Application of Geographic Information System in Urban Green Space Management: A Review

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Background

The growing of city is effected to the both regional and local climatic change. (Oke.1973) The result of urbanization is expressed as concentration of population, modification of earth's surface constituent materials, and expansion of living space onto and under the ground. These bring about changes in morphological and physical features of the urban surface, and its energetic conditions (Yamashita. 1990/91). So, the urban air temperature is gradually rising in all cities in the world (Jusuf et al. 2007) cause of urbanization and development of urban are released the anthropogenic heat; the high heat capacity of building materials; the reduction of the area of evapotranspiration surfaces; the trapping of long-wave radiation beneath roof-level; increased counter radiation from the urban pollution dome; trapping of heat due to stagnation between the large roughness elements (Oke.1975); diminishing of green area etc. These factors cause urban heat Island (UHI). See in Figure 1 and 2.

Urban Heat Island is the importance problem. As far as, a human no silently neglect with regard to try solve this which can see from many researches. This attemption will research in all story at relates such as Heat Island of a small city and its influences on the formation of a cold air lake and radiation fog in Xishuangbanna, Tropical China. It was found that radiation fog disappeared within about one hour where the city is located. Moreover they found that population increasing, urbanization and deforestation are effected on the local climate has been changing (Yamashita. 1990/91) reported on the results of field observation and three-dimensional computer simulation of the urban heat island in the Tokyo metropolitan

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area. Quite a good agreement was obtained between the present simulation and the observed data. Yamashita (1995) studied the detailed horizontal structure of the heat island of Metropolitan Tokyo, a huge heat island of more than 30 km. of diameter forms in the Metropolitan Tokyo area. The temperature rise to the urban center occurs in phases. Moreover the study in the South America; the Argentine Republic; Buenos Aires Urban Meteorological Data Analysis of a five – day period found that daily maximum, minimum temperature differences between the same stations show that the urban island effect temperature, relative humidity and airflow fields are different according to the hour Mexico research aspects of heat-island development in Guadalajara. The result of this studied the relation of the city's growth, air temperature in the tropical city. This relation indicated that beside of size of the city, the land use characteristic has effected the heat island in the tropical city.

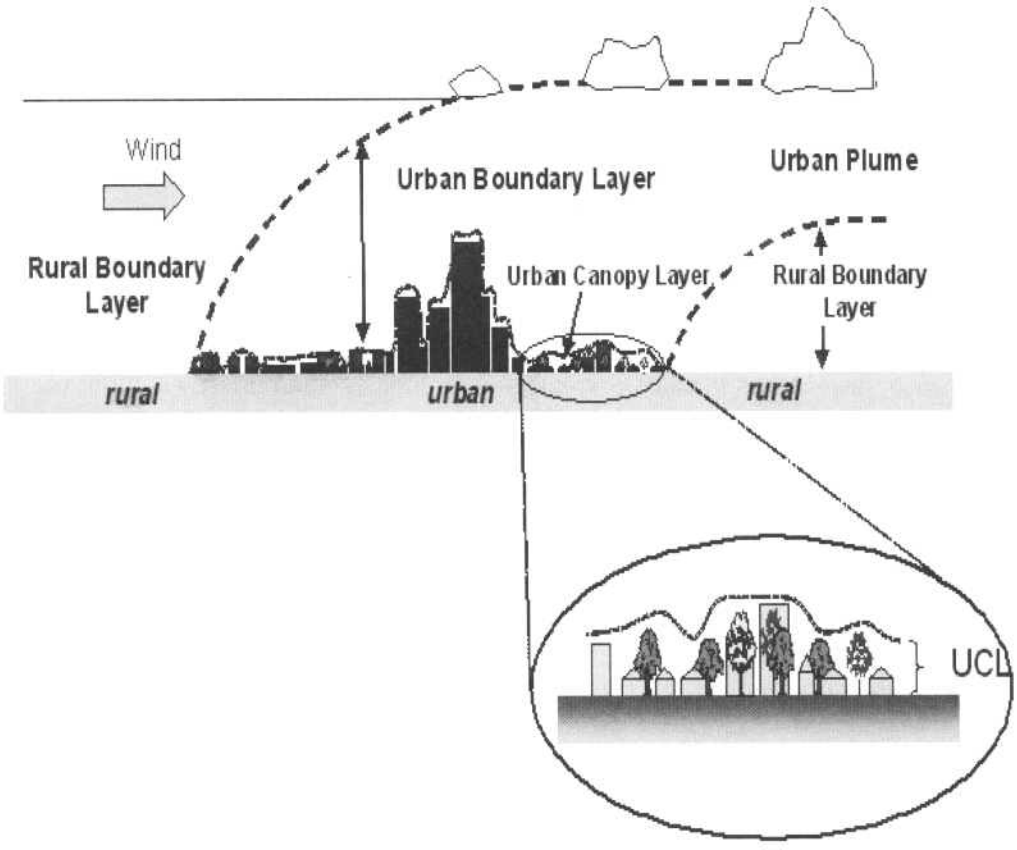

Figure 1 : Schematic Depiction of the Min Components of the Urban Atmosphere.
Source: http://www.actionbioscience.org/environment/voogt.html

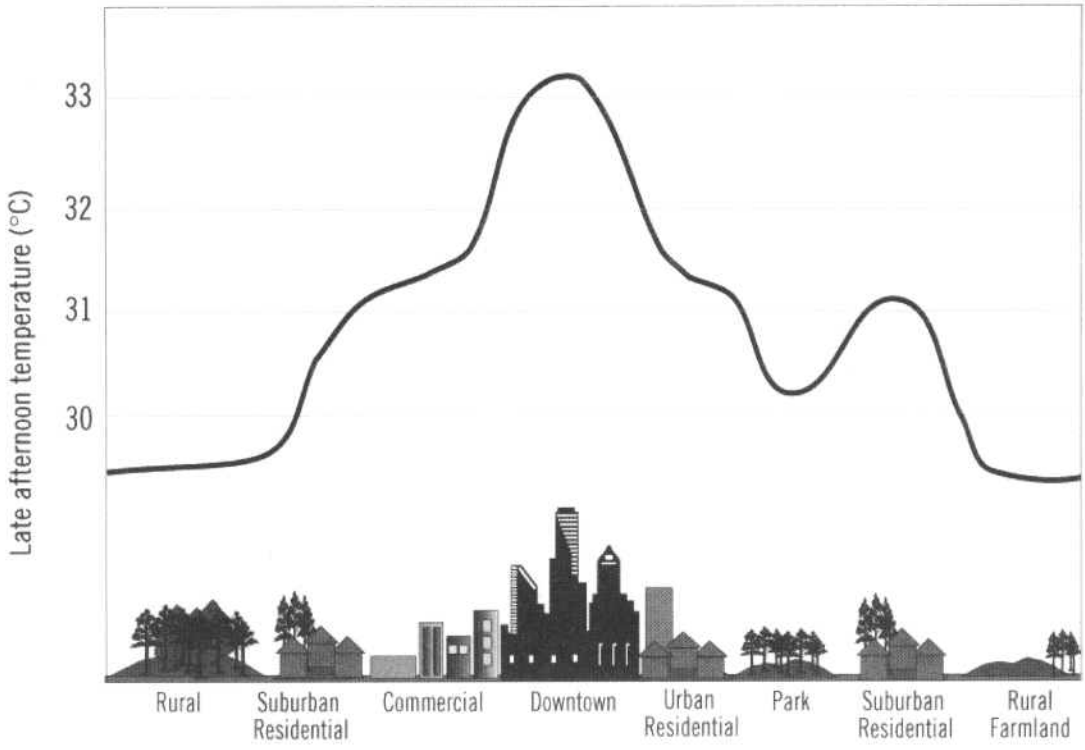

Figure 2 : Sketch of an Urban Heat Island Profile.

SOURCE : Http://adaptation.nrcan.gc.ca/perspective/images/figure2_urbanheat.jpg

The Utilities of Tree

Many sciences discovered that tree can help decreasing global worming problem.With fewer trees in cities and large communities solar energy is more readily absorbed into manmade structures, causing higher urban area temperatures. Trees help to reduce the urban heat island effect, which contributes to increased levels of such things as higher ambient temperatures, air pollution, higher demands on cooling systems, and health problems related to heat and pollution. Trees are a very simple, attainable means of reducing the effects. They act as nature's air conditioners. They help to cool the surrounding air in two ways: (a) trees provide shade, thereby keeping street and building surfaces cooler; and (b) trees use evapotranspiration to cool themselves and the surrounding air. Evapotranspiration is the process by which trees "transpire", or perspire, so to speak, from both the leaves and the root systems. The result is, as the water evaporates it dissipates the heat in and around the tree which leads to cooler air in the area encompassing the tree. Higher temperatures and air

pollution can result in the formation of smog in our larger cities, and can cause very real health problems. Smog is the result of pollutants in the air acted upon by the sun's light, this is known as a photochemical reaction. These pollutants are such things as: nitrogen oxide, hydrocarbons and other particulates in the air. Leaves help reduce air pollution by "capturing" airborne particles, such as Nitrogen dioxide, NO_2, Nitrogen oxide, NO, and Sulfur dioxide, SO_2, while at the same time they are releasing Oxygen, O_2. Trees intercept and absorb rain through their leaves and roots, thus reducing the amount of water falling on the pavement and hard surfaces and subsequently removed via storm water drainage systems. Trees, their leaves, and the soil around them act as natural filters for water purification. Leaves collect the dust that blows around the city on their leaves. This helps to reduce some of the air pollution. The dust, for the most part, remains on the leaves until it rains where upon it washes to the ground. Minerals, some heavy metals, and impurities are pulled into the roots where they are stored until the trees utilize them. Some are stored in its shoots, stems, leaves or fruit.

The Application of Geographic Information System (GIS) for Green Area Management

Geographic Information System (GIS) is high effective technology. They have been utilized for analysis, monitoring and management about green areas in several studies. For instance, Ahn et al. (1991) measured accessibility to open spaces including green belts, rivers, and lakes from residential areas in Seoul. The study results revealed that areas within a linear distance of 700 m. from open spaces composed 98.6% of the entire area of Seoul and thus the provision of open spaces in Seoul was judged to be more than adequate. Because the study relied mainly on uniform distance from parks, measuring actual travel routes of park users was not possible, and thus the service area of parks tended to be inaccurate. Coulombe and Lowell (1995) was used GIS to relate measured basal area and cartographically derived to relate measured basal area and cartographically derived ecophysiographic variables in an effort to produce locally reliable estimates of basal area over a forest rather than. This work has wider implications as it demonstrates that, while GIS technology has the capability to apply a statistical

model to a spatial framework, the results will not necessarily reflect local ground conditions with precision. Nicholls and Shafer (2001) adopted GIS technology in their study of urban parks and recreational services to evaluate accessibility and equity in a local park system. They used the simple radian buffering method to ascertain the number of facilities and the proportion of the population in the selected area. They also performed network analysis to calculate the actual travel distance along streets to local parks. Van Herzele and Wiedemann (2003) constructed an urban core, green spaces barriers, and crosswalks of four Belgian cities. They implemented qualitative and quantitative assessments by drawing "access possibility areas" and analyzing levels of green-spaces. In their study, the access distance from urban parks was calculated using a cost map which considered physical barriers in raster-based GIS. Toccolini et al. (2004) defined a methodology useful for greenways planning in Italy at regional level, and demonstrated the application of this methodology to a case study. The result found that the Lambro River Valley Park allowed the development to a green ways network in corporating the existing network of green trails: 80% of the network is, in fact, already in place. The methodology also proved to be useful in the definition of a network dedicated to non motorized traffic capable of connecting the numerous urban centres with the many resources present in the area. Oh and Jeong (2007) assessed the spatial distribution of urban park by using the network analysis method of GIS. This study analyzed pedestrian accessibility to urban parks. They found to have been inadequately distributed in relation to population, land use, and development density. See in Figure 3, 4, 5 and 6. Matthew et al.(2008) discovered quantify the current size and state of public green space within small towns in the thicket biome, and seek patterns between this and socio-economic attributes of the towns by GIS .The result found that the area and state of current public green space varied markedly between the towns, with the poorer towns faring the worst. Lower income levels were significantly negatively correlated with the area and quality of public green space. Despite this, human population density and per capita green space were the best predictors of the proportion and mean area of public green space present in the towns. The proportion of town green space and the per capita green space were the best predictors of changes in woody plant composition and density. See in Figure 7 and Table 1.

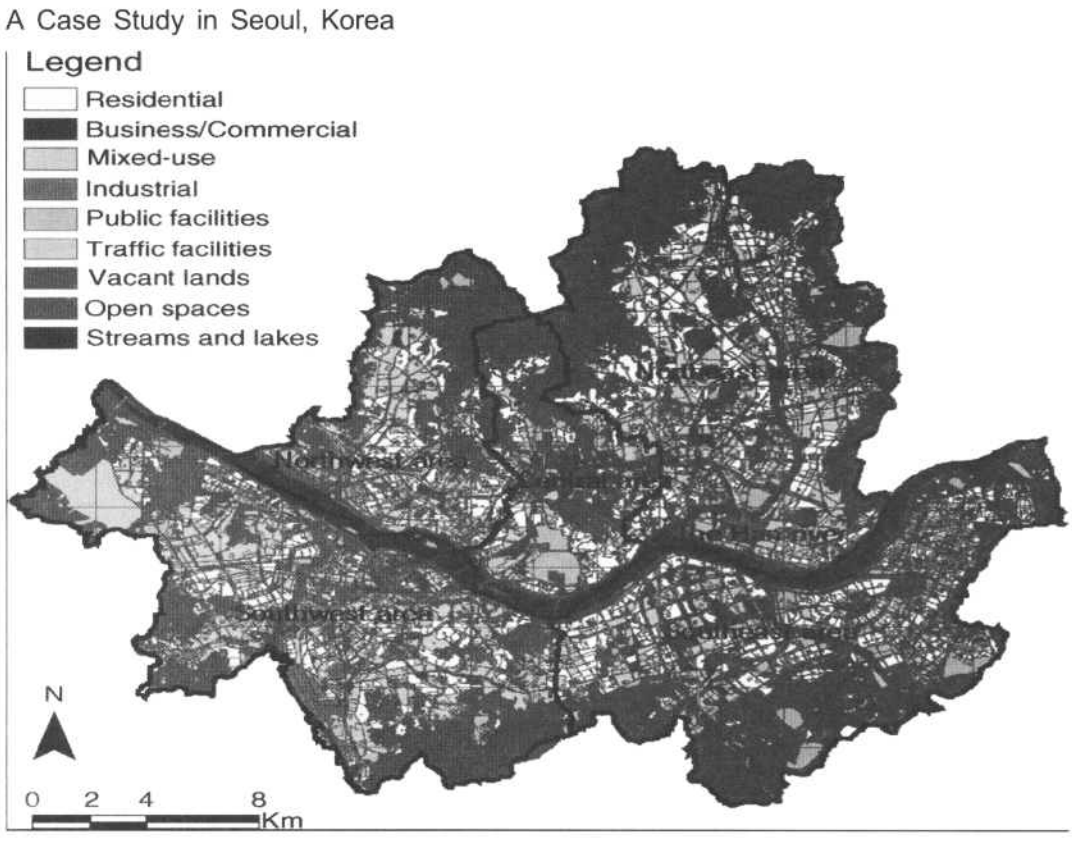

Figure 3 : The Study Area.

Source: Oh and Jeong (2007)

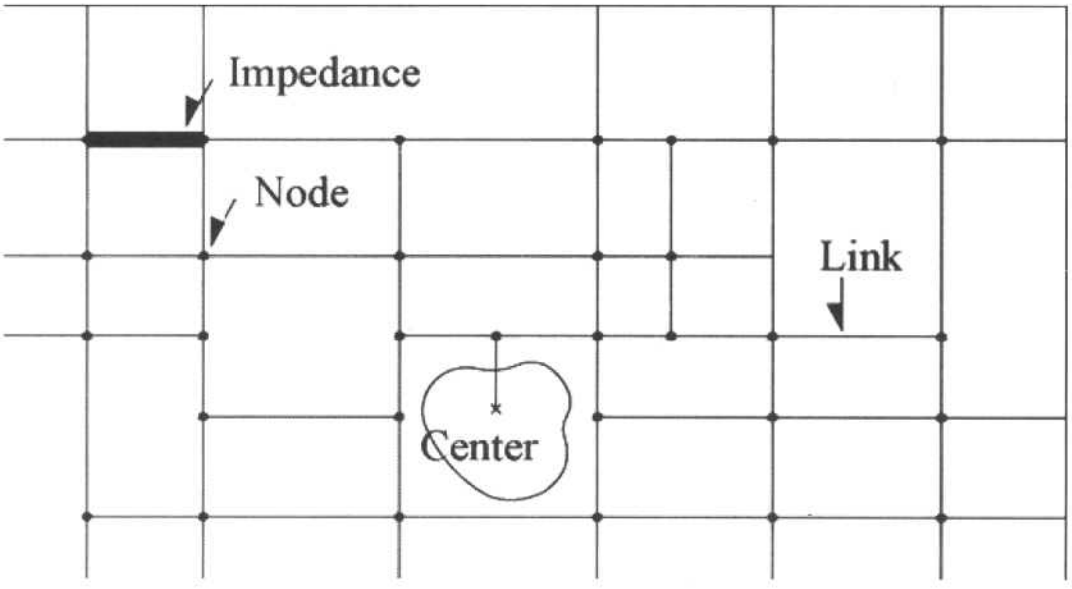

Figure 4 : The Network Analysis as a Useful Tool in Research about Green Area.

Source: Oh and Jeong (2007)

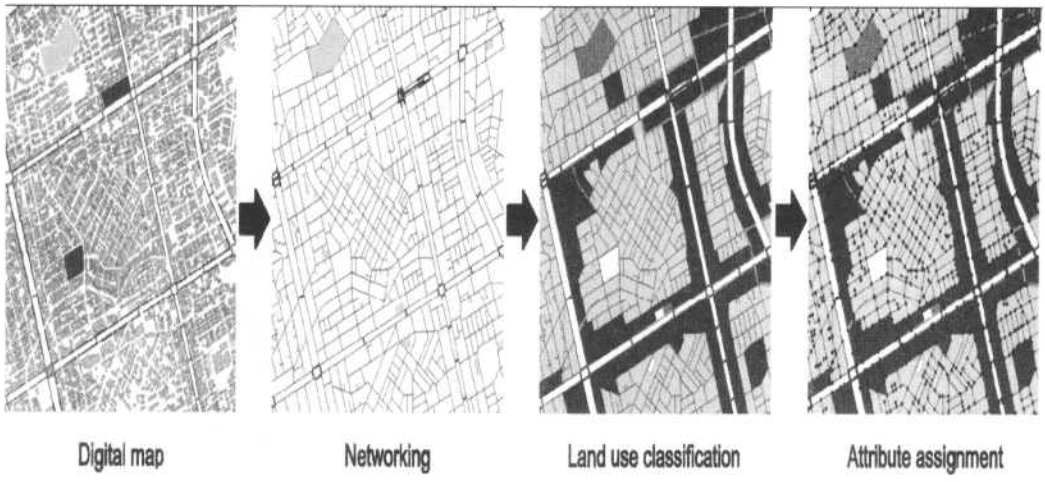

Figure 5 : Data Preparation Process.

Source: Oh and Jeong (2007)

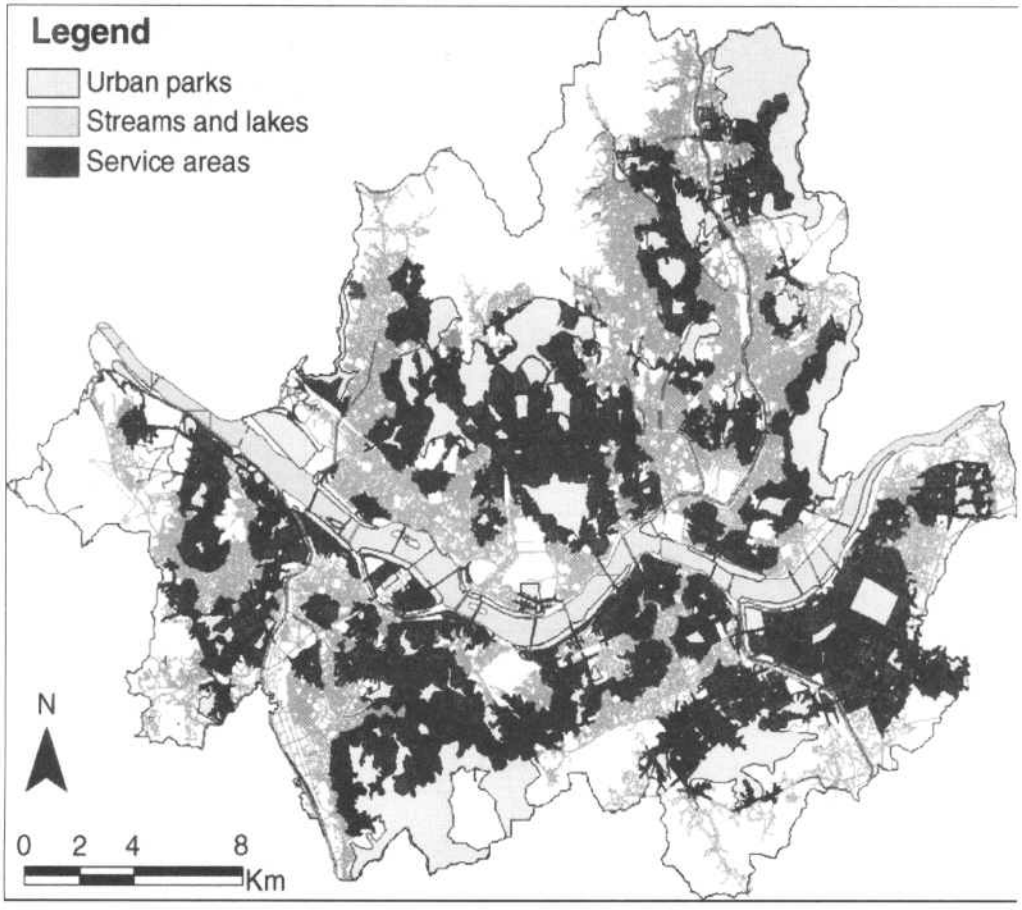

Figure 6 : An Example of Result Analyzed Urban Park by Network Analysis:

A Case Study in Seoul, Korea.

Source: Oh and Jeong (2007)

A Cast Study in the Eastern Cape, South Africa

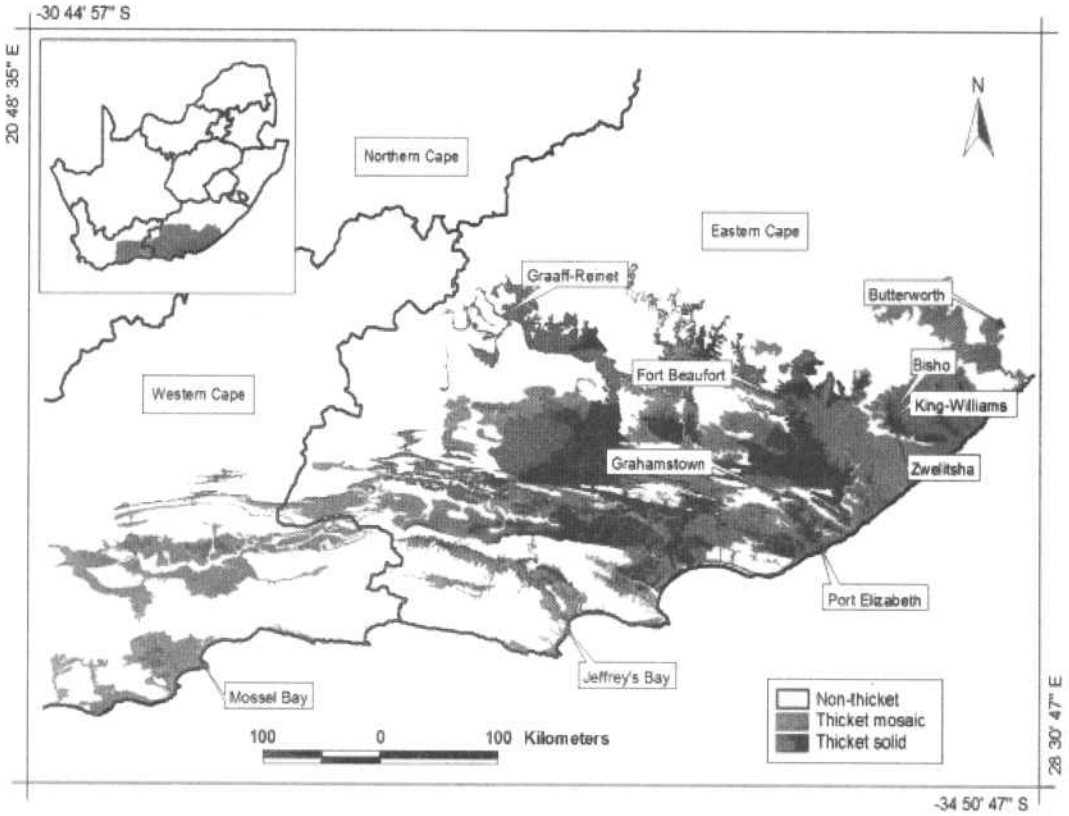

Figure 7 : The Location of the Study Sites within the Sub-Tropical Thicket Biome

Source: Matthew et al. (2008)

Table 1 : Total and Proportionate Sizes of Green Space

Town	% Green space	Total green space area (ha)	Green space per capita (m^2)	Total area (ha)	No. of green spaces	Mean size of green space (ha)
Bisho	6.2	22.4	11.6	360.2	26.0	0.86
Butterworth	7.3	59.7	12.8	822.3	44.0	1.36
Fort Beaufort	11.2	72.3	28.9	644.0	48.0	1.51
Graaff-Reinet	12.0	87.4	23.6	725.7	77.0	1.14
Grahamstown	13.9	246.6	43.2	1774.8	128.0	1.93
Jeffrey's Bay	15.2	119.8	68.9	789.2	45.0	2.66

Town	% Green space	Total green space area (ha)	Green space per capita (m^2)	Total area (ha)	No. of green spaces	Mean size of green space (ha)
King-Williams	9.3	73.4	51.8	786.1	56.0	1.31
Mossel Bay	10.8	144.5	30.9	1336.5	96.0	1.51
Port Alfred	13.1	120.6	71.5	917.8	47.0	2.66
Zwelitsha	6.6	23.8	21.6	361.9	13.0	1.83
Mean	10.6	97.0	36.5	8518.5	58.0	1.68
S.E.	0.9	20.9	6.8	135.0	10.7	0.20

Source: Matthew et al. (2008)

Conclusions

Previous studies about green area are typically used documentary data such as statistic data, census data, land uses, and development density etc. Numerous studies have shown that Geographic Information System (GIS) can be applied to study about green area. The Previous studies technology utilized in this topic can be useful in helping to understand spatial distribution of green area, more actually locations and to establish effective policies on green area management. More over, we can use it for designing, maintenance, and multiple using. Consequently, it could be of help in the decision process related to economic, social and environment for efficient management.

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