From green to gold: A South African example of valuing urban green spaces in some residential areas in Potchefstroom

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Abstract

Recent scientific studies identified multiple benefits of green areas in terms of liveability and sustainability. As such, the need to value green spaces within residential areas is increasing, especially in developing countries. This article summarizes current approaches to green space planning, and introduces the Potchefstroom case study as example where 1) the value of green spaces were determined by means of hedonic price analysis and 2) the impact of green spaces were evaluated on site-scale and neighbourhood-scale, also identifying certain uses and benefits, described as ecosystem services. Five sites in the more affluent residential areas in Potchefstroom were selected to investigate the impact of proximity to green spaces in relation to residential property prices. This research illustrated contradicting results to most international case studies. Green spaces were found to have a negative impact on site-scale, but a positive impact on neighbourhood-scale. Similar studies need to be conducted in more areas to make evidence-based conclusions in this regard. This article can serve as point of departure for such.

Keywords: urban green space valuation, hedonic price analysis, South Africa

VAN GROEN TOT GOUD: 'N SUID-AFRIKAANSE VOORBEELD OM DIE WAARDE VAN GROEN RUIMTES IN SEKERE RESIDENSIËLE GEBIEDE IN POTCHEFSTROOM TE BEPAAL

Onlangse wetenskaplike navorsing toon die veelvuldige voordele van groen gebiede in terme van leefbaarheid en volhoubaarheid. Binne hierdie konteks neem die behoefte toe om die waarde van groen ruimtes in residensiële gebiede te bepaal, veral in ontwikkelende lande. Hierdie artikel som die huidige benaderings tot groen ruimtebeplanning op en verwys na die Potchefstroom gevallestudie waar 1) die waarde van groen ruimtes bepaal is deur middel van hedoniese prys analise en 2) die impak van groen ruimtes geëvalueer is binne die erf-skaal en buurt-skaal en sekere gebruike en voordele as ekosisteemdienste beskryf is. Vyf plekke in die meer gegoede woongebiede in Potchefstroom is geselekteer om die impak van die nabyheid van groen ruimtes in verhouding tot residensiële eiendom pryse te bepaal. Hierdie navorsing het kontrasterende resultate getoon tot meeste internasionale gevallestudies. Daar is bevind dat groen ruimtes 'n negatiewe impak het op erf-skaal, maar 'n positiewe impak op buurt-skaal. Soortgelyke studies moet egter in meer gebiede gedoen word ten einde bewysgebasseerde gevolgtrekkings te kan maak. Hierdie artikel kan dien as sodanige vertrekpunt.

Sleutelwoorde: groen ruimte waardasie, hedoniese prysontleding, Suid-Afrika

1. INTRODUCTION

South Africa is ranked as the globe's third most biologically diverse country (Wilhelm-Rechmann & Cowling, 2013: 2). Although South Africa has an extensive system of protected areas, these areas do not represent its biodiversity comprehensively. Local land-use planning procedures are therefore increasingly being recognised as a strategic way for the conservation sector to influence land transformation, a major driver of biodiversity loss (Wilhelm-Rechmann & Cowling, 2013: 2). Integrated Development Plans and Spatial Development Frameworks provide an important strategic opportunity to incorporate biodiversity information into decisions relating to the location of developments, the provision of services, environmental management and economic activities that provide employment and alleviate poverty (Cadman, Petersen, Driver, Sekhran, Maze & Munzhedzi, 2010: 49). However, decision-making within the local authority structure takes place within a broad framework of stakeholders and several objectives have to be met, resulting in green-spaces continuously competing against other urban land-uses, driven by housing demands, infrastructure facilities, economic and business development (Cilliers, Diemont, Stobbelaar & Timmermans, 2011: 695-698).

Schäffler & Swilling (2013: 247) suggested that green infrastructure planning, which regards cities as complex social-ecological systems and acknowledges the assets of the entire green infrastructure (a network of multifunctional green spaces enhancing social and ecological processes), is the best way to increase resilience in cities.

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The green infrastructure planning approach, as interpreted in South Africa, has three essential elements: working beyond the boundaries of protected areas; focusing conservation efforts on biodiversity and ecosystem services priority areas; and using a range of tools in these priority areas to expand protected areas, mainstream biodiversity and ecosystem service priorities in land-use planning and decision-making, and engage with production sectors to encourage biodiversity-compatible production practices (Cadman *et al*., 2010: 16; Schäffler & Swilling, 2013: 255).

Recently the relationship between urban liveability and green spaces as incorporated in overall urban green structures has become the focus of international studies (Casepersen, Konijnendijk & Olafsson, 2006: 7). The green hype is becoming stronger in terms of the benefits that green spaces provide (Liu, Mao, ZhoU, Li, Haung & Zhu, 2007: 1; Stigsdotter, 2007: 3). However, the provision of green spaces in South Africa, as in other developing countries, is inflated by limitations in budgets and human resources (Kuruneri-Chitepo & Shackleton, 2011), inequities in terms of green space availability and political legacies of the past (Lubbe, Siebert & Cilliers, 2010: 1905; Cilliers, Cilliers, Lubbe & Siebert, 2013: 682). Implementation of “green policies” in planning, and management of urban green spaces, is a major challenge in developing countries, as in South Africa (Roberts & Diederichs, 2002; Roberts, 2008: 525; Cilliers, 2009: 617; Cilliers, 2010b; Cilliers *et al*., 2011). The economic valuation of urban green spaces could sensitise planners, policy makers and also the general public to realise the value of these areas (Luttik, 2000: 166; Wolf, 2004; Roberts, Boon, Croucamp & Mander, 2005; Defrancesco, Rosato & Rossetto, 2006). The aim of this article is to provide a short overview of the value of urban green spaces and methods how to value such, as background for a case study in the city of Potchefstroom, where the proximity principle and hedonic price analysis was used to determine the value of green areas.

2. URBAN GREEN SPACES AND SPATIAL PLANNING

There are several definitions for the concept of green spaces and ecosystem services (ES) (Fisher, Turner & Morling, 2009) as interpreted in various disciplines (Escobedo Kroeger & Wagner, 2011). Costanza, d’Arge, de Groot, Farber, Grasso, Hannon, Limburg, Naeem, O’Neill, Paruelo, Raskin, Sutton, van den Belt (1997: 255) distinguished between ecosystem “goods (such as food) and services (such as waste assimilation) which represent the benefits human populations derive, directly or indirectly, from ecosystem functions”. In later studies ecosystem services were classified under four groups, namely provisioning (e.g. food, water, medicine), regulating (e.g. climate regulation, water purification, erosion control), supporting (e.g. provide habitat and conserve genetic diversity) and cultural (e.g. tourism, recreation, spirituality) services (MA, 2005; TEEB, 2011; Gómez-Baggethun, Gren, Barton, Langemeyer, McPhearson, O’Farrell, Andersson, Hamstead & Kremer, 2013).

Several studies have indicated the importance of including the entire green infrastructure in Spatial Planning approaches to increase sustainability and resilience (Tzoulas, Korpela, Venn, Yli-Pelkonen, Kazmierczak, Niemelä & James, 2007: 170, Cilliers *et al*., 2011: 583; Colding, 2007: 50; Ahern, Cilliers, & Niemelä, 2014). The literature base of such studies linking ecosystem services with spatial planning is mainly focused on case studies from developed countries. One of the first studies listing the ecosystem services of urban areas was by Bolund & Hunhammer (1999: 293-299) who discussed the ecosystem services of specific urban ecosystems, namely treed sidewalks, lawns and parks, urban forests, cultivated land, wetlands, lakes and oceans and streams. More recently, Niemelä, Saarela, *Söderman*, Kopperoinen, Yli-Pelkonen, V*äre* & Kotze (2010) listed several ecosystem services provided by green and water areas in urban regions and discussed the usefulness of the ES concept as a framework for urban planning. Gómez-Baggethun & Barton (2013) focused on the value of the urban ES concept in planning, classifying urban ES, and discussing different economic and non-economic valuation methods for urban ES as well as their limitations. ES are not formally and systematically included in spatial planning in developed countries, but Kabisch (2015: 560- 566) stated that some recent strategic documents referred to ES in their planning goals in Berlin. Interestingly Wilkinson, Saarne, Peterson & Colding (2013: 37) found that strategic spatial plans of the cities of Melbourne and Stockholm have historically included some ES although no valuations were done. Although this might indicate that the ES approach is not new in spatial planning, Wilkinson *et al.* (2013: 37) indicated the need for more scientific research on the social-ecological basis of the ES approach and how to include it in decision-making processes.

Additionally the ecosystem approach can be used to link objectives of green planning and spatial planning, as this approach entails a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way, stressing the need for holistic and integrated decision-making (Cadman *et al*., 2010: 16; Dudley, Stolton, Belokurov, Krueger, Lopoukhine, Mackinnon, Sandwith, Sekhran, 2010). It further ensures ecosystem sustainability (the capacity of an ecosystem to resist disturbances, such as population explosions of a particular species, or invasions of species from outside of the ecosystem (Cadman *et al*., 2010:18). Following the ecosystem services (ES) approach could also ensure the recognition of all the extensive benefits humans are drawing from natural ecosystems, indicating their reliance on the preservation of green spaces in and around urban areas, and could assist decision-making if ES are valuated (either monetary or non-monetary) (Wilkinson *et al*., 2013: 37).

3. TRANSFORMING GREEN TO GOLD

Natural resources, green spaces and the ecosystem services they provide can be viewed as a form of natural capital that is needed for development, socio-economic activities and adequate quality of life. It is however hard to quantify the value of green spaces and services (Herzele & Wiedemann, 2002: 122). Economic valuation of green spaces and green infrastructure has been criticized as presenting the risk that nature will just be transformed to a human service and therefore to a human-centred product (Niemelä *et al*., 2010). However, putting 'numbers' to the environment is crucial to being able to speak the language of policy-makers, who generally make decisions based on economic or financial criteria (Faccer, 2009). Provided that the information is packaged appropriately, these numbers can be used to provide a good economic case for environmentally beneficial legislation (Rodriguez, 2009) and the planning and management of green spaces.

3.1 Tools and methods to value green spaces

The total economic value of green spaces and green infrastructure is defined differently in literature but consists mainly of two kinds of values, use value and non-use values (De Groot, Alkemade, Braat, Hein, Willemen, 2010: 395-399; Gómez-Baggethun *et al*., 2013; Sareav, 2012: 37). Non-use value is derived from the knowledge that environmental resources continue to exist (existence value), or are available for others to use now (altruistic value) or in the future (bequest value) and use value is associated with current or future uses of a good or service (Sareav, 2012: 37), as illustrated by De Wit & Blignaut (2006: 9) (Figure 1).

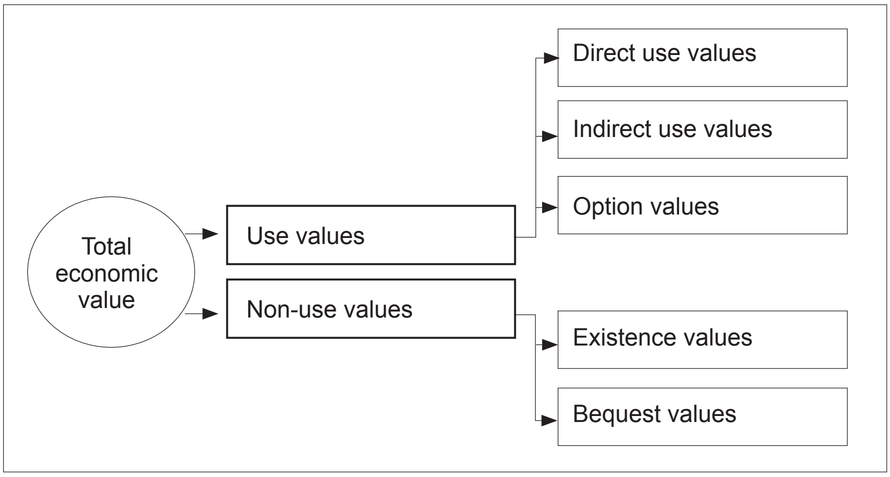

Figure 1: Typology environmental values
Source: Based on De Wit & Blignaut (2006: 9)

The economic value of green spaces (use and non-use values) can be measured in terms of direct and indirect benefits. Indirect benefits include social and environmental benefits, such as public's demand for green space, aesthetic enjoyment, recreation, access to quiet environments (Liu *et al*., 2007: 1), stress levels and health (Stigsdotter, 2007: 3), social cohesion, enhancing the identity of towns and cities, along with attraction for living and working, and providing environmental goods (Cilliers, 2009; Fausold & Lilieholm, 1999; Wolf, 2004). It includes the provision of ecosystem services such as food supply (Altieri, Companioni, Cañizares, Murphy, Rosset, Bourque & Nicholls, 1999), water flow regulation and runoff mitigation (Villarreal & Bengtsson, 2005), urban temperature regulation (Bolund & Hunhammar, 1999: 295- 299), air purification (Chaparro & Terradas, 2009), moderation of environmental extremes (Danielsen, Sorensen, Olwig, Selvam, Parish, Burgess, Hiraishi, Karunagaran, Rasmussen, Hansen, Quarto & Suryadiputra, 2005), waste treatment (Vauramo & Setälä, 2011), climate regulation and cognitive development (Chiesura, 2004: 133-136).

Direct benefits include economic benefits as a direct result of green space provision, such as investment and tourism, contribution to the competitiveness and marketability of cities and urban areas (Baycan-Levent & Nijkamp, 2007; Meadows, 2000; Luttik, 2000: 166; Thompson, 2002: 60; Schmidt, 2008: 98), residents willingness to pay more for a residential property close to a green space, favourable image of places, increased retail sales, increased tourism (Woolley, Swanwick, & Dunnet, 2003), enhance inward investment in the area (Cabe Space, 2005), favorable working spaces, increased value of properties (Tyrväinen, 1997: 211; Cho, Poudyal & Roberts, 2008: 412), higher tax returns and land values to local authorities, and cost savings due to limited spatial planning, maintenance, energy consumption, CO2 emission and storm water costs (Cilliers, 2010a).

In order to valuate green spaces and green infrastructure and to be able to place it in a broader decision-making context (Korsgaard & Schou, 2010), various environmental and resource economics tools were developed. The most common of these include economic-valuation tools and decision-support tools. Economic-valuation tools measure the monetary value of natural resources, ecosystem goods and services, or environmental impacts. It is a source of valuable information in cases where market prices are missing, the information is inadequate, or because of externalities (Pearce, 1993; Perman, Ma, McGilvray & Common, 2003; Gómez-Baggethun *et al*., 2013). Decision-support tools on the other hand, enable the comparison of development options/tradeoffs, in terms of cost-benefit analysis, cost-effectiveness analysis, ecological-economic modelling, and inputs to conservation planning (Lambert, 2003: 7). Table 1 summarises the most common methods used for economic-valuation of green spaces.

3.2 Case studies to determine the value of green spaces

During the last two decades increasing efforts were made to value ecosystem services in monetary terms, and to articulate such values through markets in order to create economic incentives for conservation (Gómez-Baggethun & Pérez, 2011: 613). Most of these attempts to assign monetary values to green spaces in urban areas were conducted in developed countries (e.g. Hougner, Colding & Söderqvist, 2006; Philadelphia Parks Alliance, 2008; De Groot *et al*., 2002; TEEB, 2010) to emphasise its value and not to put a price tag on the environment (Turner, Paavola, Cooper, Farber, Jessamy & Georgiou, 2003: 508; Korsgaard & Schou, 2010).

Recently, a number of studies have also attempted to value (monetary and non-monetary) the green infrastructure in South African cities and the services they provide (De Wit, Van Zyl, Crookes, Blignaut, Jayiya & Goiset, 2012; O'Farrell, Anderson, Le Maitre & Holmes, 2012; Roberts *et al*., 2005: 45; Schäffler & Swilling, 2013: 25337). Durban was the first city in South Africa that valuated their ecosystem services following a resource economics approach (Roberts *et al*., 2005), relying heavily on international research (Costanza *et al*., 1997: 255), also acknowledging the uncertainties in this approach. De Wit *et al*. (2012: 42) followed a more objective approach in valuating certain ecosystem services in Cape Town (tourism, recreation, aesthetics and sense of place, space for biota, water purification and waste treatment, and natural hazard regulation) than was followed in Durban as they used four different economic valuation techniques (Cilliers & Siebert, 2012: 33). De Wit *et al*. (2012: 44) concluded that the economic value of healthy ecosystems in Cape Town contribute up to 25% to the city's total budget, and also mentioned that if these "free" services are neglected, it would cost the city a substantial amount to replace these services. In Johannesburg, Schäffler & Swilling (2013: 253) calculated the carbon storage capacity of urban forests and determine their monetary value using a market related carbon price and estimated the economic contribution of garden employment, in an attempt to show the value of the urban green infrastructure as sources of resilience for cities in developing countries. O'Farrell *et al*. (2012) developed a rapid assessment method using spatial models to indicate the influence of land transformation on four themes of ecosystem services (agricultural provision, water run-off regulation, ground water and coastal zone protection) in Cape Town. Although it is quite a useful non-monetary and spatially explicit method, it is based on coarse scale data. More time and resources are needed for fine-scale studies which are needed to determine the ecosystem services of specific green spaces more objectively.

3.3 Valuing green spaces by means of hedonic price analysis

Various case studies have been conducted to determine the economic value of green spaces by means of hedonic price analysis, as captured in Table 2. Most studies refer to "urban parks", defined as delineated open space areas, mostly dominated by vegetation and water, and generally reserved for public use (Konijnendijk *et al*., 2013: 3).

Research conducted by Konijnendijk *et al*. (2013: 20) illustrated that most studies applied a hedonic pricing approach to assess the impact of nearby parks on house prices. Most studies supported the proximity principle (Crompton, 2001: 25) and concluded that open spaces in general raise the value of nearby properties (Brander & Koetse, 2011; Konijnendijk *et al*., 2013: 21). Some contradicting results were observed by Troy & Grove (2008), Chen & Jim (2010) and Kong & Nakagoshi (2007: 248) where certain factors were identified which can 'pull down' the positive effect of parks on property values. Factors mainly included noise and crime rates in the area (Konijnendijk *et al*., 2013: 22). These are examples of the so-called ecosystem disservices in urban areas which are described by Lyytimäki & Sipilä (2009) as functions of ecosystems that are perceived as negatives for human well-being.

It is thus evident that the precise impact on property value ranges widely among cities and countries (Konijnendijk *et al*., 2013: 21). In this regard, a pilot study was conducted

Table 1: Methods to value green space

Method	Description
Market price method	This method is applicable to direct use values. The value is estimated from the price in commercial markets (law of supply and demand).
Replacement / substitute cost method	Applicable to indirect use values where the value can be estimated from the substitute cost.
Contingent valuation / stated preference method	Value public goods and services in terms of willingness to pay for improvements, or willingness to accept damages to a resource.
Contingent choice method	Estimate values based on asking people to make tradeoffs among sets of ecosystem or environmental services.
Benefit transfer method	Value eco-system services and recreational uses in particular, by transferring existing benefit estimated from studies completed for another location or context.
Hedonic pricing method	Used when green space values influence the price of marketed goods, or for estimating the economic value of open space and recreation areas, which do not have a market value. Prices of properties are used to isolate the differential effect of environmental attributes on property values.

Source: Based on Konijnendijk, Annerstedt, Nielsen & Maruthaveeran (2013: 20); Lambert (2003: 7); Gómez-Baggethun & Barton (2013)

Table 2: Economic value and impacts of green space

Case studies	Author(s)	Findings
Meta-analysis	Crompton (2001)	Impact of parks on property values is 20%.
North-America	Cho, Poudyal & Roberts (2008)	Gradual decrease in the positive value of larger forest blocks as one move away from the city center.
	Georgheham, Waigner & Bockstael (1997)	Nature and the pattern of land use surrounding a parcel of land have an influence on its price.
		Individuals value permanent open space in their neighbourhood.
	Lutzenhisher & Netusil (2001)	Natural parks have the largest statistically significant effect on home sale prices.
	Shultz & Kind (2001)	Proximity to large protected natural areas has a positive influence on housing values.
	Smith, Poulos & Kim (2002)	Proximity to vacant land has a positive effect on property price, but proximity to agricultural/ forested land had a negative effect.
Europe	Luttik (2002)	Netherlands: Effect of water and open spaces proofed positive.
	Morancho (2003)	Spain: House prices relate inversely with the distance that separates it from an urban green space.
	Tyrvainen (1997)	Finland: The effect of urban forest on property prices is nonlinear rather than linear.
China	Jim & Chen (2006)	Environmental quality contributes to house-buyers preferences.
	Kong, Yin & Nakagoshi (2007)	Proximity to a scenery forest had a positive amenity impact.
	Jim & Chen (2007) and Chen & Jim (2010)	Visibility of urban parks is generally valued positively by property owners in the Chinese cities of Guangzhou and Shenzhen.
United Kingdom	Dehring & Dunse (2006)	Proximity to parks raised prices of houses and flats in Aberdeen, but it did not find an effect for lower density type housing.

Source: Based on Greenspace Scotland (2008: 39-46) and Konijnendijk *et al*. (2013: 21).

in Potchefstroom, South Africa, to determine whether green spaces have an impact on residential property prices.

4. POTCHEFSTROOM CASE STUDY

Potchefstroom (26° 42’ 53’’ S; 27° 05’ 49’’ E) is situated in the North-West Province of South Africa (Figure 2) and covers an area of 55 km2 with a population of approximately 250 000 (Tlokwe City Council, 2012: 37). Several urban ecological studies were conducted in Potchefstroom over the last decade focusing on urban biodiversity and ecosystem services and are highlighted in a reflection study of urban ecological studies in Cape Town (Cilliers & Siebert, 2012: 33).

The aim of the current study was to determine the impact of green spaces in terms of (1) residential property prices based on proximity to green spaces, and (2) neighbourhood value based on average property prices within the area. Potchefstroom was selected as case study to test this method because similar valuation studies were previously conducted in this area (Cilliers, 2010a; Cilliers *et al*., 2013). Proximity to green space was proven to be a key factor in residential value (Konijnendijk *et al*., 2013: 21) and therefore hedonic pricing methods were used to determine the impact of green spaces on residential property prices.

4.2 Sampling methods

Five residential areas were selected in Potchefstroom and was a refinement of previous research conducted by Cilliers (2010a) and Cilliers *et al*. (2013), as illustrated in Table 3 and Figure 2.

The five areas were selected based on the proximity to a green space and included: Area A: Grimbeek Park, situated next to a golf course, Area B: Van der Hoff Park, borders on a wetland and equestrian open space, Area C: Potch Dam, containing the natural dam and green space with playground, Area D: Heilige Akker, adjacent to the North-West University Sport fields and Area E: Oewersig, adjacent to the Mooi River and an open space. Research sites were not limited to a specific green space, but ranged from recreational green spaces to aesthetic green spaces. The size of these green spaces was not taken into consideration. The function and accessibility to these spaces were considered in terms of safety concerns as factor impacting on value. Three zones within each of these areas were selected and sampled according to location and distance from the

Table 3: Comparison of previous conducted research and current case study

Areas included	Cilliers (2010a)	Cilliers et al (2013)	Current research (2015)
	N = properties included (Average R/m2 for area)		
Baillie Park	10 (914.69)		
Potch Dam	8 (782.15)		27 (829.19)
Grimbeek Park	10 (1204.28)	25 (867.15)	41 (908.69)
Heilige Akker	10 (1224.12)		36 (1225.37)
Owersig		21 (1196.45)	41 (1157.97)
Potch CBD	7 (983.12)		
Van der Hoff Park	14 (1062.15)	25 (1077.14)	43 (1081.98)
TOTAL PROPERTIES INCLUDED	59	71	188

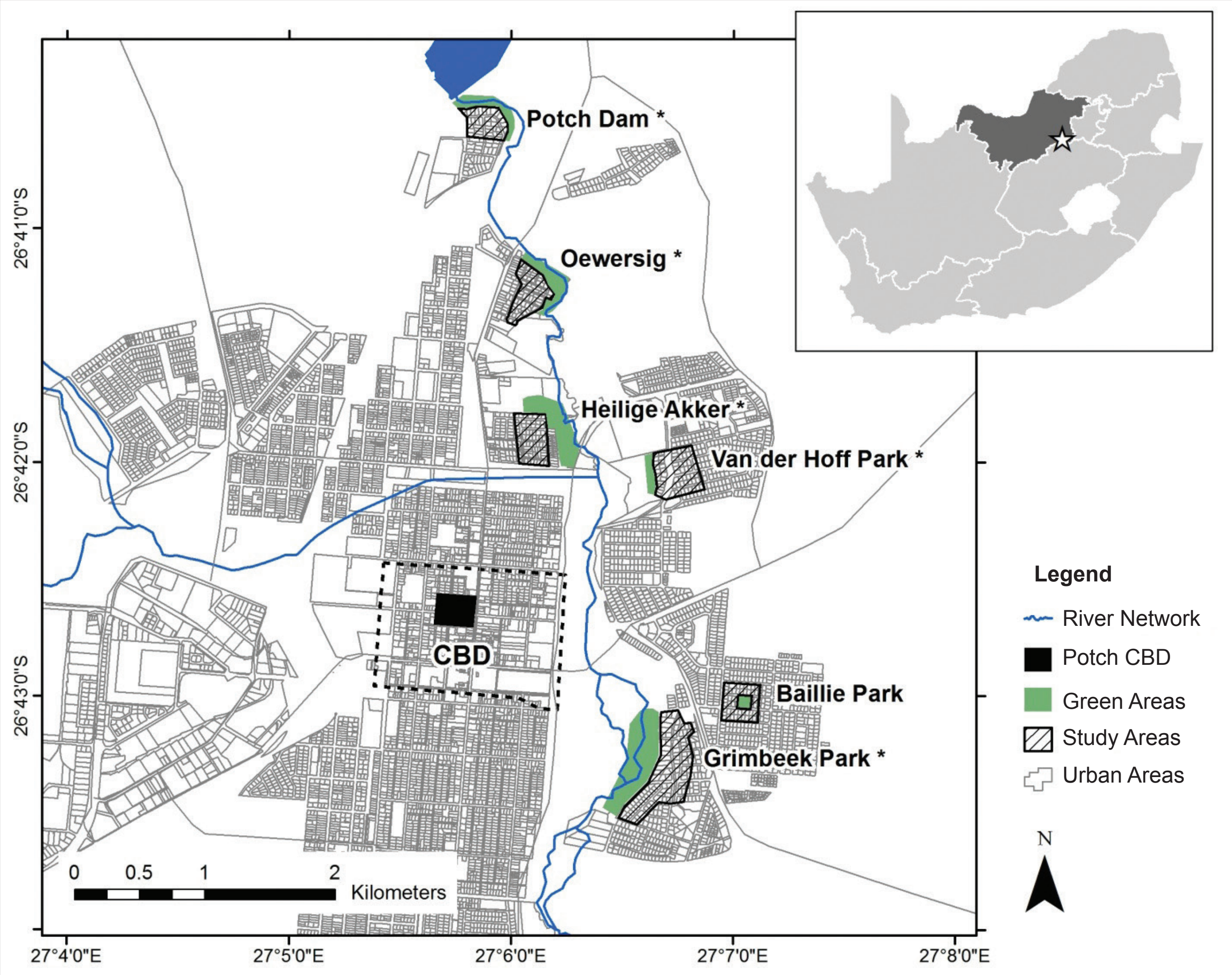

Figure 2: Greater Potchefstroom and location of study area and associated green areas (*2015 study areas)

green space. The residential property prices were based on the municipal property valuations (Tlokwe City Council Valuation Roll) for the period 2009/2013, as provided by the Local Municipality (Tlokwe City Council, 2010). The price per square meter of each property was determined and compared and a mean value was determined for each zone.

Figure 3 presents an example of the zones selected in each of the areas. Zone 1 adjacent to the green space, Zone 2 further away and Zone 3 located the furthest from the green space.

4.3 Limitations of sampling method

In previous studies five socio-economic status (SES) classes (1-5) were identified in Potchefstroom based on aspects such as unemployment, household size, number of rooms in house, access to basic services and educational status of residents (Lubbe *et al*., 2010; Cilliers *et al*., 2013). SES class 1 indicates the poorest residents and SES class 5 the most affluent residents (Lubbe, 2011). Only residential properties (zoned residential 1) in the more affluent areas (SES class 5) of Potchefstroom were selected as previous studies indicated that the demand and supply for ecosystem services differ between the residential areas along a socio-economic gradient (Cilliers *et al*., 2013). Another reason why the poorer areas (SES classes 1-3) could not be included in the calculations was because no property values were estimated by the local municipality for these areas.

4.4 Data analyses

Analysis of variance (ANOVA) was applied to the property values from residential areas to determine if there is a significant difference between the means of five areas located at different distances from an urban green space. ANOVA is a manner of comparing the relation of organized variance to disorganized variance in an experimental study. A one-way ANOVA may yield inaccurate estimates of the p-value when the data are not normally distributed at all (Hecke, 2000: 248). The one-way ANOVA is a test statistic and it is difficult to tell which specific groups were significantly different from each other it only tells that at least two or three groups were different. Kruskal-Wallis analysis was also conducted to determine the significant differences between the groups (zones) of the selected areas and verify results of the

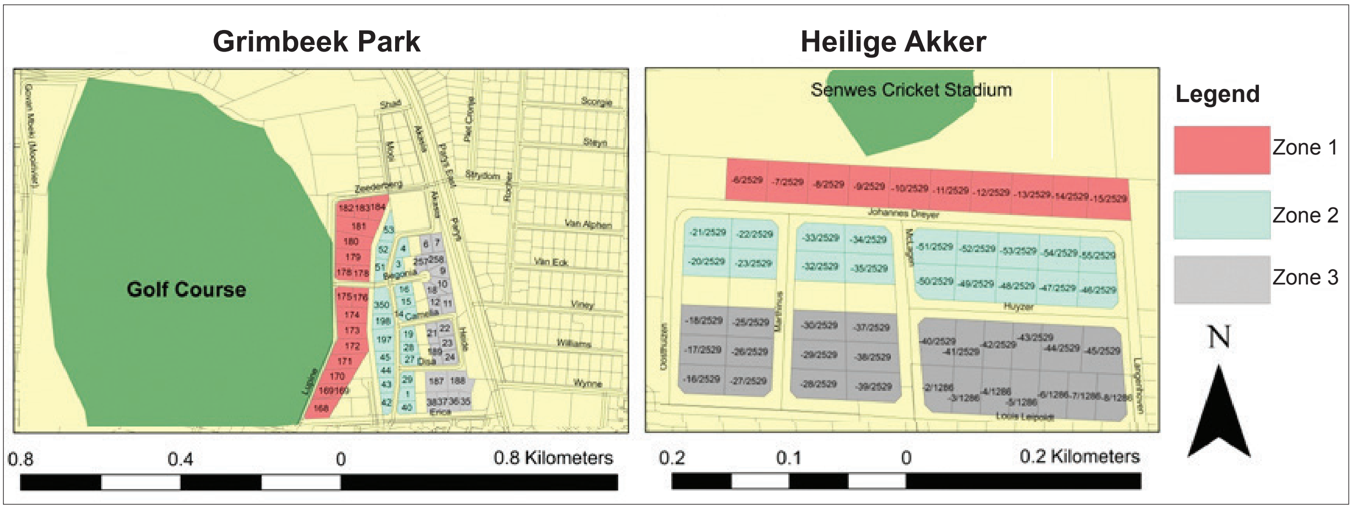

Figure 3: Example of selection of zones within each area

ANOVA analysis. The Kruskal-Wallis test is the nonparametric analogue of a one-way ANOVA, which does not make assumptions about normality. Like most non-parametric tests, it is performed on the ranks of the measurement observations (Hecke, 2000: 248). Data were analysed in terms of 1) ANOVA effect sizes, 2) ANOVA p-values, 3) ANOVA between means p-value and 4) Kruskal-Wallis p-value. The software package STATISTICA 10.0 (StatSoft Inc, 2011) was used to perform both the analyses.

The null hypothesis assumed that all areas should have the same property value irrespective of their distances from the green space. Significant differences would reject the hypothesis. In the case of significance differences, Unequal N Honestly Significant Difference (HSD) test was used to compare the sample means pair wise with that of every other sample (i.e. mean property price per distance from the green space) and identify samples which were significantly different.

4.5 Results and discussion

4.5.1 Results of site-scale analysis

Table 4 summarizes the data obtained from the analysis of variance (ANOVA) and Kruskal-Wallis analysis of the five different areas and three zones per area as included in the Potchefstroom case study.

Comparisons between Zone 1 and Zone 2 in terms of the ANOVA effect sizes illustrated a large practical significant difference (≈ 0.8) between the mean, as well as the effect size within four of the five areas and a medium effect size in Grimbeek Park. Three of the five areas indicated that there is a statistically significant difference between the means ($p<0.05$ ANOVA analysis) and between the groups ($p<0.05$ Krusal-Wallis analysis). In all five areas Zone 1 had a lower price per square meter than in comparison to Zone 2.

Comparisons between Zone 1 and Zone 3 in terms of the ANOVA effect sizes illustrated a large practical significant difference (≈ 0.8) between the mean, as well as the effect size within three of the five areas, a medium effect size in the Potch Dam

Table 4: Statistical analysis ANOVA and Kruskal-Wallis

Area	Zone	N (188)	R/m2	(SD)	Effect size: a ≈ 0.2 Small, b ≈ 0.5 Medium, c ≈ 0.8 Large — 1 with…	2 with…	ANOVA: Statistically significant difference between the means (p< 0.05).	Kruskal Wallis: Statistically significant difference between the groups (p< 0.05).
Area A: Grimbeek Park	1	14	798.20	153.97			0.022	0.005
	2	14	953.12	244.06	0.63b			
	3	13	974.76	76.13	1.15c	0.09a		
Area B: Vd Hoff Park	1	15	938.29	177.71			0.003	0.010
	2	15	1105.07	193.00	0.86c			
	3	13	1202.56	216.72	1.22c	0.45b		
Area C: Potch Dam	1	9	718.97	131.06			0.130	0.089
	2	9	843.41	68.49	0.95c			
	3	9	925.29	330.07	0.63b	0.25a		
Area D: Heilige Akker	1	10	1114.23	176.19			0.005	0.010
	2	12	1413.52	257.52	1.16c			
	3	14	1238.36	152.32	0.7c	0.68b		
Area E: Owersig	1	14	1079.50	190.48			0.055	0.061
	2	14	1292.09	275.04	0.77c			
	3	13	1120.30	264.15	0.09a	0.69c		

area (≈ 0.5) and a small effect size in the Owersig area (≈ 0.2). Three of the five areas indicated that there is a statistically significant difference between the means (p<0.05 ANOVA analysis) and between the groups (p<0.05 Krusal-Wallis analysis). All five areas in Zone 1 illustrated also a lower price per square meter than in comparison to Zone 3.

The collective result of the Potchefstroom Case study (N=188) illustrated a statistical difference between Zone 1 and the Zones located further from the green space, thus rejecting the null hypothesis assuming that all areas should have the same property value irrespective of their distances from the green space. Results of the collective study area are captured in Table 5.

4.5.2 Results of neighbourhood-scale analysis

The five residential areas captured above were used to determine the impact of the green space on the overall neighbourhood value. The five areas were ranked according to the average property price per square meter of the area, based on the findings of the previous conducted research of Cilliers (2010a), Cilliers *et al*. (2013) and the ANOVA and Kruskal-Wallis analyses presented above.

Based on the average property price per area, the Sports grounds (Heilige Akker) were ranked first in two studies, implying the added value as a result of the Sports grounds presence in the area, and recreational use thereof. Owersig, adjacent to the River front ranked second, implying added value of the green space in terms of the aesthetic value thereof. Grimbeek Park, adjacent to the Golf course and Van der Hoff Park, adjacent to the wetland and equestrian ranked together in third place, both areas providing recreational function within the neighbourhood. The impact of green spaces on the neighbourhood were thus evident, especially in cases where public had recreational opportunities in close proximity, and where the spaces were maintained, thus implying green spaces of function and use. Accordingly, use and benefits of the green spaces (some of them identified as ecosystem services) within each of the five areas were subjectively awarded by the authors based on their experiences in an attempt to identify possible factors impacting on the neighbourhood-scale value. Results are indicated in Table 7, but it is not claimed herewith that all the possible uses and benefits (ecosystem services) were included. The neighbourhood with the highest average property value (Heilige Akker) also have the most perceived uses and benefits. Potch Dam with the lowest average property values also have the least perceived uses and benefits. It seems therefore that the more uses and benefits a green space provide (collectively), the greater the positive impact on the neighbourhood will be.

5. CONCLUSIONS AND ANALYSIS OF FINDINGS

From literature it is clear that proximity to green space is a key factor in increased residential value (Konijnendijk *et al*., 2013: 21) (refer to Table 4). It was concluded from international case studies that there are some contradicting results and the value of green spaces differ between countries and cities. This was also evident in the Potchefstroom case study where the proximity principle was rejected. Residential properties located adjacent to green spaces had a lower price per square meter than properties located further away. Ecosystem disservices, such as crime rates and noise (Konijnendijk *et al*., 2013: 22), could be a factor in this regard. A study conducted by Perry, Moodley & Bob (2010) examined the environmental perceptions of crime and violence, especially in relation to spatial dimensions and proofed that open spaces are perceive as crime hotspots. These perceptions are reflective of increased resistance to open spaces in residential areas (Perry *et al*., 2010:1). Given the unique challenges and characteristics of South African neighbourhoods, it can be argued that safety, along with availability of private green spaces in the more affluent urban

Table 5: Statistical analysis of collective study area

Area	Zone	N (188)	R/m2	(SD)	*Marked differences are significant at p<0.05000	
					[1]	[2]
Collective Potchefstroom area	1	62	935.08	219.33		0.762247
	2	64	1133.77	287.21	0.000062	
	3	62	1101.61	240.52	0.000820	

Table 6: Comparison of selected areas based on average residential property prices

Areas included	Green space	Cilliers (2010a)	Cilliers et al (2013)	Current research
		Ranking in terms of average R/m2 for area		
Baillie Park	Open field	5		
Potch Dam	Dam and playground	6		5
Grimbeek Park	Golf course	2	3	3
Heilige Akker	Sports grounds	1		1
Owersig	River front		1	2
Potch CBD	Vacant site	4		
Van der Hoff Park	Wetland, equestrian	3	2	3

Table 7: Comparative analysis of use and benefits of green spaces and selected residential areas

Benefits of green spaces		Heilige Akker (Sports grounds)	Owersig (River front)	Van der Hoff Park (Wetland/ equestrian)	Grimbeek Park (Golf course)	Potch Dam (Dam, playground)
Environmental benefits (Regulating, provision and supporting services)	Habitat with high biodiversity	X	X	X		
	Climate regulation (tree cover)		X		X	X
	Water flow regulation	X	X	X	X	X
	Provide environmental goods (e.g. medicinal plants)	X	X	X	X	X
Social benefits (Cultural services)	Aesthetic value	X	X	X	X	X
	Cohesion	X		X	X	X
	Health and recreation	X	X	X	X	X
	Quiet environment		X	X		
	Attraction for living	X		X	X	
	Enhancing identity of area	X	X		X	
Economic benefit (Linked to broad range of ES)	Services support	X	X	X		X
	Image of place	X	X		X	
	Marketability	X			X	X
	Increased tourism	X	X			X
	Cost savings (storm water)	X	X	X	X	X
	Higher land values	X	X	X		
Total use and benefits per areas identified (n)		14	13	11	11	10

areas, are probably the greatest reasons for contradicting results in the Potchefstroom case. Although other approaches in valuating urban green infrastructure were followed in South Africa (De Wit *et al.*, 2012; O'Farrel *et al.*, 2012; Roberts *et al.*, 2005; Schäffler & Swilling, 2013: 37), the hedonic pricing method (and proximity approach) as followed in this study, provides a quicker method indicating the value of green spaces, than was used before. There are, however, limited studies conducted in South Africa following this approach, and more cities and methods needs to be tested in order to make reliable conclusions in this regard.

This research further identified 'scale' as a core factor when determining the value of green spaces. The Potchefstroom case study showed a negative economic impact of green spaces in terms of site-scale (hedonic analysis), but a positive economic impact in terms of neighbourhood scale. The type of green space was found crucial, as perceived function and uses were identified as factors contributing to the total value of the neighbourhood, in this case the recreational and aesthetic functions provided by the green spaces in the different neighbourhoods (market value analysis). The comparison between green space that is essentially natural and green space that is to some extent intensive in terms of use; access control; and maintenance, needs to be explored in further research, as well as the development of a set of criteria to determine the specific ecosystem services of the specific green spaces.

In terms of future planning initiatives: (1) There is a need for development of valuation methodologies and new approaches to understanding the potential economic benefit of green spaces, especially in local context, (2) social issues and ecosystem disservices need to be addressed in integrative spatial planning approaches (Cilliers, 2009), and (3) green space value should be linked to scale, but in a more objective manner.

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REFERENCES LIST

AHERN, J., CILLIERS, S.S. & NIEMELä, J. 2014. The concept of ecosystem services in adaptive urban planning and design: A framework for supporting innovation. *Landscape and Urban Planning*, 125(2014), pp. 254-259.

ALTIERI, M.A., COMPANIONI, N., CAÑIZARES, K., MURPHY, C., ROSSET, P., BOURQUE, M. & NICHOLLS, C.I. 1999. Greening of the 'barrios': urban agriculture for food security in Cuba. *Agriculture and Human Values*, 16(2), pp.131-140.

BAYCAN-LEVENT, T. & NIJKAMP, P. 2007. Critical success factors in planning and management of urban green spaces in Europe. Istanbul, Turkey: Istanbul Technical University, pp.1-14.

BOLUND, P. & HUNHAMMAR, S. 1999. Ecosystem services in urban areas. *Ecological Economics*, 29(2), pp. 293-301.

BRANDER, L.M. & KOETSE, M.J. 2011. The value of urban open space: Meta-analyses of contingent valuation and hedonic pricing results. *Journal of Environmental Management*, 92(10), pp. 2763-2773.

CABE SPACE. 2005. *Paying for parks: Eight models for funding urban green space*. London: Commission for Architecture and the Build Environment.

CADMAN, M., PETERSEN, C., DRIVER, A., SEKHRAN, N., MAZE, K. & MUNZHEDZI, S. 2010. *Biodiversity for Development. South Africa's landscape approach to conserving biodiversity and promoting ecosystem resilience*. Pretoria: South African National Biodiversity Institute.

CASEPERSEN, O.H., KONIJNENDIJK, C.C. & OLAFSSON, A.S. 2006. Green-space planning and land use: An assessment of urban regional and green structure planning in Greater Copenhagen. *Geografisk Tidsskrift, Danish Journal of Geography*, 106(2), pp. 7-20.

CHAPARRO, L. & TERRADAS, J. 2009. Ecological services of urban forest in Barcelona. Institut Municipal de Parcs i Jardins Ajuntament de Barcelona, Àrea de Medi Ambient.

CHEN, W.Y. & JIM, C.Y. 2010. Amenities and disamenities: A hedonic analysis of the heterogeneous urban landscape in Shenzhen (China). *Geographical Journal*, 176(3), pp. 227-240.

CHIESURA, A. 2004. The role of urban parks for the sustainable city. Landscape and *Urban Planning*, 68(1), pp. 129-138.

CHO, S., POUDYAL, N.C. & ROBERTS, R.K. 2008. Spatial analysis of the amenity value of green open space. *Ecology Economics*, 66(2-3), pp. 403-416.

CILLIERS, E.J. 2009. Bridging the Green-Value-Gap: A South African Approach. *International Journal of Environmental*, Chemical, Ecological, Geological and Geophysical Engineering, 3(6), pp. 24-29.

CILLIERS, E.J. 2010a. Rethinking sustainable development: The economic value of green spaces. Dissertation (M.Com Economics), Potchefstroom: North West University.

CILLIERS, E.J., DIEMONT, E., STOBBELAAR, D.J. & TIMMERMANS, W. 2011. Enhancing sustainable development by means of the Workbench Method. *Environment and Planning B: Planning and Design*, 38(4), pp. 579 - 584.

CILLIERS, S.S. & SIEBERT, S.J. 2012. Urban ecology in Cape Town: South African comparisons and reflections. *Ecology and Society*, 17(3), pp. 3-33.

CILLIERS, S.S. 2010b. Social aspects of urban biodiversity: an overview. In: Müller, N., Werner, P. & Kelsey, J.G. (Eds). *Urban biodiversity and design*. Oxford: Wiley-Blackwell, pp. 81-100.

CILLIERS, S.S., CILLIERS, E.J., LUBBE, C.E. & SIEBERT, S.J. 2013. Ecosystem services of urban green spaces in African countries - perspectives and challenges. *Urban Ecosystems*, 16(4), pp. 681-702.

COLDING, J. 2007. Ecological land-use complementation for building resilience in urban ecosystems. *Landscape and Urban Planning*, 81(1-2), pp. 46-55.

COSTANZA, R., D'ARGE, R., DE GROOT, R., FARBER, S., GRASSO, M., HANNON, B., LIMBURG, K., NAEEM, S., O'NEILL, R.V., PARUELO, J., RASKIN, R.G., SUTTON, P. & VAN DEN BELT, M. 1997. The value of the world's ecosystem services and natural capital. *Nature*, 387(1997), pp. 253-260.

CROMPTON, J.L. 2001. The impact of parks on property values: a review of the empirical evidence. *Journal of Leisure Research*, 33(1), pp. 1-31.

DANIELSEN, F., SORENSEN, M.K., OLWIG, M.F., SELVAM, V., PARISH, F., BURGESS, N.D., HIRAISHI, T., KARUNAGARAN, V.M., RASMUSSEN, M.S., HANSEN, L.B., QUARTO, A. & SURYADIPUTRA, N. 2005. The Asian tsunami: a protective role for coastal vegetation. *Science*, 310(5748), pp. 643.

DE GROOT, R.S., ALKEMADE, R., BRAAT, L., HEIN, L. & WILLEMEN, L. 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecology Complex*, 7(3), pp. 260-272.

DE GROOT, R.S., WILSON, M.A. & BOUMANS, R.M.J. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economy, Vol. 41:393-408

DE WIT, M., VAN ZYL, H., CROOKES, D., BLIGNAUT, J., JAYIYA,T., GOISET, V. & MAHUMANI, B. 2012. Including the economic value of well-functioning urban ecosystems in financial decisions: Evidence from a process in Cape Town. *Ecosystem services*, 2(2012), pp. 38-44.

DE WIT, M.P. & BLIGNAUT, J.N. 2006. Monetary valuation of the grasslands in South Africa making the case for the value of ecosystem goods and services in the grassland biome. Report prepared for Lala Steyn at South African National Biodiversity Institute

DEFRANCESCO, E., ROSATO, P. & ROSSETTO, L. 2006. The appraisal approach to valuing environmental resources. In: Alberini, A., Rosato, P. & Turvani, M. (Eds). *Valuing complex natural resource systems: The case of the Lagoon of Venice*. Cheltenham, UK: Edward Elgar Publishing, pp. 40-57.

DEHRING, C., DUNSE, N., 2006. Housing density and the effect of proximity to public open space in Aberdeen, Scotland. *Real Estate Economics*, 34(4), pp. 553-566.

DUDLEY, N., STOLTON, S., BELOKUROV, A., KRUEGER, L., LOPOUKHINE, N., MACKINNON, K., SANDWITH, T. & SEKHRAN, N. (Eds). 2010. *Natural Solutions: Protected areas helping people cope with climate change.* Gland, Switzerland: IUCNWCPA, TNC, UNDP, WCS, The World Bank and WWF.

ESCOBEDO, F.J., KROEGER, T. & WAGNER, J.E. 2011. Urban forests and pollution mitigation: Analyzing ecosystem services and disservices. *Environmental Pollution*, 159(8-9), pp. 2078-2087.

FACCER, K. 2009. Rethinking the business of biodiversity conservation. Environmental Resource Economics Conference: Environment & Economy: Mind the Gap, Cape Town, 21 and 22 May 2009.

FAUSOLD, C.J. & LILIEHOLM, R. 1999. The economic value of open space: A review and synthesis. *Environmental Management*, 23(3), pp. 307-320.

FISHER, B., TURNER, R.K. & MORLING, P. 2009. Defining and classifying ecosystem services for decision making. *Ecological Economics*, 68(3), pp. 643-653.

GÓMEZ-BAGGETHUN, E. & BARTON, D.N. 2013. Classifying and valuing ecosystem services for urban planning. *Ecological Economics*, 86(2013), pp. 235-245.

GÓMEZ-BAGGETHUN, E. & PÉREZ, M.R. 2011. Economic valuation and the commodification of ecosystem services. *Progress in Physical Geography*, 35(5), pp. 613-628.

GóMEZ-BAGGETHUN, E. GREN, A., BARTON, D.A., LANGEMEYER, J., McPHEARSON, T., O'FARRELL, P., ANDERSSON, E., HAMSTEAD, Z, & KREMER, P. 2013. Urban ecosystem services. In: T. Elmqvist *et al*. (Eds). *Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities: A Global Assessment*, pp. 175-251. London: Springer.

GREENSPACE SCOTLAND. 2008. Greenspace Scotland research report: greenspace and quality of life – a critical literature review. Transforming urban spaces. [online] Available from: <http://www.openspace.eca.ac.uk/

pdf/appendixf/OPENspacewebsite_APPENDIX_F_resource_9.pdf> [Accessed 2 August 2015].

HERZELE, A. & WIEDEMANN, T. 2002. A monitoring tool for the provision of accessible and attractive urban green spaces. *Landscape and Urban Planning*, 63(2), pp. 109-126.

HOUGNER, C., COLDING, J. & SÖDERQVIST, T. 2006. Economic valuation of a seed dispersal service in the Stockholm National Urban Park, Sweden. *Ecological Economics*, 59(3), pp. 364-374.

JIM, C.Y. & CHEN, W.Y., 2006. Impacts of urban environmental elements on residential housing prices in Guangzhou (China). *Landscape and Urban Planning*, 78(4), pp. 422-434.

JIM, C.Y. & CHEN, W.Y., 2007. Consumption preferences and environmental externalities: A hedonic analysis of the housing market in Guangzhou. *Geoforum*, 38(2), pp. 414-431.

KABISCH, N. 2015. Ecosystem service implementation and governance challenges in urban green space planning - The case of Berlin, Germany. *Land Use Policy*, 42(2015), pp. 557-567.

KONG, F., YIN, H. & NAKAGOSHI, N. 2007. 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. *Landscape and Urban Planning*, 79(3-4), pp. 240-252.

KONIJNENDIJK, C.C., ANNERSTEDT, M., NIELSEN, A.B. & MARUTHAVEERAN, S. 2013. Benefits of Urban Parks: A systematic review. A Report for IFPRA, Copenhagen & Alnarp, January 2013.

KORSGAARD, L. & SCHOU, J.S. 2010. Economic valuation of aquatic ecosystem services in developing countries. *Water Policy*, 12(1), pp. 20-31.

KURUNERI-CHITEPO, C. & SHACKLETON, C.M. 2011. The distribution, abundance and composition of street trees in selected towns of the Eastern Cape, South Africa. *Urban For Urban Green*, 10(3), pp. 247-254.

LAMBERT, A. 2003. Economic valuation of wetlands: an important component of wetland management strategies at the river Basin scale. Ramsar Convention, pp. 1-10.

LIU, Z., MAO, F., ZHOU, W., LI, Q., HAUNG, J. & ZHU, X. 2007. Accessibility assessment of urban green space: A quantitative perspective. School of Architecture, Tsinghua University. Beijing. 2p.

LUBBE, C.S. 2011. Comparison of the urban domestic garden flora along a socio-economic gradient in the Tlokwe City Municipality. Dissertation, North West University, Potchefstroom

LUBBE, C.S., SIEBERT, S.J. & CILLIERS, S.S. 2010. Political legacy of South Africa affects the plant diversity patterns of urban domestic gardens along a socioeconomic gradient. *Scientific Research and Essays*, 5(19), pp. 2900-2910.

LUTTIK, J. 2000. The value of trees, water and open space as reflected by house prices in the Netherlands. *Landscape Urban Planning*, 48(3), pp.161-167.

LUTZENHISHER, M. & NETUSIL N.A. 2001. The Effect of Open Spaces on a Home's Sale Price. *Contemporary Economic Policy*, 19(3), pp. 291-298.

LYYTIMÄKI, J. & SIPILÄ, M. 2009. Hopping on one leg – the challenge of ecosystem disservices for urban green management. *Urban For Urban Green*, 8(4), pp. 309-315.

MA. 2005. *Millennium ecosystem assessment: Ecosystems and human well-being: Synthesis*. Washington, DC: Island Press.

MEADOWS, M. 2000. The ecological resource base: Biodiversity and conservation. In: Fox, R. & Rowntree, K. (Eds). *The Geography of South Africa in a Changing World*, South Africa, Cape Town: Oxford University Press, pp. 361–389.

MORANCHO, A.B. 2003. A hedonic valuation of urban green areas. *Landscape and Urban Planning*, 66(11), pp. 35-41.

NIEMELÄ, J., SAARELA, S.R., SÖDERMAN, T., KOPPEROINEN, L., YLI-PELKONEN, V., VÄRE, S. & KOTZE, D.J. 2010. Using the ecosystem approach for better planning and conservation of urban green spaces: a Finland case study. *Biodiversity Conservation*, 19(11), pp. 3225-3243.

O'FARRELL, P.J., ANDERSON, P.M.L., LE MAITRE, D.C. & HOLMES, P.M. 2012. Insights and opportunities offered by a rapid ecosystem service assessment in promoting a conservation agenda in an urban biodiversity hotspot. *Ecology and Society*, 17(3), article 27.

PEARCE, D.W. 1993. *Economic values and the environment*. UK: The MIT Press.

PERMAN, R., MA, Y., McGILVRAY, J. & COMMON, M. 2003. *Natural resource and environmental economics*. Harlow: Pearson Education.

PERRY, E.D., MOODLEY, V. & BOB, U. 2010. Open Spaces, Nature and Perceptions of Safety in South Africa: A Case Study of Reservoir Hills, Durban. School of Environmental Science, University of KwaZulu-Natal. 17p.

PHILADELPHIA PARKS ALLIANCE. 2008. How much value does the City of Philadelphia receive from its park and recreation system? A report by the Trust for Public Land's Centre for City Park Excellence for the Philadelphia Parks Alliance. Philadelphia, USA

ROBERTS, D.C. & DIEDERICHS, N. 2002. Durban's Local Agenda 21 programme: tackling sustainable development in a post-apartheid city. *Environ Urban*, 14(1), pp.189-201.

ROBERTS, D.C. 2008. Thinking globally, acting locally – institutionalizing climate change at the local government level in Durban, South Africa. *Environ Urban*, 20(2), pp. 521-537.

ROBERTS, D.C., BOON, R., CROUCAMP, P. & MANDER, M. 2005. Resource economics as a tool for open space planning Durban, South Africa. In: Trzyna, T. (ed) *The Urban Imperative, urban outreach strategies for protected area agencies*. Published for IUCN-California Institute of Public Affairs. IUCN, Sacramento: California Institute of Public Affairs, pp. 44-48.

RODRIGUEZ, C.M. 2009. Keynote address: Environmental Services Payments in Costa Rica. Environmental Resource Economics Conference: Environment & Economy: Mind the Gap, Cape Town, 21-22 May 2009.

SAREAV, V. 2012. *Economic benefits of greenspace: A critical assessment of evidence of net economic benefits*. Forestry Commission: Edinburgh. London.

SCHÄFFLER, A. & SWILLING, M. 2013. Valuing green infrastructure in an urban environment under pressure — The Johannesburg case. *Ecological Economics*, 86(2013), pp. 246–257.

SCHMIDT, S.J. 2008. The evolving relationship between open space preservation and local planning practice. *Journal of Planning History*, 7(2), pp. 91-112.

SHULTZ, S.D. & KING, D.A. 2001. The Use of Census Data for Hedonic Price Estimates of OpenSpace Amenities and Land Use. *Journal of Real Estate Finance and Economics*, 22(2-3), pp. 239-252.

SMITH, V. K., POULOS, C. & KIM, H. 2002. Treating open space as an urban amenity. *Resource and Energy Economics*, 24(1-2), pp.107-129.

STATSOFT, INC. 2011. STATISTICA (data analysis software system), version 10. www.statsoft.com.

STIGSDOTTER, U.A. 2007. Urban green spaces: Promoting health through city planning. Swedish university of Agricultural Sciences. In: *Conference proceeding of the 30th Annual Conference of NAEP (National Association of Environmental Professionals): Inspiring Global Environmental Standards and Ethical Practices*, 16-19 April 2005, Alexandria, Virginia, 17p.

TEEB. 2011. The economics of ecosystems and biodiversity: TEEB Manual for Cities – Ecosystem services in urban management.

THOMPSON, C. 2002. Urban open space in the 21st century. *Landscape and Urban Planning*, 2(7), pp. 59-72.

TLOKWE CITY COUNCIL. 2010. Tlokwe City Council Valuation Roll for the period 2009/2013. Potchefstroom.

TROY, A. & GROVE, J.M. 2008. Property values, parks, and crime: A hedonic analysis in Baltimore, MD. *Landscape and Urban Planning*, 87(3), pp. 233-245.

TURNER, R.K., PAAVOLA, J., COOPER, P., FARBER, S., JESSAMY, V. & GEORGIOU, S. 2003. Valuing nature: lessons learned and future research directions. Ecological Economics, 46(3), pp. 493-510.

TYRVÄINEN, L. 1997. The amenity value of the urban forest: An application of the hedonic pricing method. *Landscape and Urban Planning*, 37(3- 4), pp. 211-222.

TZOULAS, K.K., KORPELA, K., VENN, S., YLI-PELKONEN, V., KAZMIERCZAK, A., NIEMELÄ. J. & JAMES, P. 2007. Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. *Landscape and Urban Planning*, 81(3), pp. 167-178.

VAURAMO, S. & SETÄLÄ, H. 2011. Decomposition of labile and recalcitrant litter types under different plant communities in urban soils. *Urban Ecosystems*, 14(1), pp.59-70.

VILLARREAL, E.L. & BENGTSSON, L. 2005. Response of a Sedum green-roof to individual rain events. *Ecological Engineering*, 25(1), pp. 1-7.

WILHELM-RECHMANN, A. & COWLING, R.M. 2013. Local land-use planning and the role of conservation: An example analysing opportunities. *South African Journal of Science*, 109(3/4), March/April, pp.1-6.

WILKINSON, C., SAARNE, T., PETERSON, G.D. & COLDING, J. 2013. Strategic Spatial Planning and the Ecosystem Services Concept – a Historical Exploration. *Ecology and Society*, 18(1), p. 37.

WOLF, K.L. 2004. Public value of nature: economics of Urban trees, parks and open space. In: Miller, D. & Wise, J.A. (Eds). *Design with Spirit: Proceedings of the 35th Annual Conference of the Environmental Design Research Association,* Albuquerque, New Mexico, June 2-6, 2004. Edmond, OK: Environmental Design Research Association, Washington, pp. 88-92.

WOOLLEY, H., SWANWICK, C. & DUNNET, N. 2003. Nature, role and value of green space in towns and cities: an overview. [online] Available from: <http://www.atypom-link.com/ALEX/doi/abs/10.2148/benv.29.2.94.54467.> [Accessed 18 September 2009].