness-to-pay approach" to examine the recreational value provided by green

space in Guangzhou (China). They estimate that residents are likely to pay 17.4 RMB/person/month to consume the green space which is higher than the entrance fee. Recreational benefits, which have been expressed in a monetary terms are meaningful for both users and planners. In addition, the esthetic value of the green space has also been measured using CV. Price (2003) measures the esthetic value of the urban tree using CV and suggests that people in Britain would like to pay £25 million per year to support amenity woodland. The monetary value of green space for human health can also be evaluated by CV (Freeman, 2003). Other than recreational, healthy, and esthetic value, educational, scientific benefits, or the regional identity like culture heritage or historical legacy can be measured through CV (Yang *et al.*, 2008). Yang *et al.* (2008) measure the value of constructed wetland using this method and estimate around 800,000 yuan as the monetary value in Hangzhou (China).

Hedonic price method is frequently used to value the social benefits of green space. It is a flexible means to capture the social values. Different types of green space have been valued, such as the urban forest (Tyrväinen and Miettinen, 2000), wetland (Mahan *et al.*, 2000), and golf courses (Do and Grudnitski, 1995). The beauty from the surrounding environment, the landscape in the neighborhood, and distance from coast have been evaluated through hedonic model (Bourassa *et al.*, 2004; Paterson and Boyle, 2002; Sander and Polasky, 2009). Bourassa *et al.* (2004) find that esthetic landscape within eye sight may boost the property value by 27 percent. The influences derived from the characteristics of green space, like the public or the private, temporary or permanent, natural or semi-natural, can be also examined using hedonic price methods (Geoghegan, 2002; Irwin, 2002). Anderson and West (2006) suggest that the value of the green space varies according to the location of the green space and demographic characteristics.

3.2 Measurements of accessibility

Generally, different methods of accessibility measurements have been used to evaluate the location of public facilities, traffic condition, or land use. These measurements can be divided into two categories: qualitative measurement and quantitative measurement. The latter measurement can be further classified as opportunity-based model, spatial separation measurement, gravity-based model, and individual-based model. Geurs and Wee (2004) provide a review of different measurements in terms of their theoretical background, interpretability, and communicability. Moreover, Liu and Zhu (2004) summarize different measurements and their analysis in geographical information system (GIS). Based on their approaches, this section discusses the usefulness of different models in measuring accessibility to green space.

3.2.1 Qualitative measurements. Qualitative measurements usually analyze the intuitive accessibility of citizens to green space and the major barriers that block the citizens to get access to green space. Moreover, many studies also consider demographic characteristics of different groups of people (Blackman *et al.*, 2003; Dawson, 1995; Mullick, 1993). Although qualitative measurement can reflect many aspects of accessibility, it is hard to provide a general standard to compare the results of accessibility found in different studies (Li *et al.*, 2008).

3.2.2 Opportunity-based measurement. Opportunity-based model measures the number of interested objects, or destinations within a certain distance from its origin (Breheny, 1978). In green space accessibility analysis, the origin can be defined as residential blocks; whereas the destination can be a set including urban parks, gardens, or conservatories. Accessibility can be either measured as the distance from origin to

its nearest destinations or the number of the destinations within a certain distance from the origin. The opportunity-based model is a simple measurement and the results are easy to interpret. However, this measurement does not consider the attribute of different green spaces. For instance, the size and structural difference of parks may have diverse attractiveness, which should be incorporated into the evaluation process. Moreover, this model does not reflect distance decay, which is an important characteristic in location science (Handy and Niemeier, 1997). Closer parks are supposed to be preferable to residents. However, in opportunity-based model, this concept cannot be represented.

3.2.3 Spatial separation measurement. Spatial separation measurement defines accessibility as the cost to move from the origin to the destination (Ingram, 1971). The cost includes time duration, transportation fees and so on. The accessibility index is the addition of these costs. Low index for a pair of origin and destination means fewer obstacles between them. As a result, this destination is more easily reachable for the corresponding origin. The formation of this model is direct and simple, but still cannot reflect distance decay.

3.2.4 Gravity-based measurement. Gravity-based measurement (also known as potential-based model) is based on the theory that the intensity of spatial interaction is determined by the attractiveness and the travel impedance among places. The attractiveness is positively correlated and distance, negatively correlated to accessibility (Linneker and Spence, 1992). Gravity-based model can solve two limitations of opportunity-based model. First, the attractiveness of the green space and the population density of residents can be incorporated into this model. As a result, the attribute of different green patches can be distinguished. Second, spatial interaction can be determined by a distance decay function, reflecting the decreasing intensity of interaction with increasing distance. As a result, gravity-based model has been widely used in accessibility analysis (Geurs and Wee, 2004). Despite many advantages of the gravity-based model, an accurate simulation of accessibility depends on elaborate design of impedance function and attractiveness, which entails a comprehensive understanding of the places.

3.2.5 Individual-based measurement. The individual-based measurement gauges accessibility from the individual's viewpoint. It mainly comprises two methods: utility-based model and the space-time model. The utility-based model aims to find "the benefit or consumer surplus which is the maximum utility of a choice set received by each individual" (Liu and Zhu, 2004, p. 108). On the other hand, the space-time model gauges the potential area that each individual can reach with a certain time period (Geurs and Wee, 2004; Recker *et al.*, 2001). Although this measurement comes from a disaggregated perspective and captures a growing interest, the application is still rare (Geurs and Wee, 2004), especially in green space accessibility studies.

3.2.6 Applications of accessibility measurements. Green space distribution and accessibility within the cities have become central focusses in many studies (Smoyed-Tomic *et al.*, 2004). Accessibility derived from a social equity perspective examines the demand and supply of green space from geographical insights. Most studies about the accessibility of green space always treat the social benefits obtained from green space as a whole. In accessibility studies, there are two branches – one that takes all the citizens into account and the other that focusses on certain group of people in a society.

Oh and Jeong (2007) investigate the distribution of urban parks for the entire citizens in Seoul (South Korea) using the opportunity-based model. In their study, the

authors use the network analysis method in GIS to analyze the pedestrian accessibility to urban parks. The traditional Euclidean distance between origin and destination has been replaced by route distance, which is the distance along the road network. This measurement is much more accurate than the traditional opportunity-based method since it simulates the real walk behavior. In addition, Herzele and Wiedemann (2003) separately define attractiveness and accessibility and provide a monitoring tool for local accessibility planning. The spatial separation measurement has also been used to evaluate green space accessibility in two time periods (Yin and Kong, 2006). Their study finds that citizen's accessibility to green space has greatly improved in the last decade in Jinan (China). The gravity-based model has been used to incorporate the factors like urban transportation system, size, and shape of green space and distribution of residence to evaluate and optimize the urban green space (Wang and Li, 2008).

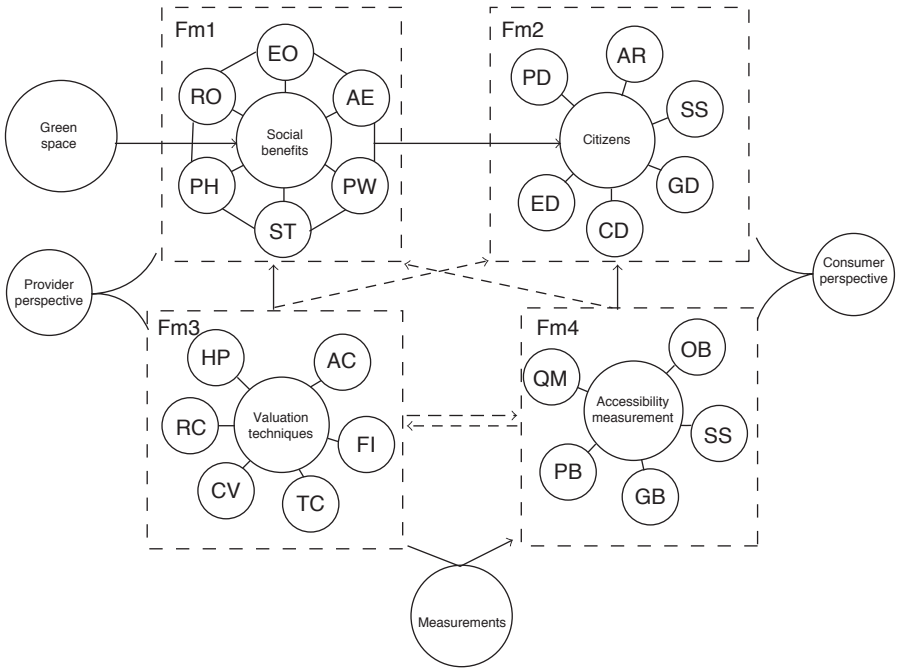
Another type of accessibility analysis focusses on certain group of people. Urban green space accessibility for different ethnic and religious groups has been examined in many studies (Comber *et al.*, 2008; Kessel *et al.*, 2009). Comber *et al.* (2008) find that the distribution of green space is uneven among different religious people. Opportunity-based network analysis has been used and suggested as a good way to quantify accessibility for different societal groups, such as people with disability, different occupations, and healthy conditions. Barbosa *et al.* (2007) examine the accessibility to two types of green space, i.e., the public green space and the municipal parks in Sheffield (UK) according to different subdivisions of society. Raster analysis in GIS has been used to compare accessibility to those two types. The authors indicate the importance of analyzing accessibility to green space from a socioeconomic perspective. Age and gender are other important aspects in accessibility analysis. Hillsdon *et al.* (2006) use three measurements to investigate the relationship between the levels of activity and access to green space of people in different age, gender, and education levels.

4. Valuation and measurement of urban green space: a framework

The previous sections discuss individual measure techniques of social benefits of urban green space. Despite advantage of each measurement, singular technique cannot afford a comprehensive understanding from both provider's perspective and consumers' perspective. To overcome this challenge, the following section tries to frame an integrated model to evaluate and measure social benefits.

As can be seen in Figure 1, the top part demonstrates social benefits of urban green space and their consumption variability in terms of age, gender, professional, educational, and cultural backgrounds. The bottom part of the figure shows two measurement techniques of the green space. The techniques may be used to measure benefits of green space in monetary term from providers' perspective. On the other hand, the accessibility analysis offers assessment of green space distribution in a city from consumers' perspective.

Most monetary valuations focus on the green space as a provider from which benefits are obtained. Different kinds of green space are found to be valued in different ways. Aside from looking at green space itself, it is useful to consider the characteristics of users, such as people with different socioeconomic status and their perception towards nearby green space. Thus, the studies on valuation should take different groups of people into account. In doing so, sorting out the opinions from different groups of people and adding them together can better understand the benefits provided by green space.



Notes: In Fm1: EO, educational opportunities; AE, aesthetic enjoyment; PW, psychological well-being; ST, social ties; PH, physical health; RO, recreational opportunities; in Fm2:PD, professional difference; AR, age range; SS, socioeconomic status; GD, gender differences; CD, cultural differences; ED, educational differences; in Fm3: HP, hedonic price model; AC, avoid cost; FI, factor income; TC, travel cost; CV, contingent valuation; RC, replacement cost; in Fm4: QM, qualitative measurement; OB, opportunity-based model; SS, Spatial separation model; GB, gravity-based model; PB, person-based model

Figure 1.
Framework of valuation and measurement of social benefits of urban green space

The analysis of accessibility to green space is conducted from consumers' perspective. Some studies take all the citizens as a whole, and others focus on certain group of citizens. There is a necessity to consider different benefits derived from green space when evaluating the accessibility (Herzele and Wiedemann, 2003). In addition, accessibility study needs to recognize the diversity of green space itself and how it functions differently to citizens (Barbosa *et al.*, 2007).

The integrated model also establishes some connections between the valuation techniques and accessibility measurements. Valuation may include some accessibility concepts in the process, such as incorporation of distances and locations in the hedonic model. The value of green space in different locations may differ. Keeping all other factors constant, the more accessible the green space is, the greater value the green space possesses. Hence, it is significant to attach accessibility analysis in the valuation process. On the other hand, accessibility may also apply the monetary values derived from valuation process to classify the green space into different levels. For instance, the willing-to-pay techniques can evaluate the attractiveness of different parks. Subsequently, the attractiveness of green space can support gravity-based model, strengthening the robustness of the model.

The sustainable planning and management of urban green space requires a comprehensive criteria system and a series of indicators expressed in monetary terms to formulate and evaluate the public policies (Choumert and Salanie, 2008). Hence, the monetary valuation of green space provides a constructive and useful reference to management. Nonetheless, monetary valuation is hard to completely represent the true value of the green space, and some methods might depreciate the true value (Luttik, 2000; Yang *et al.*, 2008). This requires another perspective to evaluate the importance of urban green space. Having green space with good quality in an accessible distance is important for citizens. Therefore, thinking of the demands of residents, accessibility is definitely an important criterion when evaluating the spatial distribution of green space. The proposed evaluation framework of this study includes both provider and consumer components, reflecting the importance of urban green space.

The framework can be implemented using GIS. GIS, with strong spatial data management ability and powerful spatial analytical functions, plays an important role in tackling spatial problems. In valuation analysis, most hedonic models value green space by means of GIS to reflect the increased property price when the property is in close proximity to green space. In accessibility analysis, almost all measurements can be fulfilled using GIS (Liu and Zhu, 2004; Herzele and Wiedemann, 2003). In addition, verification of the credibility of the proposed model can be conducted through questionnaire survey to match certain green space.

5. Conclusion

The paper aimed to review literatures focussing on social benefits of urban green space and its measure techniques in terms of monetary valuation and accessibility analysis. It was found that the urban green space provides ample opportunities for recreation, social communication, esthetic enjoyments, and education. It also promotes psycho-physiological health of the residents. Moreover, these benefits can also be extended to groups of people with age, gender, profession, culture, and education difference.

The review also suggests that valuation of urban green space has been recognized as a useful technique to quantify different types of benefits provided by green space in explicit monetary terms, even though few studies consider different citizen groups (as consumers). Accessibility measures the availability of green space, but diverse benefits of urban green space are not always accounted in prior studies. To fill up this gap, this paper develops a new integrated model which includes both consumers' and providers' perspectives in evaluating social benefits of urban green space. The model provides a comprehensive understanding about the social benefits of urban green space, which can be used to guide future urban sustainable planning. Finally, the constructed model requires empirical studies to verify the validity and applicability, which points out the future research directions.

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