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The integration of GIS into demographic surveying of informal settlements: The case of Nelson Mandela Bay Municipality, South Africa

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ABSTRACT

A number of informal areas in Nelson Mandela Bay Municipality, South Africa have experienced rapid expansion over the past decade. Census data available for these areas is outdated and does not provide enough information for local authorities to plan tasks such as service delivery management and resource allocation. In this study, a GIS based demographic study of informal settlements within Nelson Mandela Bay was undertaken. The study aimed to significantly improve the collection, analysis, interpretation, display and management of demographic survey data and provide the accurate and necessary updates required between census collections. Data relating to informal settlements were captured from 1996 aerial photographs and 2007 satellite imagery, and demographic data were collected from field surveys.

Specific demographic trends identified through spatial analyses included a 71% and 109% decline and increase in informal and formal dwellings respectively. A significant increase in backyard shacks paradoxically came with the development of many formal structures in settlements. The capture and collection of data at household level and creation of customized boundaries for informal settlements facilitated analyses independent of any fixed set of areal units. The study concluded that GIS based demographic studies are vital for providing the necessary updates to decennial censuses for municipalities, particularly in urban environments of developing countries.

Introduction

The collection of demographic data for a population is vital for giving a comprehensive report of the social and living conditions within a city. The data are commonly collected in the form of a nation-wide census, conducted every five to ten years. One of the greatest strengths of a census is the provision of detailed population figures at local level. This information is of particular importance in the more informal settlements within a city and needs to be collected on a far more regular basis than for formalized, developed areas (Barry & Ruther, 2005). The way in which demographic data are collected, analyzed and interpreted is crucial in gaining an understanding of the needs of local communities. Geographical Information Systems (GIS), although underutilized by many of today's social scientists, can provide strategic display and analysis capabilities for interpreting and managing demographic and socio-economic survey data (Brown, 2003). In the past couple of years, there has been a move towards what is known as 'demographic information systems', a combination of population information and selected GIS functionality. Although this approach stresses the importance of the geographic dimensions of population analysis, it has been argued that the potential for the application of GIS techniques in socio-economic studies has not yet been fully realized (Martin, 2003).

A number of mostly informal settlements in Nelson Mandela Bay Municipality (NMBM), South Africa have experienced rapid expansion over the past decade. Two of the major contributing factors for their development are rapid urbanization, and the inadequate ability to cope with the housing needs of urban migrants. Census data available for these areas are outdated and do not provide enough information for local authorities to accurately plan for tasks such as resource allocation and service delivery management. Demographic studies have been undertaken in some of these areas in the past, but none have provided the spatial

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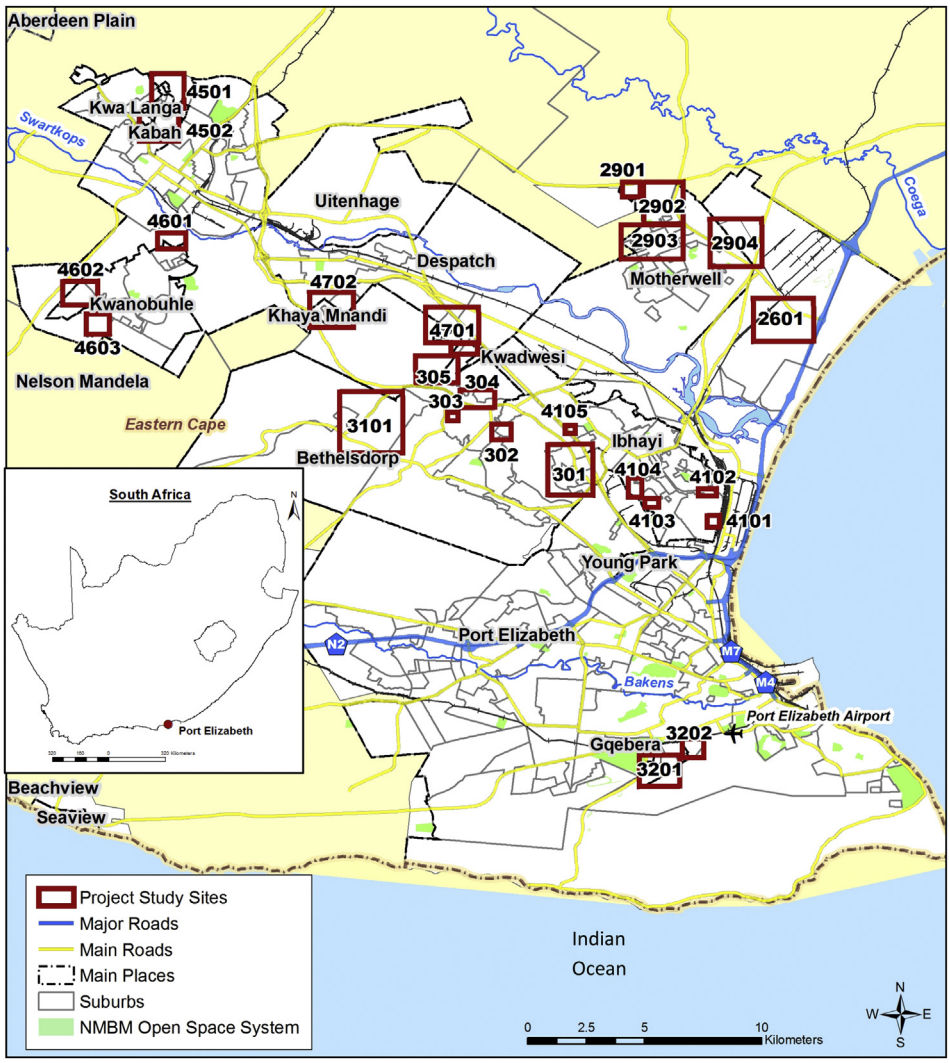

Fig. 1. Sites of considerable dwelling change in Nelson Mandela Bay Municipality.

information that is critical to effective planning and management of situations in which informal settlements occur (Barry & Ruther, 2001). Although GIS tools can provide powerful analysis and display capabilities, there still seems to be a lack of integration of this technology in demographic and socio-economic surveying, not only within NMBM, but in a number of cities in South Africa and other developing countries. Weeks (2004) points out that population studies that include a spatial component have not occupied a significant space in major demography journals, and spatial demography is virtually ignored as part of the regular training of future professionals in the field. Many social science studies focus on social, economic, cultural and survey data that have limited or no spatial question associated with them (Steinberg & Steinberg, 2006).

According to Matthews (2003), spatial demography was listed as a priority area of the Demographic and Behavioural Sciences Branch (DBSB) as evidenced by the 2002–2006 "Goals and Opportunities" report. In fact, the recent combination of population information and GIS functionality has been identified as 'demographic information systems' and is commonly known as 'Geodemographics' (Harris, Sleight, & Webber, 2005). The current integration of GIS technology in social science research could be attributed to the improved access and availability of spatial data and improvements in GIS technology. As noted by Matthews (2003), recent years have seen a rapid growth in interest in the addition of a spatial perspective to population research. This growth has in part been driven by the ready availability of geo-referenced data, and the tools to analyze and visualize them. Similarly, Martin (2003) also observes that the most basic requirement for the growth of socio-economic applications for GIS technology is the supply of large volumes of suitable spatially referenced data, which are rapidly developing. Current and future opportunities for the application of GIS in the social sciences are tremendous; the surface has just been scratched (Steinberg & Steinberg, 2006) and further advances are likely to emerge in the coming years (De Castro, 2007).

Some of the biggest problems facing the integration of GIS technology into social science research are the Modifiable Areal Unit Problem (MAUP) and ecological fallacy. These issues surround the use of discrete spatial neighbourhood boundaries to map

Table 1
GPS data dictionary.

Entity	Feature	Field	Attribute
Point	Households	Unique key Dwelling type	Number e.g. A6012 Formal dwelling, Informal dwelling or backyard shack