

# Distribution Pattern Analysis of Green space in Al-Madinah Using GIS

Haifaa Al-Ballaa<sup>1</sup>, Alexis Comber<sup>2</sup>, Claire Smith<sup>3</sup>

<sup>1</sup>Department of Geography, University of Leicester, Leicester LE1 7RH, UK  
Tel. (00441162523823) Fax (00441162523854)  
Email, [ha169@le.ac.uk](mailto:ha169@le.ac.uk)<sup>1</sup>, [ajc36@le.ac.uk](mailto:ajc36@le.ac.uk)<sup>2</sup>, [cls53@le.ac.uk](mailto:cls53@le.ac.uk)<sup>3</sup>

**Summary:** parks and green spaces provide important services to individuals and communities in terms of recreation, exercise and sport. This study will examine the population distribution in the province of Madinah and accessibility to green spaces using GIS. In addition, an exploration will be made of alternative solutions for ensuring fair distribution and accessibility.

**KEYWORDS:** Green space; GIS; accessibility; Spatial Analysis

## 1. Introduction

Green spaces and parks are of great importance both for ecological balance and for the health of individuals. They play a fundamental role in providing opportunities for rest and relaxation and enjoying the beauty of nature for the urban population. Hence, this study will examine the distribution and analysis of ease of access to public parks for all categories of the population using (GIS). When there is a significant increase in population and urban growth in a region, the need for public places of recreation increases. For example, in Britain, the area dedicated to national parks and green areas is in the region of 10,000 square miles or 17% of the total area of England and Wales (Cullingworth, 1972). Increasing rates of urbanisation in Madinah have led to increased pressure on many of the services and facilities, especially green spaces and gardens which are a key requirement for high density neighbourhoods.

This study will evaluate the equity of the distribution of public green spaces and their accessibility. In this way this research will consider problems that some public parks are experiencing which relate to location, size or suitability for their local population.

## 2. Background and Literature Review

Many studies have addressed the subject of green spaces, their accessibility, and economic importance (Comber, et al, 2008). These show the relationship between the distribution of green spaces and the road systems linking them with residential neighbourhoods, as well as how ease of access to a particular site can be measured by the cost of the trip or its duration. Green spaces are important for improving air quality and reducing levels of carbon dioxide and other pollutants; they also beautify the environment, create a soothing atmosphere, and protect people from the glare and heat of the sun (Kiichiro, 2011). In another study, Chang & Liao (2011) focused on assessing the spatial distributions of public parks and their accessibility.

Access to urban green space is important. According to Hillsdon et al (2009), a relationship exists between access to urban green space and the recreational and physical activity levels of local inhabitants. (Hackney, 2004) indicated the importance of the distribution of, and admission to, public parks, in relation to the need to identify population density when assessing access to public parks.

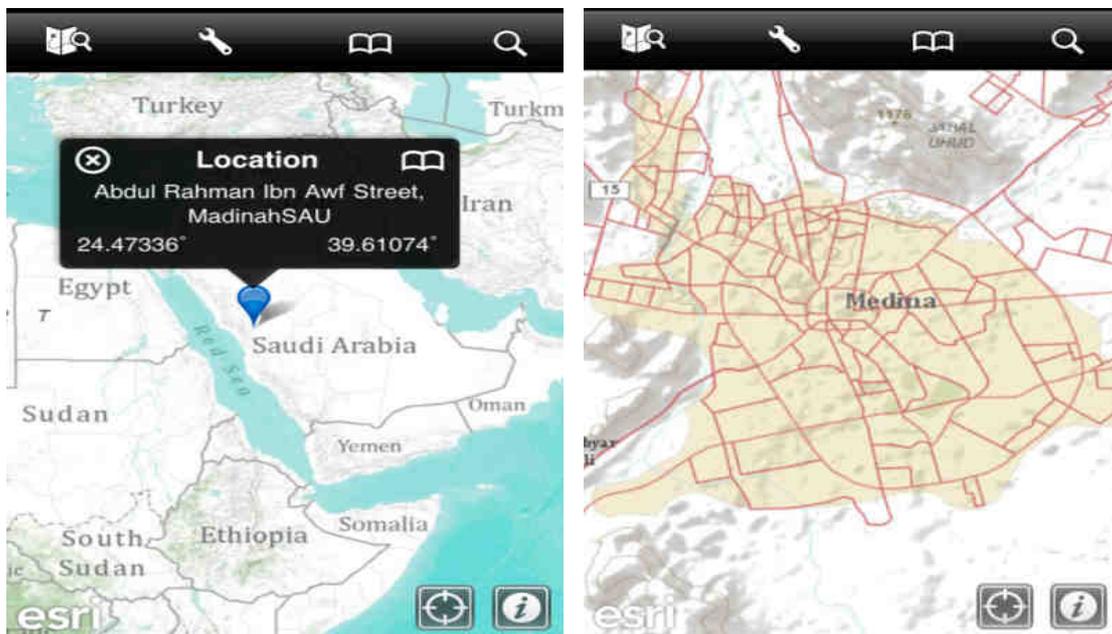
Many studies have focused on ease of access to green spaces, including de Vries et al, (2000) research which examined residents' needs and their selection of a neighbourhood which is close to services for easy access.

Recently, the benefits of green infrastructure (GI) have been widely promoted, and interest in the potential ecosystem services they provide has stimulated GI research in a range of environments . Comber, et al. (2008) analysed green spaces in England using GIS; introducing a general method to measure the differences occurring in society and to provide the services that are available to them. They described the actual use of services within various recreational parks in references to available services; highlighting the importance of spatial analysis in providing easy access to the best methods available (Comber et al, 2011).. In the case presented in this research the theoretical basis for the initial distribution of parks in the study area can be based on spatial distribution and the use of geographic information systems. According to Hillsdon et al. (2009) there is a relationship between access to urban green space, recreational and physical activity levels of individual and the relationship between them This research will be discovering if there distribute fair or not in Al-Madinah of Green space

### 3. Method

#### Study area

Al-Madinah is located in the north western part of central Saudi Arabia. Its position is: longitude 39°, 36; latitude 24°, 28 (figure 1). It has a population of approximately 1.6 million (Department of Statistics in Riyadh, 2008).



**Figure 1.** Location of Madinah for the Saudi Arabia ArcGIS Mobile

## The Data Sources and Network Analysis

The data for this study was collected from the following sources:

**Table1.** The data sources

Data & maps	shapes	sources
Road maps	Shape file (line)	Al-Madinah Municipality
Neighborhoods' maps	Shape file (polygon)	Al-Madinah Municipality
Green space maps	Shape file (point)	Al-Madinah Municipality
population data	Excel file	Al-Madinah Municipality
Location Al-Madinah	Photos	Geo Mobile & ArcGIS Mobile

There are a number of parks in AL-Madinah almost 47 distributed to 102 on neighborhoods, based on the analysis of data collected from many sources, using the map of the road network and the distribution of the neighborhoods and Greenspaces. It has located them using the results of the analysis OD. It is connected with the polygons for the analysis of people accessibility in the following format:

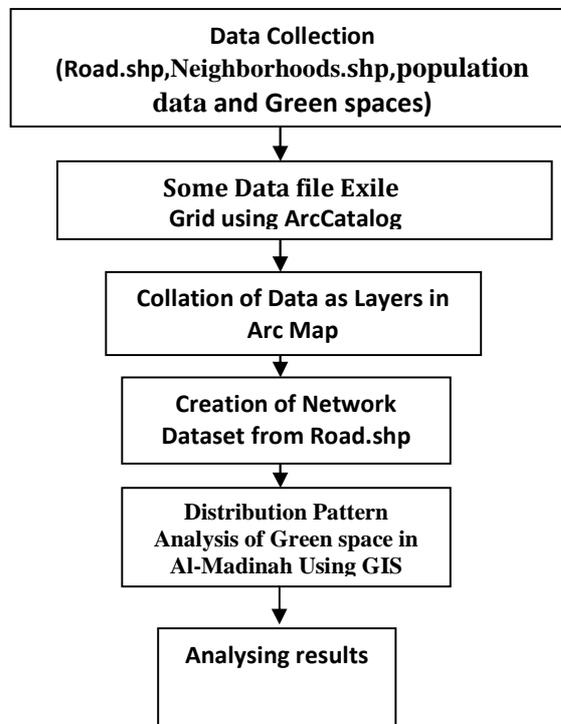
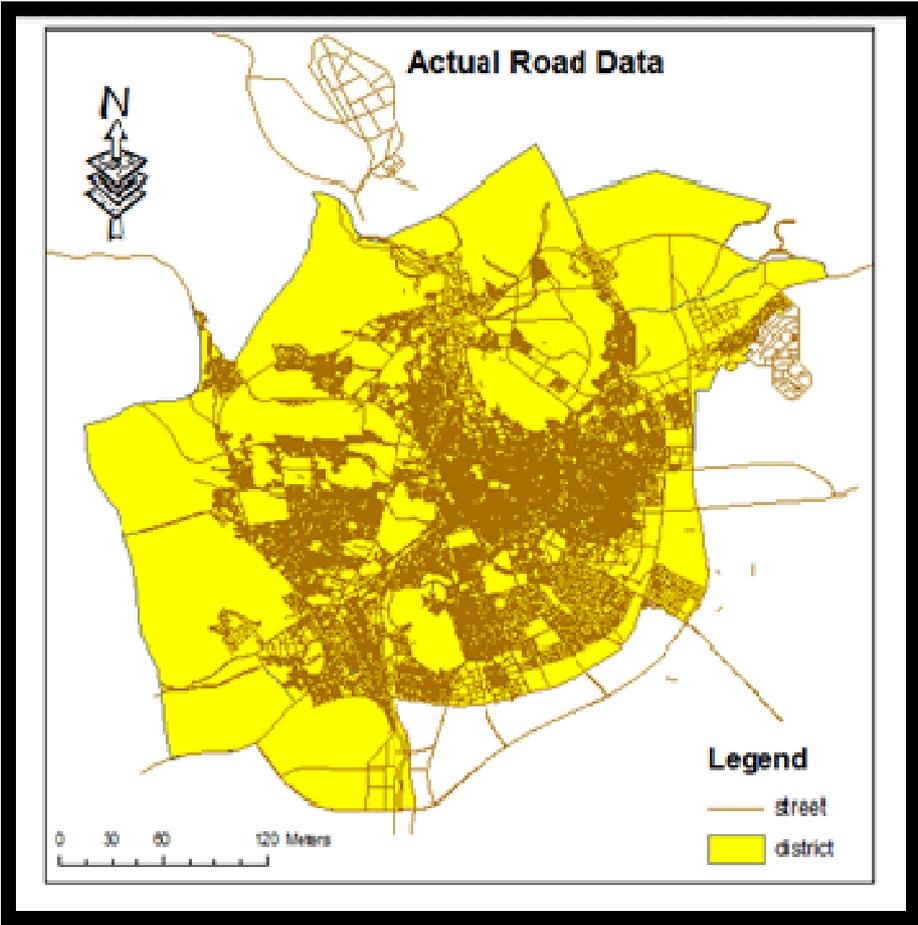
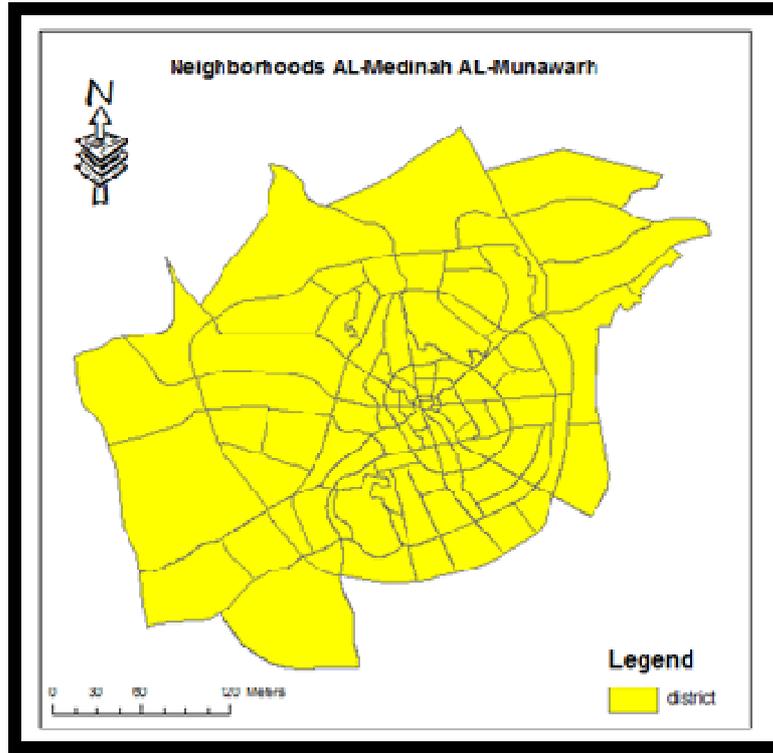


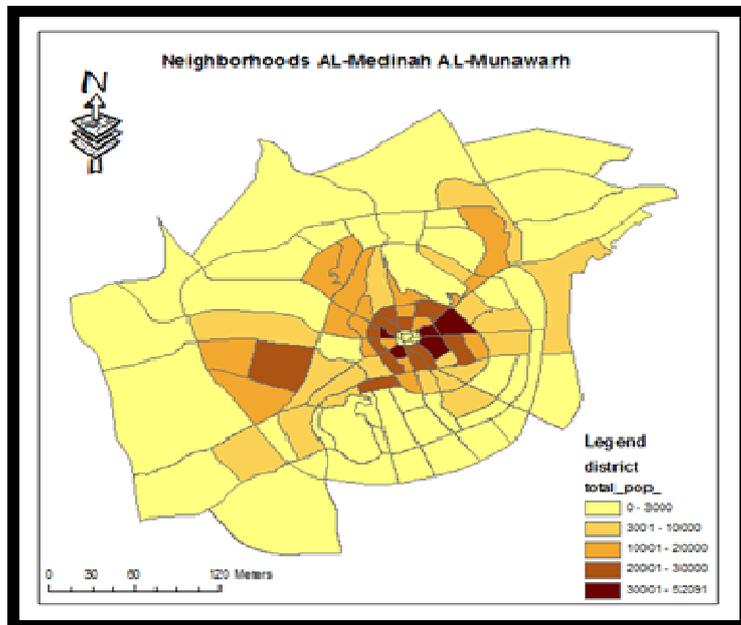
Figure 2 shows the network of roads in the study area serving all neighbourhoods. Figure 3 illustrates the distribution of 102 neighbourhoods in the study area. Figure 4, shows the distribution of population. Based on the it is clear that the population is largely concentrated in the central region, while a smaller proportion of the population l in the periphery, as shown in figure 4 .



**Figure 2.** Actual Road in Al- Madinah



*Figure 3. Neighborhoods in Al-Madinah*



**Figure 4.** Total Population in AL-Madinah

#### 4. Results

Visual analysis and result from GIS spatial query from greenspace map (see Figure 6 and 7) indicate that distribution of green spaces in the neighbourhoods is uneven. For example, the gardens of King Fahd have a dense concentration of green spaces Square kilometers almost (79%), while other neighbourhoods are completely deprived of any.. Furthermore, transport is very cheap compared with Europe.

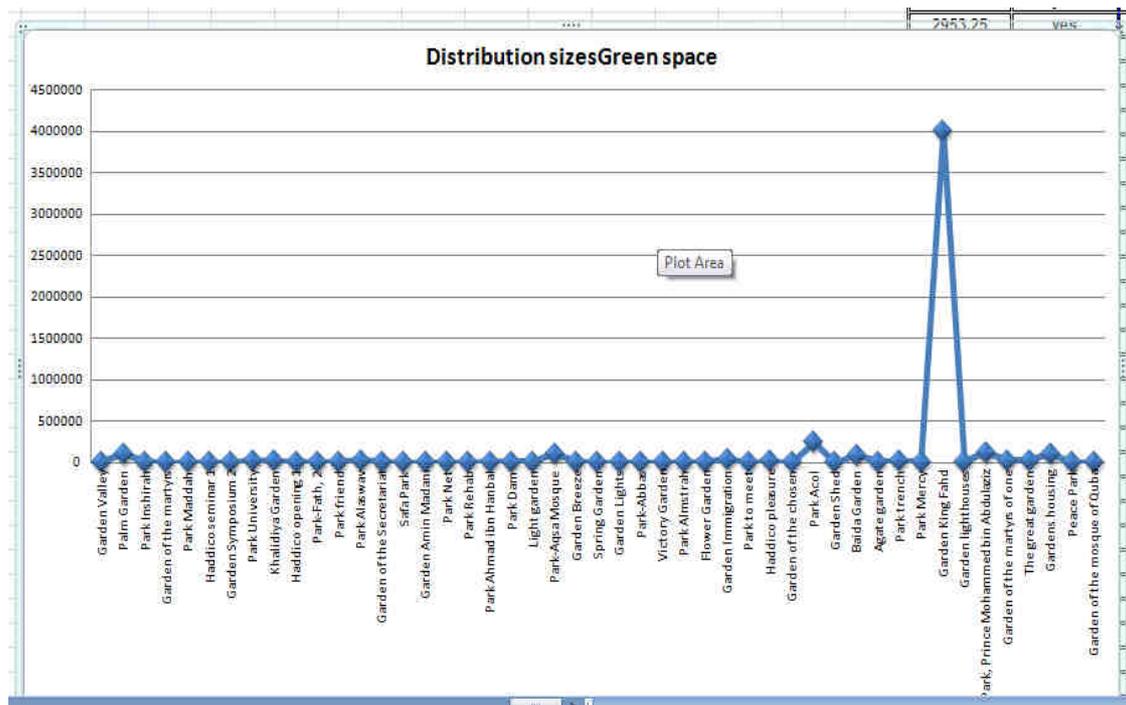
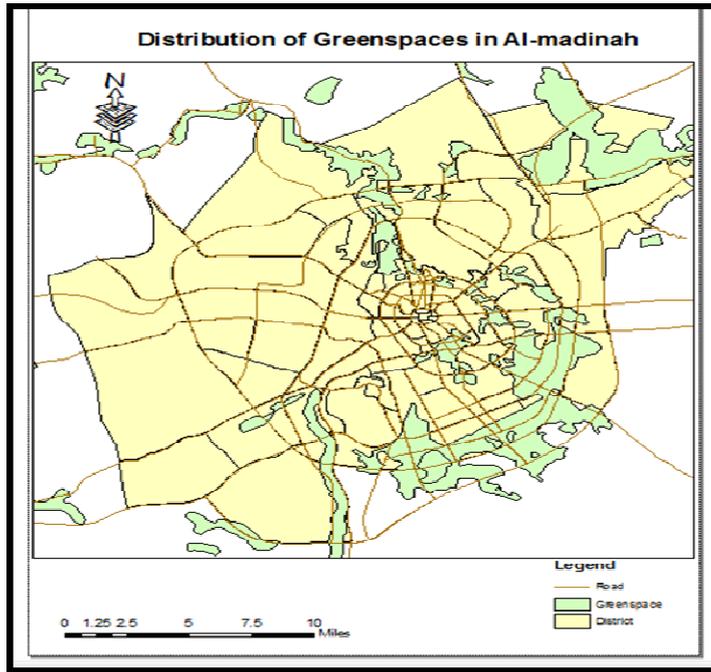
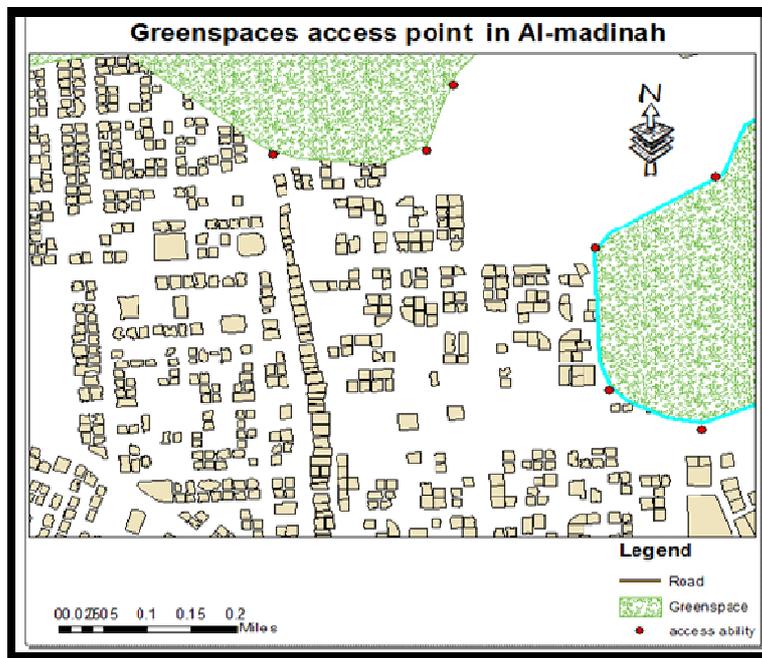


Figure 5. Percentage distribution of green spaces within each park

As illustrated in Figure 5, the King Fahd district includes several gardens in close concentration, which indicates the uneven distribution of parks in the area. According to the Municipality of Madinah (2010), the number of public parks is 47; in addition, more than 90 green spaces are distributed throughout the city. Arc GIS were used to analyse the distribution of gardens and green spaces (figure 6). The results of analysing the spatial distribution of green spaces indicate gaps in the provision of green space, and potential locations that may have low levels of that accessibility. Ongoing research is seeking to quantify inequalities in green space accessibility and will suggest spatial planning strategies that specifically address .



**Figure 6.** Distribution of green space



**Figure 7.** Greenspace access points

## 5. Acknowledgements

The author of this study would like to thank the General Secretariat of Municipalities in Al-Madinah and for the data they provided.

## 6. References

- Chang, H. & Liao, C (2011). Exploring an integrated method for measuring the relative spatial equity in public facilities in the context of urban parks. *Cities*, 28(5), pp.361-371.
- Chapin, F. et al (2002). Urban Land Use Planning. University of Illinois, Press Urbana.
- Chiesura, A (2003). *The role of urban parks for the sustainable city*, Department of Leisure, Tourism and Environment, Wageningen University, The Netherlands.
- Comber A.**, Brunsdon, C. and Radburn, R. (2011). A spatial analysis of variations in health access: linking geography, socio-economic status and access perceptions. *International Journal of Health Geographics*, 10:44
- Comber, et al (2008). Using a GIS-based network analysis to determine urban green space accessibility for different ethnic and religious groups. *Landscape and Urban Planning*, 86(1), pp.103-114.
- Comber, et al (2009). Using a GIS-based network analysis and optimisation routines to evaluate service provision: a case study of the UK post office Applied Spatial Analysis and policy, 2(1), pp.47-64.
- Comber, et al (2011). A modified grouping genetic algorithm to select ambulance site locations. *International Journal of Geographical Information Science*: 25(5) p.807.
- Corcoran et al, (2007), The use of spatial analytical techniques to explore patterns of fire incidence: A South Wales case study, *Computers, Environment and Urban Systems*, 31, ( 6), Pp 623-647 .
- de Lope, J. & Maravall, D( 2001). Landmark recognition for autonomous navigation using odometric information and a network of perceptions. *Bio-Inspired Applications of Connectionism*, LNCS 2085. J. Mira, A. Prieto (Eds.) Springer-Verlag, Berlin Heidelberg, pp.451-458.
- Gutierrez, J. P. & Rafael E. G. A (2001). *A Study of Train accessibility Using GIS*.
- Hackney Open Space and Sports Assessment (2004). *Final Open Space Assessment Report*; 1. [online] Available at: <http://www.hackney.gov.uk/ep-open-space.htm>, [Accessed 23/10/11].
- Hillsdon, et al (2009). The relationship between access and quality of urban green space with population physical activity. *Public Health*; 120(12), pp.1127-1132.
- J.B.Cullingworth (1972). Problems of an urban society. London: Ruskin.
- Jacob J. de Vries et al*,( 2000),Alonso's General Theory of Movement: Advances in Spatial Interaction Modeling, Available online at <http://www.tinbergen.nl/uvatin/00062.pdf> [Accessed 18/11/11].
- Kong, F, et al (2005). *Using GIS and landscape metrics in the hedonic price modeling of the amenity value of urban green space*. [online] Available at: <http://www.sciencedirect.com/science/article/pii/S0169204606000466> [Accessed 23/10/11].
- Kumagai, K (2011). Verification of the analysis method for extracting the spatial continuity of the vegetation distribution on a regional scale. *Original Research Article, Computers, Environment and Urban Systems*; 35(5), pp.399-407.
- Longley, Paul, (1996), Spatial analysis: modeling in a GIS environment , pp 1-21 .
- Onder, S. et al (2011). The evaluation of existing and proposed active green spaces in Konya Selçuklu District, Turkey. *African Journal of Agricultural Research*; 6(3), pp.738-747.
- The Commission for Architecture and the Built Environment (2009). *Making the invisible visible: the real value of park assets*, CABE Space/Elizabeth Hoehnke, Barry Quirk CBE, London

## **7. Biography**

Haifaa Al-Ballaa <sup>1</sup>: PhD student in Human Geography & GIS, Department of Geography, University of Leicester. Research interests in the distribution pattern analysis of public parks in Al-Madinah using GIS techniques.

Alexis Comber <sup>2</sup>: Senior Lecturer in Geographic Information, Department of Geography, University of Leicester. Research interests in two primary areas: issues associated with uncertainty and representation in spatial data and the use of spatial analyses to evaluate policy.

Claire Smith<sup>3</sup>: Lecturer in Climate Change Adaption, Department of Geography, University of Leicester. Research interests primarily associated with the interaction between atmospheric change and the local environment.