Public green space inequality in small towns in South Africa

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Abstract

The distribution of public green space within towns is frequently uneven, and influenced by attributes such as its location relative to the commercial core, as well as the ethnicity and relative wealth and education of the residents. Yet most studies are from large cities in developed countries. In contrast, this study reports on the distribution of public green space across 9 small towns in a developing country, namely South Africa, which offers a unique case study because of its former racially defined settlement patterns. We do so using GIS analysis of aerial photographs focusing on 3 types of suburbs in each town, defined on the basis of wealth as well as race-based history under the previous apartheid regime. The more affluent suburbs, inhabited mainly by whites, have the lowest density of housing and the highest area of green space per capita. Proportionally, they have a similar area under public green space as to the previously racially defined townships, but because of the lower housing density, they have a greater area per person. The newly built low-cost housing areas (termed RDP suburbs), occupied largely by poor black South Africans, are poorly endowed with public green space, and fare worse than the other 2 suburb types on all attributes measured. This needs to be addressed in further low-cost housing developments.

Introduction

With an ever increasing proportion of the world's population living in urban areas (UN Habitat, 2006), the discipline of urban ecology is gaining momentum. It seeks to provide understanding and heuristic frameworks that will allow planners and decision-makers to adopt policies and programmes to optimise the benefits of urbanisation for human well-being. Simultaneously it requires that any negative impacts on the provision of ecosystem goods and services which also underpin human well-being, are limited.

Maintenance of green spaces and trees within urban areas is now widely recognised as one of the primary strategies available to urban planners to contribute to urban ecology and regular human contact with nature for their physical and psychological well-being (Louv, 2006). This may comprise public or private green space. Private green space is facilitated when residential plot sizes are sufficiently large to allow occupants opportunity to establish and maintain productive or aesthetic gardens. Public green space is key in areas where residential plot sizes are inadequate, or the housing stock is dominated by multi-storey buildings. However, despite the recognition of the importance of public green spaces to urban communities, a number of studies have shown that urban green space is rarely uniformly distributed within a city or town ([Barbosa et al., 2007] and [Iverson and Cook, 2000]). Some suburbs are disproportionately well endowed with public green space, whereas others have considerably less. The historical and planning reasons for such disparities have rarely been studied, but the correlates between urban green space and a number of socio-economic variables have (e.g. [Martin et al., 2004] and [Zhang et al., 2008]). Revealing and communicating such inequities can prompt better planning processes and environmental justice. This is necessary as planning officials may not have the same perspectives on the abundance, distribution and quality of public green space as do residents of the same urban area (Broussard, Washington-Ottombre, & Miller, 2008).

Attributes considered include wealth, education and race, although recognising that there is frequently a strong correlation between the first two. Within Europe and North America, a number of studies have shown that both private and public green space is significantly influenced by education and wealth ([Barbosa et al., 2007], [Martin et al., 2004], [Troy et al., 2007] and [Zhang et al., 2008]). Typically this is a result of the wealthy being able to afford to move to areas with a better environmental offering, rather than their residency resulting in an improved environment. However, wealthy suburbs, with significant areas of private green space, may experience a lowered access to public green space (Barbosa et al., 2007). The results pertaining to race are variable, with some work indicating greater private green space or tree planting in areas dominated by whites (e.g. Zhang et al., 2008), and others in areas dominated by African–Americans (Troy et al., 2007). However, much of this work has not adequately teased out other potential covariates with race, such as income, education, length of residency, age of the suburb, ratio of home owners to renters, and the like.

The majority of case studies are from the developed world, which are highly urbanised and with relatively low population growth rates. In contrast, developing nations are experiencing high rates of urbanisation and population growth, such that urban planning agencies frequently struggle to keep up (UN Habitat, 2006). In such circumstances, public green space may be a target for land invasions or expropriation for productive purposes such as urban agriculture (e.g. [Asomani-Boateng, 2002] and [Mougeot, 2006]). South Africa is such a country. It is particularly intriguing because of the lasting ill-effects of the previous racially defined apartheid regime, and the new democratic government's effort to redress these.

Under apartheid land ownership and residency was racially based and segregated at two scales. At the larger, regional scale, black Africans were required to establish a home base in one of 13 ethnically defined Bantustans (or 'homelands'). The apartheid government attempted to limit the number of black Africans residing outside of these homelands. Consequently, overall levels of urbanisation in the major cities of South Africa were arrested for several decades. In the post-apartheid period from the 1990s, there was consequently a rapid surge in urbanisation. At a lower, urban scale, those black Africans who were permitted to stay in urban towns and cities were restricted to living in racially defined suburbs (Wilkinson, 1998), locally termed 'townships'. These were poorly serviced, with a high proportion of informal structures and backyard dwellers, with limited commercial activities and widespread poverty. In contrast, whites resided in suburbs typical of any city in the first world; well laid out, well maintained, leafy suburbs, low density and adequate infrastructure. With the demise of apartheid the new democratic government sought to address the backlogs created under apartheid (Wilkinson, 1998). Significant investments were, and still are, being made in both homeland and township areas. The current government has a vigorous housing programme, although significant backlogs remain because of the high rates of influx of new urban migrants (Gilbert, 2004). The emphasis is on delivery of large numbers of houses for the poor and previously homeless at as low a cost as possible (Gilbert, 2004). Most houses are single storey, on a 40 m^2 foundation. This was part of the post-apartheid Reconstruction and Development Programme (RDP), and hence these housing developments are locally termed 'RDP houses'. In the last 10 years approximately two million RDP houses have been constructed (Department of Housing, 2007), although in some areas workmanship has been poor and the houses suffer from multiple structural defects (Huchzermeyer, 2001). Occupancy of RDP housing is reserved for the poor and indigent, with lists of eligible households maintained by local municipal housing departments.

South Africa consequently offers an interesting opportunity to examine the distribution of public green space in a developing country in relation to wealth attributes. However, it also allows a comparison of old townships which were neglected by the government of that time, with new RDP suburbs, which were centrally planned, provided with bulk infrastructure and services and are presumably developed on the basis of international best practice and norms. As such, this represents a finer, intra-town scale of analysis of the findings of McConnachie, Shackleton, and McGregor (2008) who worked in the same region. They demonstrated that the proportion, area per capita and quality of public green space were markedly different across 10 small towns in the Eastern Cape of South Africa. In particular, those in former homeland areas had less public green space in total and per capita, as well as of a lower quality than non-homeland or wealthier towns, and were well below international norms. Poorer towns had less than 7% of their area as public green space, whereas wealthier ones had 10–15%. Green spaces in poorer towns were dominated by alien invasive species which constituted over 40% of the trees present, whereas wealthier towns typically had less than 25% of trees of this nature. Thus, at the inter-town level wealth was correlated with public green space attributes. But their analysis considered each town as a homogenous unit, whereas the analysis reported here considers patterns of public green space within different suburbs of each town.

Study towns

Nine of the 10 towns covered by McConnachie et al. (2008) were selected for this study. Bhisho was not included because it has no residential areas associated with it (it was created as a homeland administrative capital – workers live in nearby King Williamstown and Zwelisha). All the towns fall within the Albany Thicket Biome (Mucina & Rutherford, 2006) in the south-east of South Africa (Fig. 1). All but one, Mossel Bay, are located in the poorest province of the country, namely the Eastern Cape. The 9 towns are scattered throughout the western half of the province, and range in size from 11,000 to approximately 70,000 people. They span a range of physiographic and climatic regimes, with the lowest mean annual rainfall being at Graaff-Reinet (400 mm p.a.) and highest at Grahamstown and Butterworth, which receive approximately 600 mm p.a. Of the 9 towns, 2 (Butterworth and Zwelisha) are located in the former racially demarcated homelands established under the apartheid regime, and thus they are markedly poorer than the other towns. Within each town, one can find affluent suburbs previously reserved for white residents, townships and in most, RDP suburbs, besides areas of unplanned informal housing.

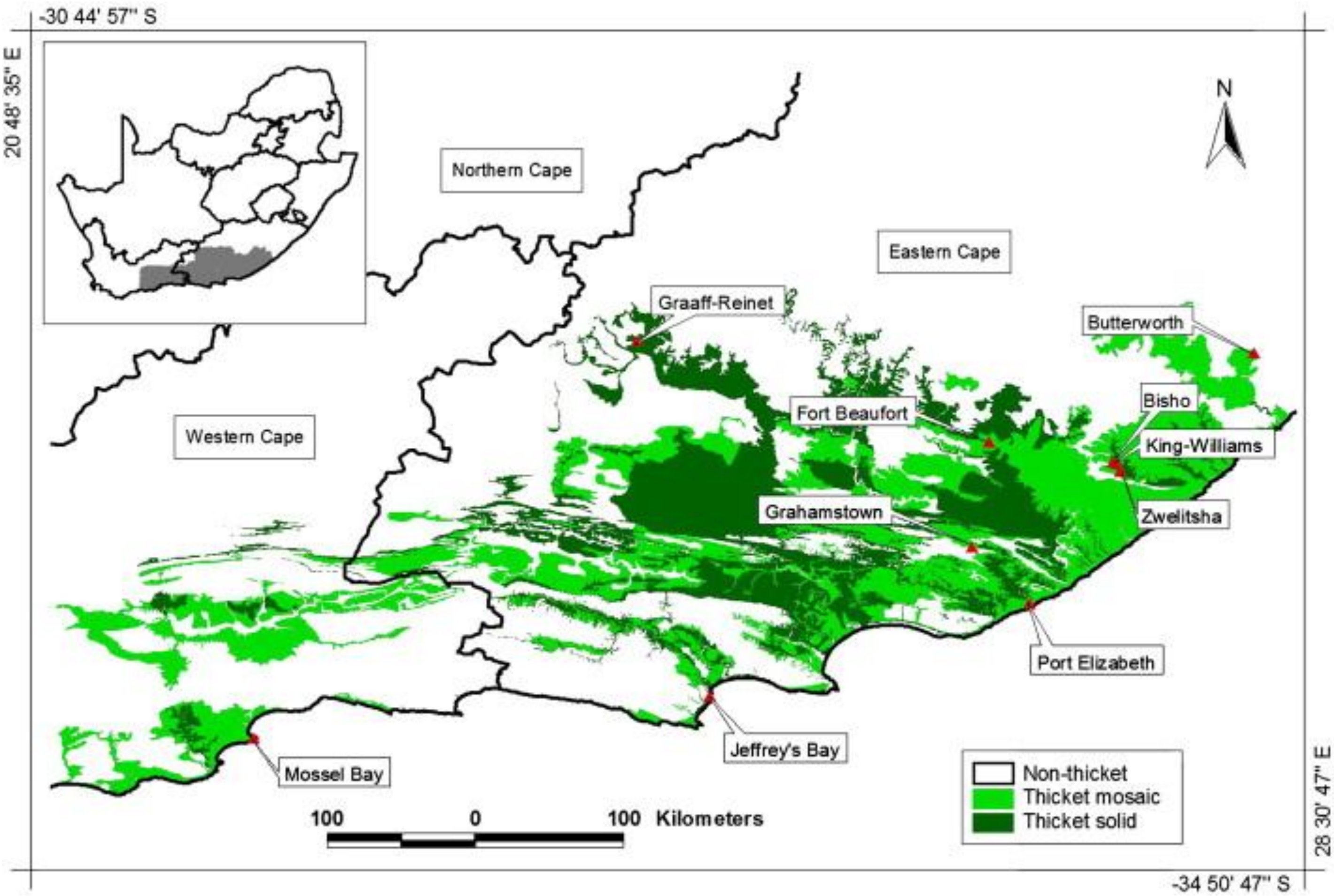

Fig. 1. The location of the study sites within the Sub-Tropical Thicket Biome (from Pierce, 2003).

Methods

Public green space attributes per suburb

GIS analysis was conducted using ArcView 3.2 (ESRI). The data sources included digital 1:10,000 orthorectified photographs, 1:250,000 STEP data layers and the Environmental Potential Atlas (ENPAT) data.

As described in McConnachie et al. (2008), STEP data layers (BGIS, 2006) and the ENPAT (ENPAT, 2006) town data were overlaid to determine the towns falling within the Albany Thicket Biome. The towns were selected according to their respective human populations, and those with populations of between 10,000 and 100,000 people were identified. The larger metropolises were excluded. Digital orthorectified aerial photographs covering each of the study towns were acquired from the Directorate of Surveys and Mapping, Department of Land Affairs, South Africa. The original dates of these images ranged between 2001 and 2004. These images were used for the on-screen digitising of polygon vector data layers displaying the outlines of the respective town attributes and green space areas.

The town boundary was taken as the line joining the edges of the delimited properties for the outermost buildings of the town. This was done so as not to include patches of green space on the periphery of the town, and so erroneously inflate the amount of green space. The towns were then divided into three suburb types namely: affluent, township and RDP suburbs. This classification was done based on visual observation of the aerial photographs.

For calculation of green space quantity private gardens, hard open spaces and roadside green spaces were not included. Thus, the study was confined to public green space, which included school grounds and sport fields. For each town every public green space was confirmed on the ground and its land use as a public green space verified. Green spaces had to be deleted, added and for a few, the boundary lines edited. The town and suburb boundaries were not edited.

Spatial attributes for the town suburbs and green spaces could then be calculated in the GIS.

Housing density and social data

In the GIS a map grid was placed over the towns with a block size of 200 × 200 m. For each suburb type, within the nine towns, 5 blocks were randomly selected for sampling. Where there were less than 5 blocks per suburb all the blocks were sampled. Since the variable of interest was housing density, the block had to have less than 5% of its area covered by public green space. It also had to include only residential land use, with commercial and industrial areas excluded from the study. To ensure a degree of interspersion, contiguous blocks were not sampled. Within each randomly located block the total number of residential stands was counted in the GIS using the aerial photographs. This was extrapolated to density per hectare for the suburb types.

The number of people per household and percentage unemployment for the suburb types was calculated using ward data from the Municipal Demarcation Board of South Africa (Demarcation Board of South Africa, 2006). In the GIS, towns were selected only if they had (i) at least two wards overlaying the area of the town without rural farmland, as well as (ii) each ward exclusively covered at least 90% of a designated suburb type. Owing to the coarse resolution of the ward data RDP and township areas were grouped together. Only 3 of the 9 towns fitted the criteria (Table 4). The estimates for these towns were extrapolated for analysis across all the towns.

Data were tested for normality, and where not met, appropriate transformations were made. Differences between the three suburb types were then tested via means of a one-way analysis of variance (ANOVA), with a post-hoc test using the Fischer LSD to check for differences in specific pair-wise comparisons.

Results

The new RDP suburbs have significantly ($F = 52.3$; $p < 0.0001$) higher housing densities than either the older townships or affluent suburbs (Table 1), which were also significantly different to one another. The density of housing within each suburb type was relatively similar across the 9 study towns.

Table 1. Density of households (number per hectare) within three suburbs (unlike superscripts next to means indicate significant differences).

Town	Suburb type		
	RDP	Township	Affluent
Butterworth	None	16.4	6.6
Fort Beaufort	22.8	15.8	4.9
Graaff-Reinet	22.3	16.7	5.5
Grahamstown	32.3	16.3	4.3
Jeffery's Bay	25.3	12.0	7.7
King Williamstown & Zwelitsha	21.0	13.2	6.4
Mossel Bay	30.8	25.7	8.5
Port Alfred	None	17.9	5.2
Mean	$25.8^{a} \pm 1.9$	$16.8^{b} \pm 1.5$	$6.1^{c} \pm 0.5$

Despite the RDP suburbs being the most recently developed, there seems to be relatively poor public green space planning, both in terms of size of spaces, as well as the total proportion of the area under public green space. There were no differences between the township and affluent suburbs for these two measures (Table 2), but the RDP areas were significantly lower than both these two for both mean public green space size ($F = 5.7$; $p < 0.001$) and proportion ($F = 7.8$; $p < 0.01$).

Table 2. Mean proportion and size of public green space within each suburb type (unlike superscripts next to means indicate significant differences).

Town	Mean size of public green space unit (ha)			Proportion (%) of suburb as public green space		
	Suburb type			Suburb type		
	RDP	Township	Affluent	RDP	Township	Affluent
Butterworth	None	1.6	0.9	None	8.0	5.4
Fort Beaufort	0	2.1	1.1	0	13.0	10.3
Graaff-Reinet	0	1.2	1.1	0	11.5	12.9
Grahamstown	1.2	1.9	2.0	6.2	11.9	15.8
Jeffery's Bay	1.6	2.1	2.7	5.8	23.9	14.5
King Williamstown & Zwelitsha	0.9	1.8	1.4	8.4	6.3	9.3
Mossel Bay	0.2	1.5	1.6	1.2	13.2	10.4
Port Alfred	None	1.3	3.4	None	8.1	15.7
Mean	$0.7^{a} \pm 0.3$	$1.7^{b} \pm 0.1$	$1.8^{b} \pm 0.3$	$3.6^{a} \pm 1.5$	$12.0^{b} \pm 1.9$	$11.8^{b} \pm 1.3$

Given that the RDP suburbs have higher housing densities and a lower proportion of public green space it is not unsurprising that the area of public green space per household is significantly lower ($F = 26.3$; $p < 0.0001$) than in the other two suburbs (Table 3). The area per household in the RDP suburb was approximately five times less than the township areas and 15 times less than the affluent suburbs.

Table 3. Area of public green space (m^2) per household within each suburb type (unlike superscripts next to means indicate significant differences).

Town	Suburb type		
	RDP	Township	Affluent
Butterworth	None	49.1	81.9
Fort Beaufort	0	82.6	212.9
Graaff-Reinet	0	68.6	237.1
Grahamstown	19.1	73.1	371.2
Jeffery's Bay	22.9	199.1	188.7
King Williamstown & Zwelitsha	40.2	48.0	146.0
Mossel Bay	4.0	51.5	121.8
Port Alfred	None	45.6	302.6
Mean	$14.4^a \pm 6.5$	$77.2^b \pm 18.1$	$207.8^c \pm 33.8$

mean number of people per household is marginally lower, although not significantly so ($t = 1.1$; $p > 0.05$) for the affluent suburb types compared to the poorer RDP and township areas (Table 4). As expected, the ward census data indicated that the percentage unemployment rate for township and RDP areas was significantly higher ($t = 3.5$; $p < 0.05$) than the affluent areas, affirming their poorer wealth status.

Table 4. Number of people per household within each suburb type and corresponding unemployment rate (of economically active population) (data from Municipal Demarcation Board of South Africa 2006) (unlike superscripts next to means indicate significant differences).

Town	No. of people per household		Unemployment rate (%)	
	Township and RDP	Affluent	Township and RDP	Affluent
Grahamstown	4.2 ± 0.04	3.6 ± 0.05	63.0	17.1
Mossel Bay	4.0 ± 0.03	2.8 ± 0.02	39.3	7.2
Fort Beaufort	4.0 ± 0.06	4.4 ± 0.10	72.7	28.6
Mean	$4.1^a \pm 0.06$	$3.6^a \pm 0.45$	$58.3^a \pm 9.2$	$17.6^b \pm 0.45$

Discussion

In common with findings elsewhere (e.g. Pedlowski, da Silva, Adell, & Heynen, 2002) this study has shown that the affluent suburbs enjoy lower household densities than the neighbouring, poorer townships. Thus, although the proportion of public green space is similar between these two, the greater housing density in the townships translates into a significantly lower area of public green space per household, and therefore per capita.

With 3.6 people per household (Table 4), then the affluent suburbs have approximately 57.2 m^2 of public green space per person, which is within international norms (Eurostat Urban Audit, 2001). In contrast, the townships had 4.1 people per household resulting in 18.9 m^2 of public green space per person. This is below international norms and those set by the City of Johannesburg in South Africa (Johannesburg Open Space System, 2002). This is in common with other developing nations. For example, in Bangkok (Thailand) the mean area of green space per person is only 11.8 m^2 and for parks only 1.8 m^2 (Thaiutsa, Puangchit, Kjelgren, & Arunpraparut, 2008). This inequality in terms of public green space availability in South Africa is mirrored economically by an increasing gap between rich and poor households, as depicted by the greater than three-fold higher unemployment rate (58.3%) for township and RDP wards relative to affluent wards (17.6%). The poor households are not enjoying the benefits of a growing gross domestic product (GDP), with a rising poverty gap and gini-coefficient in the Eastern Cape and South Africa as a whole (HSRC, 2004).

Comparing the townships with the new RDP suburbs is instructive because the racial and wealth disparities are negligible. The primary difference lies in that the townships were first established decades ago (if not more than a century) and were severely neglected by planners and municipal authorities for 50 years between the 1940 and 1990s, whereas the RDP suburbs are new (less than 15 years old) and centrally planned and serviced with bulk infrastructure. It is thus with concern that this study shows the RDP suburbs fare significantly worse than their corresponding townships in terms of all the attributes of public green space measured. Housing density is significantly higher in the RDP areas, the percentage public green space is less, the mean size per green space is smaller and the area of public green space per household is more than five times less. With 4.1 people per household (Table 4) residents of the RDP suburbs have only 3.5 m^2 of public green space per capita. However, the national guidelines stipulate a target of 40 m^2 (R. van der Merwe, personal communications, Town Planner, Makana Municipality). Consequently, there is a stark difference between the national policy and implementation on the ground.

Using the entire town as the basis of analysis McConnachie et al. (2008) reported a mean of 36. 5 m^2 public green space per capita for these same towns. However, given that the affluent suburbs have larger plots and access to private green space, one would expect the need for public green space to be greatest in the poorer suburbs. Moreover, the mean unit size of each public green space in the RDP suburbs was significantly less than that found in the township, undermining its suitability to provide a range of functions, such as aesthetic, passive recreation, conservation, carbon sequestration, wildlife habitat, and a place for sports activities.

The poor environmental sustainability of South Africa's massive housing programme has been commented on previously (Goebel, 2007), but more in relation to the geography of the developments (at the edge of towns far from jobs and shops, requiring transport to access), the low energy efficiencies of housing designs and the failure to take advantage of the latest environmental technologies. However, the broader landscape aesthetics and greening dimensions have not been investigated. This study shows that there are marked disparities in availability of green space between the established wealthy suburbs, poor suburbs and the new housing programme areas. This requires attention by planners and decision-makers otherwise the negative effects of insufficient green space will become apparent in the future (Louv, 2006).

Conclusion

It is increasingly acknowledged that public green space is important for the physical and psychological well-being of urban residents. This is especially so in poorer suburbs and towns because higher densities of residential stands mean that poorer residents frequently do not have sufficient areas of private green space around their homesteads. Previous work from developed countries has shown that poorer suburbs in large cities frequently have low ratios or access to public green space. This study in small towns in a developing country shows a similar pattern, namely relatively poor suburbs are characterised by up to 14 times less public green space per capita than more affluent ones. Moreover, recent low-cost housing developments by the South African government are poorly endowed with public green space, to the probable long-term detriment of those residents least able to afford to travel and access green spaces outside the town or suburb.

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