

**CHAPTER 3**

**GEOGRAPHICAL INFORMATION SYSTEMS (GIS) AND POLICING IN  
SOUTH AFRICA: A REVIEW**

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## **ABSTRACT**

This paper explores the developments which have precipitated the use and integration of Geographical Information Systems (GIS) within the South African Police Services (SAPS). The paper provides a historical overview of GIS within South Africa, supplemented with the legislative origins of the integration of GIS within policing in the country. Various geo-analytic operations that GIS technology affords are highlighted to illustrate the potential that the technology offers to law enforcement agencies in South Africa. GIS is envisaged as a tool to benefit the criminal justice community by playing an important role in the policing and crime prevention process, this paper identifies the major inhibitors to the potential offered by GIS to supplement policing within a South African context.

## INTRODUCTION

The reduction of crime is one of the major challenges facing South Africa. Crime has reached epidemic proportions with annual crime figures in the preceding decade continually revealing inclining broad national trends on most crime types. The crime statistics released by the South African Police Services (SAPS) in 2003 indicate that crimes such as murder, rape and hijacking are decreasing in general. These national trends however conceal vast regional differences with densely populated areas such as the Western Cape, experiencing a 35% increase in murders and a 65% increase in housebreaking (Gouws, 2004). In Gauteng, the economic hub of South Africa, incidences of assault, armed robbery and hijackings are on the increase, and more violent serial offences such as murder remain stable but high by international standards. An important impact of crime is its effect on society. The social welfare costs of crime are less tangible than perhaps the economic costs. Nevertheless these costs accrue as a rise in crime precipitates the development of various social phenomena such as the increasing urban occurrence of ‘closed neighbourhoods’ and ‘gated communities’, which since the 1990s have experienced phenomenal growth in South Africa (Landman and Schönsteich, 2002). Such urban developments fuel further negative public sentiment regarding the South African government in general, and the SAPS, in particular. Local researchers emphasise the role of economic (eg. Glanz, 1990; Demombynes and Özler, 2005), social (eg. Schurink, 1976; Louw and Parry, 1999) and demographic (eg. Redpath, 2002; Standing, 2003) variables as determinants of the high crime rate, but besides highlighting certain criminogenic risk factors, these studies don’t propose any technologically tangible solutions to the scourge of crime. With mounting crime levels remaining one of the key challenges

facing South Africa, Geographical Information Systems (GIS) are envisaged as tools to facilitate policing through crime mapping and analysis. Internationally, GIS has been widely utilised to supplement crime-fighting strategies (eg. Wendelken, 1995; Hirshfield *et al.*, 1995; Bowers *et al.*, 2004; Ashby, 2005; Ashby and Longley, 2005); locally, however, the question remains whether South Africa, and the SAPS, have the necessary Geographical Information (GI) infrastructure, capacity and knowledge required to supplement the policing process.

This article is structured into four main sections. The first section provides a brief history of GIS and policing within South Africa. The second section outlines the legislative developments that led to the integration and implementation of GIS within the SAPS. The third section of the paper highlights future possibilities of the application of GIS in local crime fighting initiatives. The paper concludes by identifying certain critical success factors for the SAPS if the potential of GIS to supplement policing is to be fully realised.

### **A BRIEF HISTORY OF GIS IN SOUTH AFRICA**

Zietsman (2002, p.34) reports that despite numerous initiatives by international and local institutions, GISes “have not really penetrated Africa to any significant degree” with van Teefelen and Kwant (1999) reporting only 1,3% of all licensed GISes being located in Africa. South Africa has always been considered more progressive than other African countries in terms of their use of information and communications technology (Saint, 1999) and this has partly contributed to the more rapid growth of GIS in South Africa than in other parts of Africa. The 1980’s in South Africa were

characterised by a general lack of awareness in national and provincial governmental departments regarding what spatial data was available as well as what capabilities GIS offered in practice (Schwabe *et al.*, 1997). This lack of awareness has since dissipated, in part, through the provision of a mandate, in the 1990's, to state institutions such as the Chief Directorate: Surveys and Mapping and the Chief Surveyor-General of South Africa. These institutions were tasked with driving the growth and development of GIS in South Africa and currently play a vital role in providing a basic geospatial framework for data (Zietsman, 2002). The availability of large-scale population datasets and the proliferation of open source desktop mapping systems in the 1990's have resulted in GIS becoming a fast-growing industry in South Africa. The technology is currently being harnessed by government, semi-privatised institutions, and the private sector for research, planning as well as business purposes. Although several years behind first world countries, GIS has developed along similar lines in South Africa (Schwabe, 2001). The initial use of the technology lay in the environmental field before being 'discovered' by larger metropolitan areas and municipalities who saw the value of GIS for managing their information and infrastructure (Schwabe, 2001). The application of GIS technology in South Africa has provided the country with a crucial link to developments in international spatial mapping technology (da Cruz, 1999) and become a pivotal decision-making tool in a variety of application areas, including health (eg. Davids, 2002; Martin *et al.*, 2002), social welfare (eg. Ashton *et al.*, 1995) and the more recently, crime (eg. Lochner and Zietsman, 1998; Redpath, 2001; Erasmus and Mans, 2005).

## **LEGISLATIVE ORIGINS OF THE INTEGRATION OF GIS WITHIN THE SAPS**

Two main policy documents have governed policing in South Africa since the inception of the African National Congress (ANC) government in 1994. They are the National Crime Prevention Strategy (NCPS) of 1996 and the National Crime Combating Strategy (NCCS) of 2000. These strategies were intended to ensure that crime levels were stabilised during the transformation process (Department of Safety and Security, 2003) and represent the legislative origins of the integration of GIS within policing in South Africa.

### **The National Crime Prevention Strategy (NCPS)**

The South African cabinet adopted the National Crime Prevention Strategy (NCPS) in May 1996. The NCPS was the first official document of the new democracy that attempted to advocate a macro-strategy towards crime; and aimed at shifting the emphasis from reactive ‘crime control’ towards proactive ‘crime prevention’ (NCPS, 1996). The NCPS was based on a four pillar approach to crime prevention that included the reforming of the criminal justice system; changing the public’s values and attitudes to crime; reducing crime through environmental design; and combating transnational crime. Sweeping as the strategic framework of the NCPS may have been, researchers (see Simpson and Rauch, 1999) were soon critical of the overly strong focus on policy and the lack of implementation of the strategy (van der Spuy, 2001). As a discursive framework and operational strategy the NCPS did however have some lasting influences including the establishment and implementation of various crime prevention projects throughout the country (van der Spuy, 2001). From

a GIS and policing perspective, the most pertinent project was an undertaking by a consortium comprising of three semi-privatised institutions, the Council for Scientific and Industrial Research (CSIR), the Human Sciences Research Council (HSRC) and the Medical Research Council (MRC). The project was funded by the South African Department of Arts, Culture, Science and Technology (DACST) and was tasked with enhancing the capability of the SAPS through, among others, developing and piloting innovative analytical methods and decision support systems (DSS) tools (Stylianides, 2000). A key activity in the project was a pilot study initiated by the SAPS's Crime Information Analysis Centre (CIAC) together with a project team comprising of all consortium members. The pilot study was conducted within the Johannesburg area and involved utilising GIS within the following types of crime mapping and analyses (Stylianides, 2000):

- Mapping the types of crime per Crime Administration System (CAS) block<sup>1</sup>
- Identifying weekly variations of crime
- Pin-mapping of priority crimes
- Correlating hijackings of vehicles with recoveries of vehicles
- Mapping crime according to time-of-day and day-of-the-week per CAS block
- Generating mosaics of CAS blocks according to magnitude of the given crime
- Identifying 'hot spots' of crime.

Detailed reviews of the work done in the Johannesburg area pilot study are provided by Cooper *et al.* (1998); Schmitz *et al.* (1999) and Stylianides (2000).

The pilot study was the first time the SAPS had utilised GIS technology in practice and represented somewhat of a watershed in the development and integration of GIS within policing in South Africa. Included in the pilot study was the informal training

in November 1998 of a handful of police officers in the techniques utilised in the pilot study as well as in the software used to create the maps and to do the analyses. Output from the pilot study conveyed spatially based insight into the development of criminals and allowed the SAPS to observe other direct benefits of utilising GIS such as cost savings, staff savings, savings in storage space and the ability to produce customised maps immediately on request (Schmitz *et al.*, 2000). The project made the following additional significant impacts to the development of GIS within South African policing (Stylianides, 2000):

- The provision of training in databases and multivariate analysis to explain crime to researchers of the SAPS
- The development of a simulation model to assist the Johannesburg emergency police in the planning of their patrols
- The provision of crime mapping assistance to the Brixton Murder and Robbery Squad in Johannesburg in two cases of serial killing
- The use of crime mapping (cellular calls, crime scenes, *et cetera*) in two court cases in the Western Cape; including the successful conviction of two murderers and hijackers in the first case and of a murderer in the second case as a result of, *inter alia*, the evidence provided by the maps
- Workshopping with international geographical profiling expert Dr Kim Rossmo.

A final significant output of the project was the development of a national crime GIS database at a police station level. Approximately 1100 police station boundaries were captured into GIS and integrated with crime statistics from 1997 to 1999 and to socio-demographic information from the 1991 and 1996 censuses (Schwabe and Schurink,



2000). This development allowed the SAPS for the first time to link crime statistics with police station boundaries as well as allowing the SAPS to explore the relationship between crime types and socio-demographic variables through the use of multivariate statistical techniques (eg. Schurink and Schwabe, 2000). The study was completed on the 31 March 2000; with various key activities in progress including the provision of assistance to the State Information Technology Agency (SITA) for the rollout of a web-enabled GIS; and the development of a spatial information system to provide further information on crime.

A critical review of the NCPS was undertaken in 1999 (NCPS, 2000) in response to the ideas encapsulated in the White Paper for Safety and Security (1998). The White Paper advocated closer coordination of law enforcement and crime prevention; an expansion of partnerships; and moved towards a closer definition of the role of different tiers of government in respect of crime prevention (van der Spuy, 2001). The NCPS was renamed the National Crime Prevention Centre, and tougher legislation was sought to transcend the “nebulous philosophical disposition” that was the NCPS (van der Spuy, 2001, p.171-172).

### **The National Crime Combating Strategy (NCCS)**

The National Crime Combating Strategy (NCCS, 2000) was launched in April 2000 to guide operations and resources at a police station level. The NCCS adopted a more intelligence driven approach to policing and aimed to reduce crime in selected crime spots throughout the country which accounted for nearly 50% of all crime incidences (Nqakula, 2003). The NCCS advocated a ‘geographic approach’ in which areas affected by high crime rates, particularly violent crime, were clustered into ‘crime-

combating zones’, which were then targeted for aggressive high density street level policing (Mokonyane, 2000). One of the main steps taken in the initiation of the strategy was the continuation of assistance to SITA for the rollout of a web-enabled GIS and the mapping and analyses of crime at a police station level. The action resulted in the implementation of a GIS for crime pattern analysis at five police stations within Johannesburg in 2001. The GISes focused specifically on map searches; crime pattern analyses of plotted crimes; time and grid analyses of plotted crimes and was eventually rolled out to 340 priority police stations in 43 police areas covering almost 80% of the country (Committee of Safety and Security, 2004). The rollout came into operation upon the release of crime statistics in July/August/September in 2001. The SAPS enlisted 72 new data analysts and 600 data typists, as well as trained 1800 members to ‘increase the service’s ability to analyse crime information as well as to implement and utilise these systems (Streek, 2001). While GIS was a key tool in the implementation of this legislative strategy, it is difficult to evaluate the NCCS, and hence assess the rollout of GIS within the SAPS given the fact that no public document has ever been issued describing the strategy in any detail (Leggett *et al.*, 2003). There is also an alarming lack of documentation from the SAPS regarding the implementation and detailed operations of the GISes at these 340 priority police stations countrywide. An increase in crime levels and a lack of public awareness regarding new technologically driven crime intelligence initiatives would seem to suggest a slow start to the integration of GIS within the SAPS. Presently, the CSIR continues to provide assistance to the SAPS in developing its crime mapping and analysis capabilities as well as providing specialised analyses for detectives working on selected prioritised cases (Cooper *et al.*, 2001). A number of these cases have been presented at International Crime Mapping Research

Conferences held annually in the United States (US) (eg. Cooper *et al.*, 1999; Schmitz and Cooper, 2000; Cooper *et al.*, 2000; Cooper *et al.*, 2001; and Schmitz *et al.*, 2002). For examples of independent crime mapping research in South Africa consult Lochner and Zietsman (1998); Geldenhuys (2001); Redpath (2001); Redpath (2002); Weir-Smith (2004); Parker and Dawes (2003) and Erasmus and Mans (2005).

## **POTENTIAL GIS APPLICATIONS FOR USE BY THE SAPS**

The possibilities of utilising GIS to supplement local crime fighting strategies are unlimited. Harries (1999) describes the future of crime mapping as lying in integrating certain technologies within a GIS, such as GPS, orthophotography, digital photography, digital videography, the Internet and a wide range of local databases with relevance to policing. The following discussion proposes potential crime mapping possibilities for South Africa. It is noted that the possibilities mentioned may already be realities in a number of more developed countries; nevertheless, the challenges to their potential use and introduction within the SAPS are discussed.

### **Interactive Internet-based crime mapping**

South Africans today have access to more information about the country's crime situation than ever before (Du Plessis and Louw, 2005). Crime information is released on the SAPS' website annually and provide detailed levels of reported crime at a national, provincial, and police station level. Although extremely useful in monitoring and understanding the crime rate in the country, the tabular format of the crime data negates the geographic aspect inherent in criminal activity. A controversial type of information to which people have increasing access to is crime-related data and maps

on the Internet (Wartell and McEwen, 2001). These are often in the form of interactive Internet-based crime mapping websites offering spatial and statistical queries and analysis tools. Police departments in the US were the first to put crime maps on the web and there are currently many policing agencies that use web mapping technology to inform the public regarding crime patterns (GisLounge, 2001; Chainey and Ratcliffe, 2005). The dissemination of crime data on an Internet Map Server (IMS) can provide residents of a particular area with easy access to the vast database of crime information in the possession of the SAPS, and put crime into its spatial perspective. The result for the SAPS could potentially be a reduced work load, in that fewer calls can be made to the SAPS CIAC for data requests if the maps are readily available; the facilitation of partnerships with researchers and other agencies, and increased accountability for various police departments (Wartell and McEwen, 2001). The result for the government is a constituency better informed and aware of criminal incidents in their towns and cities. Lochner and Zietsman (1998) hypothesise about the possibility of geographically displaying South African crime data on-line. The researchers state that through the use of a GPS, crime locations and associated attributes can quickly be registered and then transferred to a GIS by means of a cellphone or data logger. The eventual aim being to have temporal and spatial crime data available on-line to aid planning and decision-making.

Residents working online should be able to access specialised mapping applications so that they can find out about crime in their area (Boba, 2005). In this sense interactive Internet-based crime mapping can be used as an effective communication tool between the SAPS and the public. Online initiatives can additionally empower community members to become involved in local Community Policing Forums (CPF)

where GIS has already been used to plot crimes and potential criminal activities in certain regions of South Africa (see Papenfus, 2005). South Africans can currently report crime online at the ‘CrimeStats’ website<sup>2</sup> which provides the opportunity for online users to view the levels and type of crime in a particular area of the country. A logical next step would be the provision of mapping functionality for the dissemination of crime information. The HSRC’s GIS centre in South Africa is in the process of developing a web mapping facility<sup>3</sup>, which will provide detailed crime statistics at a police station level for the entire country. For the moment however, this initiative is still in development and not yet operational. The US government’s Mapping and Analysis for Public Safety programme<sup>4</sup> provides useful online information on crime analysis and mapping information. For examples of websites displaying crime maps consult the Amethyst Information Hub<sup>5</sup>, Crime and Disorder Information Exchange (CADDIE)<sup>6</sup> and the City of San Antonio Police Department websites<sup>7</sup>.

### **Geographic profiling**

Geographic profiling is a progressive criminal investigative methodology with huge potential for policing in South Africa. This methodology was developed by Dr Kim Rossmo, and is an aspect of offender profiling, which focuses on determining the most probable area of an offender’s residence based on locations of a connected series of crimes (Canter *et al.*, 2000; Rossmo, 2000a). It is an analytical tool which is gaining ground worldwide in investigations of serial violent and sexual crimes and is being promoted as one of a set of tools to be used in South Africa (CSIR, 1999). In brief, crime locations are entered by address, (ie. latitude/longitude, or digitised) and are “analysed with a patented criminal hunting algorithm that produces a probability

surface showing likelihood of offender residence” (Rossmo, 2000a; Rossmo, 2000b, p.197). A range of geographic profiling strategies may be employed (see Snook *et al.*, 2005) and are inserted into a computerised geographic profiling system (ie. Rigel™ (Rossmo (2000a); Dragnet (Canter *et al.* (2000)) to produce a three-dimension probability map, or ‘jeopardy’ surface. This surface represents a topographical map indicating peaks and valleys colour ramped to highlight the areas most likely to be the residence of the offender. The greatest benefit of geographic profiling in police investigations is in its generation of a prioritisation of a large number of suspects (LeComber *et al.*, 2006). The addresses of known suspects are evaluated according to their ‘hit’ percentage on a probability chart (z-score histogram), which prioritises registered offenders or other known criminals (Harries, 1999). Prioritised suspects can then be further monitored using a range of investigative techniques (Rossmo, 2000a).

Geographical profiling is not a stand alone technique but should be used to supplement conventional policing strategies and tactics such as tip and suspect prioritisation, address-based searches of police record systems, database searches (eg. government and business databases, motor vehicle registration), patrol saturation, stakeouts, neighborhood canvasses, missing bodies and DNA screening prioritisation (Beauregard *et al.*, 2005; Rossmo, 2000a, 2000b; Krish, 2003). In 1999, a geographic profiling consultant conducted a workshop at the CSIR in Pretoria and presented the principles behind geographic profiling to a selected number of members of the SAPS and CSIR. Following the workshop, geographic profiling techniques were used to assist the CSIR and the Brixton Murder and Robbery Unit in Johannesburg in two serial killer cases (eg. Cooper *et al.*, 2000). Although the suspect had already been arrested, geographic profiling software was used to analyse the case, and the resultant

maps, showing the activity space and probability surfaces, were forwarded to the SAPS investigating team as well as to the CSIR project team (Stylianides, 2000). The maps proved to be remarkably accurate in determining the place of highest probability of the serial offender's residence (Cooper *et al.*, 2000). Geographic profiling systems are currently not in use within the SAPS, and currently there are a limited number of South Africans who have completed an authorised geographic profiling analysis course. With almost 50 serial murderers having been identified in South Africa in the preceding two decades (Hodgskiss, 2004) and with South Africa rated as second in the world with respect to serial sex related crimes (Builta, 1995), it is easy to see the potential of such a tool for the SAPS. For more detailed reviews of geographic profiling consult Rossmo (1997); Rossmo (2000a) and Rossmo (2000b); for examples of its application consult LeComber *et al.* (2006); Cooper *et al.* (2000); Santtila *et al.* (2003) and Laukkanen and Santtila (2006).

### **Geodemographic segmentation systems**

Geodemographics is posited on the now familiar 'First law of Geography' (Tobler, 1970) and is essentially the clustering of a population at a particular spatial level into categories or neighbourhoods based on their demographic and socio-economic characteristics (Schwabe, 2000). The origins of geodemographic segmentations lay specifically in marketing research with geodemographic 'cluster systems' being used to reach new customers, choose new business locations and to target direct mail (Mitchell, 1995). This focus is changing, however, with Singleton (2004) noting a growing trend to utilise geodemographic neighbourhood segmentation systems in a variety of fields including health (eg. Aveyard *et al.*, 2000; Tickle *et al.*, 2000; Stafford and Marmot, 2003), education (eg. Tonks, 1999; Tonks and Farr, 1995) and

crime (eg. Massimo *et al.*, 2001; Bowers and Hirschfield, 1999). In the latter, Ashby and Longley (2005) demonstrated how geodemographics could be used to better deploy police resources at a variety of spatial scales throughout England and Wales; while Williamson *et al.* (2005) used geodemographics to examine the extent to which the level and the pattern of youth offending varied between different types of neighbourhood and the schools they attend.

Geodemographic segmentation systems are not new in South Africa. A number of marketing firms employ geodemographic techniques to define the types of communities within which their clients are residing as well as identifying potential markets. Additional specialised marketing companies provide customer insights to businesses empowering them to make informed decisions on their customers and markets. Schwabe (2000) notes the segmentation of the South African population into 20 categories at an EA level using the 1991 census data. Artificial neural network (ANN) technology was used as a clustering algorithm to define 20 categories based on socio-economic gradients such as population size, income, language, race and education, among others (Schwabe and O'Donovan, 1998). The 20 categories reflected a socio-economic profile of South African society and had resultant applications in terms of planning, business and the dissemination of surveys. In a project for the SAPS, Schwabe and Schurink (2000) report on the use of ANN to create a socio-crime classification of over 1100 police stations in South Africa. A database consisting of over 250 census variables and 74 crime variables was created and linked to police station boundaries and entered into an ANN and Kohonen's Self-Organising Map (SOM) algorithm was used to cluster police stations into 20 primary categories. The 20 socio-crime categories reflected a prioritisation of police stations



that required specific government intervention according to the dominant crime types and socio-demographic characteristics that occurred in each category. Schwabe (2000) reports on the possibility of the SAPS to use geodemographic segmentation systems to compile a national or provincial profile of victims and offenders for each crime type. Demographic variables, available from SAPS databases, as well as lifestyle variables associated with the area in which the victims and offenders reside can be utilised in such a system. Using these profiles, predictions can be made on victims and offenders based on changes in the demographic and lifestyle characteristics of certain areas (Schwabe, 2000). In this sense, geodemographic segmentation systems will not only facilitate a better understanding of the cultural diversity of the country but more importantly, emphasise the types of crime that dominate differing policing regions and the distinct socio-demographic variables that are associated with such areas (Schwabe, 2000; Schwabe and Schurink, 2000). These systems can additionally provide insight into the social context of crime in South Africa (Schwabe and Schurink, 2000) and highlight the socio-economic causes of criminal development. Descriptive benefits includes the provision of detailed descriptions per environment (ie. human, social, physical and economic) that contribute to crime and the prioritisation of areas not only by the SAPS in their crime prevention strategies, but also by public works programmes to, for instance, improve local infrastructure or service delivery.

## **CRITICAL SUCCESS FACTORS**

While potential GIS crime mapping applications undoubtedly exist to assist South African policing in the future, a variety of factors constrain the present ability of the SAPS to harness the technology. GIS is often claimed as a unique field of interest and expertise; the challenge lies in exploiting the technology to provide valuable analytic benefits to the SAPS. Several critical success factors are considered for the continued integration and future success of GIS within the SAPS.

### **A spatial information system for crime**

Schwabe (2000) investigated the use of information management systems within the SAPS and found that the SAPS' management had committed itself to the implementation of information systems, including spatial information systems. The predominant information system currently in use by the SAPS is their Case Administration System (CAS). The CAS is the primary source of information on victims and offenders (Schwabe, 2000) and is essentially a docket management system that gathers information at a police station level on crime cases such as the address and time of the crime. The system runs on the central computers of the SAPS, with all users across South Africa accessing it over the SAPS network (Stylianides, 2000). Besides the CAS, the SAPS has incorporated GISes at over 340 priority police stations countrywide and developed a 'pilot' spatial information system at a police station level. While the commitment of the SAPS to implement and utilise these information systems is evident, problems abound in these existing systems including the unavailability of the CAS at a number of police stations countrywide, and the non-alignment of the CAS with the census boundaries of South Africa. The CAS is

additionally not linked with any GIS mapping technology, making a spatial description and interpretation of criminal activity impossible. A spatial information system for crime analysis and prevention is required for the SAPS in order to increase its effectiveness and efficiency and better distribute its often-limited resources.

An important conceptual requirement identified by Schwabe and Schurink (2001a) for the development of such a spatial information system is an information technologically orientated police culture. This requirement translates into a culture of using information to prevent and detect criminal activities (Schwabe and Schurink, 2001a). The organisational culture of the SAPS should additionally be supportive in its desire to utilise the information system. Schwabe and Schurink (2001a) refer to the example of New York City, which implemented the CompStat approach that ensures that detailed information on crime incidents are collected and used by police officials at different stations on a daily basis. Station commanders are held responsible for the reduction of crime in their areas of jurisdiction by making use of spatial information and appropriate prevention strategies (Schwabe and Schurink, 2001a). The SAPS is currently struggling to adapt to a more intelligent information-driven approach to crime prevention with Schwabe (2000) stating that the SAPS have only recently started developing questionnaires for recording detailed information on certain crime types. Lochner and Zietsman (1998, p.71) additionally note “...one of the biggest problems regarding the implementation of GIS in policing is still the ignorance and negative attitudes amongst employees regarding the value of technology in decision-making.” Parker and Dawes (2003) tested the utility of the SAPS’ GIS information to ascertain the high-risk areas for child abuse in Atlantis in the Western Cape province of South Africa. The researchers noted the failure of the GIS system and

recommended that the SAPS utilise their GIS resources better to understand the nature of crime in their area (Parker and Dawes, 2003, p.16). It is evident that while the SAPS' management has indeed committed itself to the implementation and use of information systems, including spatial information systems, a lot more problems need to be overcome before these systems become an integral part of their day-to-day operation.

### **Crime statistics**

In crime analysis the quality of output depends on the quality of input. Good quality data provides the backbone for sound tactical, operational, and strategic plans (van der Spuy, 2001), while poor quality data undermines the intelligence that can be garnered from crime analysis studies (Chainey and Ratcliffe, 2005). In South Africa it has become an accepted practice to argue that official crime statistics — those collected and released by the SAPS — provide a poor indication of levels of crime in the country (Shaw, 1998). In the past crime figures were compounded by mistrust and suspicion associated with the apartheid government but the new democracy has still not brought an acceptance of police statistics (Louw, 1998). On the 20<sup>th</sup> of July 2000, the former Minister of Safety and Security adopted a moratorium inhibiting the access to crime statistics for analysis and dissemination purposes. The reason being the questionable accuracy of the statistics as a result of among others, insufficient note-taking at the crime scene and inefficient capturing of the data on the SAPS' CAS (Schwabe and Schurink, 2001b). The task team appointed to develop a strategy to improve the reliability of the data unearthed during the previous calculation of national crime statistics the following (Martin, 2001):

- The incorrect recording and registration of reported incidents of crime
- Inadequate supervision and control in respect of this recording and registration of incidents
- Incorrect extraction and analysis of crime information
- A number of systems and procedural issues that required improvement and modernisation.

The moratorium on the release of crime statistics was lifted in July 2001 amid some uncertainty regarding what methodological changes had actually been made to the statistics generation process (Schönteich, 2002).

Schwabe *et al.* (2000) note that crime incident data collected by the SAPS has many gaps and that crimes are seldom recorded accurately in terms of their physical location. In a spatial sense the accurate reporting of the location where the crime took place is vitally important to geocode crimes and subsequently gain a visual inspection of its distribution. Louw (1998) reports that many police members don't anticipate any benefits of crime statistics, and therefore data input receives little attention, and the quality of the statistics suffers accordingly. The Deputy Divisional Commissioner of the Training Division of the SAPS (Govender, 2001, p.4) reported the need for timely, reliable, accurate and valid crime information but refers to the fact that

“...while police departments are aware of the need for information, not all collect the same kinds of information, nor do they collect it in the same ways. Some are collected systematically, producing reliable results; some are careless and more haphazard.”

An appreciation of data quality procedures needs to be inculcated in the SAPS including generating an awareness in those who take notes at the crime scene, and

those who enter data into the SAPS' systems as to the extent to which these data are important and depended on by those conducting crime analyses.

### **Geocoding**

Geocoding is vitally important in spatial crime analysis (Ratcliffe, 2004) and "...is the name commonly given to the process of converting street addresses to latitude and longitude, or some similarly universal coordinate system" (Longley *et al.*, 2005, p.125). In a crime context, geocoding is analogous to traditional pin mapping and is required in order for crime or crime-related data to be spatially displayed in a GIS (Harries, 1999; Chainey and Ratcliffe, 2005). GIS requires that each crime incident within a police station area is provided with a geographic co-ordinate and that each point on the map has detailed information relating to the crime scene, victim and suspect/offender. Crime data pose particular challenges for geocoding (see Chainey and Ratcliffe, 2005), with two predominant challenges facing the spatially mapping of crime incidents in South Africa. First, comprehensive and accurate attribute and spatial information on all crimes committed within an area must be recorded. According to Schwabe (2000, p.11), the SAPS currently gather a "...minimal amount of information on crimes and crime scenes and consequently, are unable to effectively undertake linkage analysis between one crime and another." With the result being that with the exception of a few independent research studies (eg. Cooper *et al.*, 2000; Geldenhuys, 2001; Parker and Dawes, 2003; Weir-Smith, 2004) crimes have generally not been spatially located in South Africa (Schwabe, 2000). Additional logistical challenges lie in distinguishing between the ambiguous addresses of the physical crime address noted by the SAPS and the GIS databases that contain corresponding address data (Chainey and Ratcliffe, 2005). The problem can be as a

result of sloppy police work through an inaccurate recording of address level data at the crime location, human errors such as misspelling, or incomplete data or data omissions within the police docket. Leggett (2004) notes that in addition, many residents in South Africa live on properties in informal settlements, as well as around mine dumps and in undeveloped areas, in which there is an absence of any physical address, as well as no formal or well-defined road network. These properties or 'street segments' are extremely difficult, if not impossible, to geocode.

A second major difficulty arises when attempts are made to geocode an address for a street that does not exist or is not yet added to the GIS database at the SAPS. Address data cleaning and GIS database maintenance and management are important pre-geocoding tasks that need to be accomplished in order to improve the geocoding-hit rate of crimes in South Africa. This difficulty is particularly pertinent in South Africa which has experienced phenomenal growth in urban and rural property development in the past decade. An automated geocoding system is required to define the geographic location of crimes in a police station area, especially high priority crimes in priority police stations (Schwabe, 2000). The system would ideally be simple to use, accessible and able to effectively integrate with existing systems in the SAPS (Schmitz *et al.*, 2000).

### **Continued support of the South African government and policymakers**

A reciprocal relationship exists between governments and GIS. Geographic Information (GI) plays a significant role for governments in the context of the global information economy, while governments can create a supportive platform from which implementation policies can be developed and maintained. Masser (1998)

summarises the significance of GI for government as lying in four different conceptual standpoints:

- As a resource, wherein GI can be seen as an available source of wealth that may be drawn upon when needed
- As a commodity, wherein GI can be bought, sold and have multiple life cycles
- As an asset, wherein GI is a valuable item owned by the government, and lastly
- As an infrastructure.

The continued growth and integration of GIS within the SAPS can provide all these benefits to the South African government and to its public but requires national directives strong enough to guide local action, and that have the support of local and provincial government. Since it is the responsibility of the South African cabinet for determining national policing policy, the future of advanced GIS crime information analysis effectively lies at the hands of the South African government. While GIS practitioners would argue that the benefits of linking GIS to all crime prevention strategies is unlimited, policy makers require that provincial executives, in particular, firstly, state their need for GIS as a priority for their specific province's police, and secondly, outline specific protocol and steps for the successful integration of GIS in their policing strategy. The benefits of GIS within policing have been identified by significant government role-players including the former Minister of Safety and Security, Mr Steve Tshwete (2001) and the current Minister of Safety and Security, Mr Charles Nqakula (2003). Both officials saw the potential of GIS to enhance the capability of the SAPS in terms its strategic, tactical and operational planning, and instigated legislation that saw the introduction of GIS with the SAPS. Continued



governmental support in the form of sustained policies and guaranteed funding are however required to further guide the successful integration of GIS within all aspects of the SAPS.

## CONCLUSION

The future success of GIS within policing in South Africa is to some extent predetermined by the present status of the technology in current use by the SAPS. Further pronouncements of policy and funding will not necessarily guarantee success however, as although the SAPS may be legislatively charged with utilising GIS in policing, serious questions must be asked regarding their actual ability to do so. While legislation has been put into place to ensure that a GIS exists (or is at least supposed to exist) at the majority of police stations in the country, more effective guidelines are required to gauge the implementation of these systems and to evaluate the current crime analysis and mapping occurring at the SAPS. While the use of GIS has supplemented the intelligence-driven crime-fighting arsenal of the SAPS, various fundamental challenges are faced by the SAPS to tap into the full potential of the technology. These challenges can perhaps best be illustrated by Altbeker (1998, p.10) who investigated the functioning of the criminal justice system in the rural town of Tsolo in the Eastern Cape province of South Africa:

“These problems have not entirely escaped the notice of the providers of logistical support in the SAPS - a brand-new white Pentium PC has been delivered, gleaming in the gloom of the police station, with its colour monitor reflecting the sun coming through the holes where windowpanes ought to be. The PC is not connected to police mainframe systems such as

the crime administration system (CAS), which is used to record details from dockets and their progress.... The computer was off when I visited the station, because the one person trained to use it was off duty. But it seemed a surprising priority for procurement: this is a station that needs a horse, not a computer; it needs the basic implements for 20th-century investigation, not those of the 21st.”

The future of GIS and subsequent crime mapping in policing in South Africa revolves primarily around the ability of the GIS private sector, local and provincial government, and the broader GIS community in South Africa to overcome the basic problems regarding lack of infrastructure, be they human, capital or technical before widespread GIS integration within the SAPS can be achieved.

#### ENDNOTES

<sup>1</sup> Areas within a police station boundary defined for planning purposes

<sup>2</sup> <http://www.crimestats.co.za>

<sup>3</sup> <http://www.hsrb.ac.za/gis/webMapping/>

<sup>4</sup> <http://www.ojp.usdoj.gov/nij/maps/related.html>

<sup>5</sup> <http://www.amethyst.gov.uk/>

<sup>6</sup> <http://www.caddie.gov.uk/>

<sup>7</sup> <http://www.sanantonio.gov/sapd/maps.htm>

\* This paper was an award winner at the International Emerald Literary Network Awards for Excellence held in the US in 2007. The prize was given to the paper nominated by the Editorial Board of each journal published by Emerald for a paper that they felt had been that title's most outstanding from the previous 12 months.

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**CHAPTER 4**

**MODELING OF VIOLENT, ECONOMIC AND SEXUAL OFFENDERS: A  
TEST OF SOCIAL DISORGANIZATION IN THE CITY OF TSHWANE,  
SOUTH AFRICA**

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## **ABSTRACT**

Post-apartheid South Africa has experienced an insidious increase in crime across all categories. While local researchers postulate the proximate causes of crime, few ecological theories of crime have been used as a basis to investigate the location of offenders in the country. The current study examines, for the first time in a South African context, the spatial origin of offenders across three crime categories: violent, economic and sexual. The causes of these spatial origins are examined using variables informed by the social disorganization theory as input into a series of spatial regression models. Overall little support is found for the social disorganization theory in the city of Tshwane with findings highlighting historically based unemployment as being the driving force behind the rising crime levels in the country.

## INTRODUCTION

South Africa is affectionately referred to as the 'rainbow nation' by local and international commentators. This term, born out of the multi-racial and -cultural components that comprise South African society, paradoxically conceals the vast social and economic inequalities that exist in the country. South Africa has one of the highest rates of racially defined social and economic inequalities in the world (Frank, 2006). These high levels of inequality have also been linked to the high and rising crime rate in the country (Hodgskiss, 2004; Demombynes and Özler, 2005). Since the inception of the African National Congress (ANC) government in 1994, South Africa has experienced an increase in crime levels across all crime categories (Pelser and de Kock, 2000; du Plessis and Louw, 2005). Du Plessis and Louw (2005) report that in the 2003/04 financial year, approximately 20 000 murders were committed in South Africa, which equates to 42.8 murders per 100 000 of the population. In comparison, the United States (US) which has a population six times that of South Africa, reported 16 137 murders in 2004, which equates to 5.5 murders per 100 000 of the population. Every day fifty people are murdered in South Africa (du Plessis and Louw, 2005), an area less than twice the size of Texas. The unabated levels of crime in the country are comparable to crime levels in other post-conflict countries and have lead researchers to question whether crime is a threat to national security (Hough, 2003).

In international literature, a number of ecological theories have emerged to investigate crime. Chief among these theories is the social disorganization theory of Shaw and McKay (1942). The social disorganization theory focuses on issues of social/economic deprivation, ethnic heterogeneity and residential mobility as

predictors of the spatial patterns of criminal activity. This study aims to use the social disorganization theory as a basis to examine the origin and distribution of violent, economic and sexual offenders in the city of Tshwane, South Africa. Tshwane is located in the Gauteng province of South Africa and has a population of roughly 2 million inhabitants. Data of offenders was obtained during March 2006 from the management information systems (MIS) of the South African Department of Correctional Services (DCS) at five correctional centres within the city of Tshwane: Pretoria Central Correctional Centre (consisting of Pretoria Medium and Pretoria Maximum), Pretoria Female Correctional Centre, Odi Correctional Centre and Atteridgeville Correctional Centre.

This study is different to previous literature on the geography of crime in a number of ways. First, data of offenders has rarely been analysed at any spatial scale in South Africa. Second, common ecological theories within criminological literature such as the social disorganization theory have never been empirically employed to analyse rates of delinquency in South Africa. While the theory has also been universally applied and tested (see McCulloch, 2003; Lanier and Huff-Corzine, 2006; Chaix *et al.*, 2006) its applicability within an ‘African’ context has not yet been empirically assessed. Third, a distinction is made between three different offender categories in this study (ie. violent, economic, and sexual) in an attempt to examine the extent to which different demographic, social and economic variables drive different categories of offenders in Tshwane. Fourth, South Africa holds a unique position in terms of its previous political history as well as its current social and economic position. Findings can potentially reveal interesting insights related to criminogenic risk factors in the emerging post-apartheid city and lead to the extension of existing theories of crime.

The article is composed of four sections. The second section provides a brief theoretical history of social disorganization theory and its potentially unique application in South Africa. The results and discussion are presented in section three, followed by the conclusion in section four.

### **SOCIAL DISORGANIZATION THEORY**

Social disorganization has been defined as the inability of a community structure to realise the common value of its residents and maintain effective social controls (Sampson and Groves, 1989). The concept is synonymous with Chicago researchers Shaw and McKay (1942) who developed their social disorganization theory through mapping incidents of juvenile delinquency and analyzing the relationships between delinquency and various social conditions. The researchers introduced structural factors into research on community social organization and delinquency (Hayslett-McCall, 2002). Social disorganization and resulting crime and delinquency depended on a neighborhood's level of social/economic deprivation, residential mobility and ethnic heterogeneity (Cahill and Mulligan, 2003). For social order to exist, a sense of community or community cohesion should prevail which allows the community to uphold common goals and regulate itself through formal and informal measures (Jacob, 2006). The definition of the social disorganization theory at the neighborhood level has enabled the theory and its constructs to be utilised by a number of researchers worldwide in ecological studies of crime (Fein, 2002; Andresen, 2006). In Canada, Jacob (2006) examined the applicability of social disorganization theory to female youth crime, and found partial support for the application of the theory, while Andresen (2006) found strong support for some social disorganization constructs in

his investigation into the spatial dimensions of automotive theft, break and enter, and violent crime in Vancouver. Ouimet (2000) found that social disorganization variables predicted delinquency rates ‘fairly well’ at a census tract aggregation level in Montreal. In the US, Freisthler (2004) examined the role of social disorganization and alcohol access on child abuse and neglect rates and found that increased levels of social disorganization were associated with higher child maltreatment rates. Kawachi *et al.* (1999) found consistent results between the social disorganization constructs of deprivation and social capital and levels of violent and property crime for the whole of the US. While Oh (2005) examined the impact of urban economic change with measures of social disorganization in 153 central US cities and found that use of the social disorganization measures had an effect on central-city crime rates. Other social disorganization research in the US and Europe include Tylor (1996), Cahill and Mulligan (2003), Lanier and Huff-Corzine (2006), Mustaine *et al.* (2006), McCulloch (2003) and Chaix *et al.* (2006). While these and a plethora of other studies have aided in the investigation of ecological determinants of crime throughout much of the developed world, the use of these constructs and the application of social disorganization theory has not been empirically tested in South Africa.

### **SOUTH AFRICA AND SOCIAL DISORGANIZATION**

The recent political history of South Africa is inherently intertwined with social disorganization and community fragmentation. While a few examples may exist elsewhere, no other country in the world has endured such a direct and sustained attack on the social fabric of its society through state laws and policies aimed at enforcing and accentuating spatio-social segmentation. This disorganization and

fragmentation was seen as essential by the apartheid government to maintain class exploitation and to prevent unified resistance by the majority black African population (Emmett, 2003). According to Horn (1998) the apartheid ideology was implemented on three levels:

- Regional (macro-scale), whereby black African and some Coloured and Asian communities were relocated to separate development areas
- Urban (meso-scale), whereby residential and commercial segregation took place within the urban environment, and
- Personal (micro-scale). Through the exclusion of black Africans from quality education, employment opportunities and public amenities

Among the legislative tools used to create this ideology, and directly affecting the social fabric and organisation of South African society, the following:

### **Migrant labor system**

The demands of the mines drove the migrant labor system in the country which saw scores of non-whites migrating to urban centres to work (Manuel, 2006). The system served the dual purposes of restricting the movements of non-white people and securing a cheap supply of labor (Lalthapersad, 2003). The exploitive nature of the system resulted in non-white families being prohibited from joining migrants and being instead required to secure special rights in order to ‘cross the line’ for visits. The migrant labor system not only lead to the disruption of family life (Thomas, 1987), but enforced ruralization and the entrapment of poverty (Emmett, 2003). Other associated regulations such as the institution of pass laws, forced removals and restrictions on the construction of black housing in urban areas were used to prevent

black urbanization and the development of community cohesion among migrants (Emmett, 2003; Lalthapersad, 2003).

### **Group Areas Act**

The Group Areas Act of 1950 (Act 41) formed the basis of urban re-organization in apartheid South Africa (Horn, 1998) and provided for the comprehensive racial segregation of South African cities (Mabin, 2005). The Act involved the forced removal of non-white families into predominantly outlying rural areas, with Platzky and Walker (1985) estimating that almost 1.5 million South Africans were moved as a result of the group area proclamations. The influx of black Africans into urban areas was also strictly controlled through a network of labor recruitment bureaus in the black African reserves (Horn, 1998). The enforced urban relocation aimed at weakening the collective bonds between non-white populations and had a devastating effect on families not only because it uprooted families from their communities but also removed households to areas far from their workplaces (Emmett, 2003). The results were overcrowding of residences and schools (Pinnock, 1984) as well as the destruction of social capital (social relationships and networks) and with it the sense of continuity, security and social control (Pinnock, 1984; Emmett, 2003).

### **Bantu Education Act**

The Bantu Education Act of 1953 was a carefully thought through process in the segregation of South African society (Mahlalela-Thusi and Heugh, 2002). The policy was based on the ‘mother-tongue’ principle and the concept that education should be racially divided. Non-whites would be provided with an ‘appropriate’ curriculum (excluding mathematics) in their own language at schools in the African reserves or

‘ethnic homelands’ (Morrow *et al.*, 2004). Bantu education was met with vigorous opposition and as a consequence schools became a mouthpiece through which learners and teachers alike could voice their condemnation of the apartheid system. Boycotts and riots led to schools becoming centres of violence and conflict with a large number of children and adolescents leaving the education sector to undergo military training, while others were inducted into militarized self-defence units (SDUs) (Emmett, 2003).

The establishment of these, and other, state policies not only contributed to the social disorganization of South African society but also resulted in the depletion in the stock of social capital and the establishment of a climate of distrust and fear between and within races. A number of studies worldwide have shown that these levels of social cohesion and social capital are important in understanding levels of crime and delinquency (see Sampson and Groves, 1989; Simcha-Fagan and Schwartz, 1986; Bursik and Grasmick, 1993; Taylor *et al.*, 1984). Social capital can be defined as those “features of social organization, such as trust, norms and networks – that can improve the efficiency of society by facilitating co-ordinated action” (Putnam, 1993, p.167). The legacy of apartheid completely eroded the social structures of the vast majority of South African society and has resulted in poor and crime ridden communities not only poor in economic resources but also in social capital to address their problems (Emmett, 2003). Whilst apartheid has often been blamed for the scourge of crime engulfing the country (see Tshiwula, 1998; Schönteich and Louw, 2001), no ecological study has determined whether the ‘social disorganisation’ generated by apartheid has had any influence on the spatial distribution of offenders in contemporary South Africa.



## METHOD

Methods utilised in the study comprise three components: first, an offender index (OI) locating the area of residence of offenders was constructed at a suburb level of aggregation for three categories of delinquency: violent, economic and sexual; second, variables and indices were selected and developed to represent social disorganization theory. Last, these scores were introduced as input into a series of spatial regression models in order to determine the effect of each score on each crime category, which acted as the dependent variables. Discussions that follow refer to the suburb level of aggregation and not to infer to the level of the individual.

### Data

The offender indices were constructed using the residential addresses of sentenced offenders as well as the crime for which the offender is currently incarcerated. In instances where an offender was incarcerated for more than one type of crime, the crime for which he/she was serving the longest sentence was used in the analysis. Crimes are grouped into three main categories by the DCS: violent, economic and sexual. Violent crimes include murder, attempted murder, serious and common assault; economic crimes typically include common theft, burglary, robbery and fraud and forgery; and sexual crimes include rape, attempted rape, indecent assault, and incest. While it is readily acknowledged that certain crimes can occur simultaneously ie. economic crime can be violent in nature; the aim of the author is to provide a broad perspective of delinquency within a community.

Using a cross-sectional ecological design, the study examined all incarcerated offender records from March 2006 at all five correctional centres located within Tshwane. A total of 1004<sup>1</sup> incarcerated offenders residing within the 371 suburbs in Tshwane were obtained, verified and aggregated to a suburb level. Although obtained from reliable sources the 1004 offenders included in the study are to be viewed with caution for a number of reasons. First, this number includes only incarcerated offenders and excludes awaiting trial detainees (ATD) as well as parolees. According to Kriel (2005) approximately 28% of the prison population are awaiting trials and 60% of this number are usually acquitted as a result of cases being withdrawn. It takes an average of three months for ATDs to appear in court, while the situation is worsened by unnecessary arrests, unaffordable bail and dawdling in the finalization of cases. Second, there is a very low conviction rate in the country with McCafferty (2003) reporting that for every 1000 crimes committed in South Africa, only 430 criminals are arrested, only 77 are convicted and despite the high number of serious crimes of violence committed (a third of all South Africa's crime is violent), only 8 are sentenced to 2 or more years of imprisonment; and third, the under-reporting of crime. The offender data obtained may therefore not be representative of the exact number of offenders residing within Tshwane but is representative of the most serious and frequently occurring offenders and is the most reliable and complete dataset available by which to draw inferences and conduct analysis.

### **Unit of Analysis**

In South Africa, the suburb is the finest spatial unit provided by Statistics South Africa (SSA) and consists of between 150 – 300 households. On average, there are 5353 residents per suburb in Tshwane with a minimum of 0 and a maximum of 82002 residents. In accordance with other ecological studies (see Coulton *et al.*, 1995; Ernst, 2001; Lockwood, 2004), the neighborhood is defined as a suburb or census area.

### **Distribution of violent, economic and sexual offenders**

The three offender indices are mapped in Figure 1 and are expressed in rates per 1000 population over the age of 18. Delinquency rates are classified in terms of their standard deviation from the mean rate with high rate areas being expressed as those suburbs with a rate in excess of one standard deviation above the mean rate for each crime category.

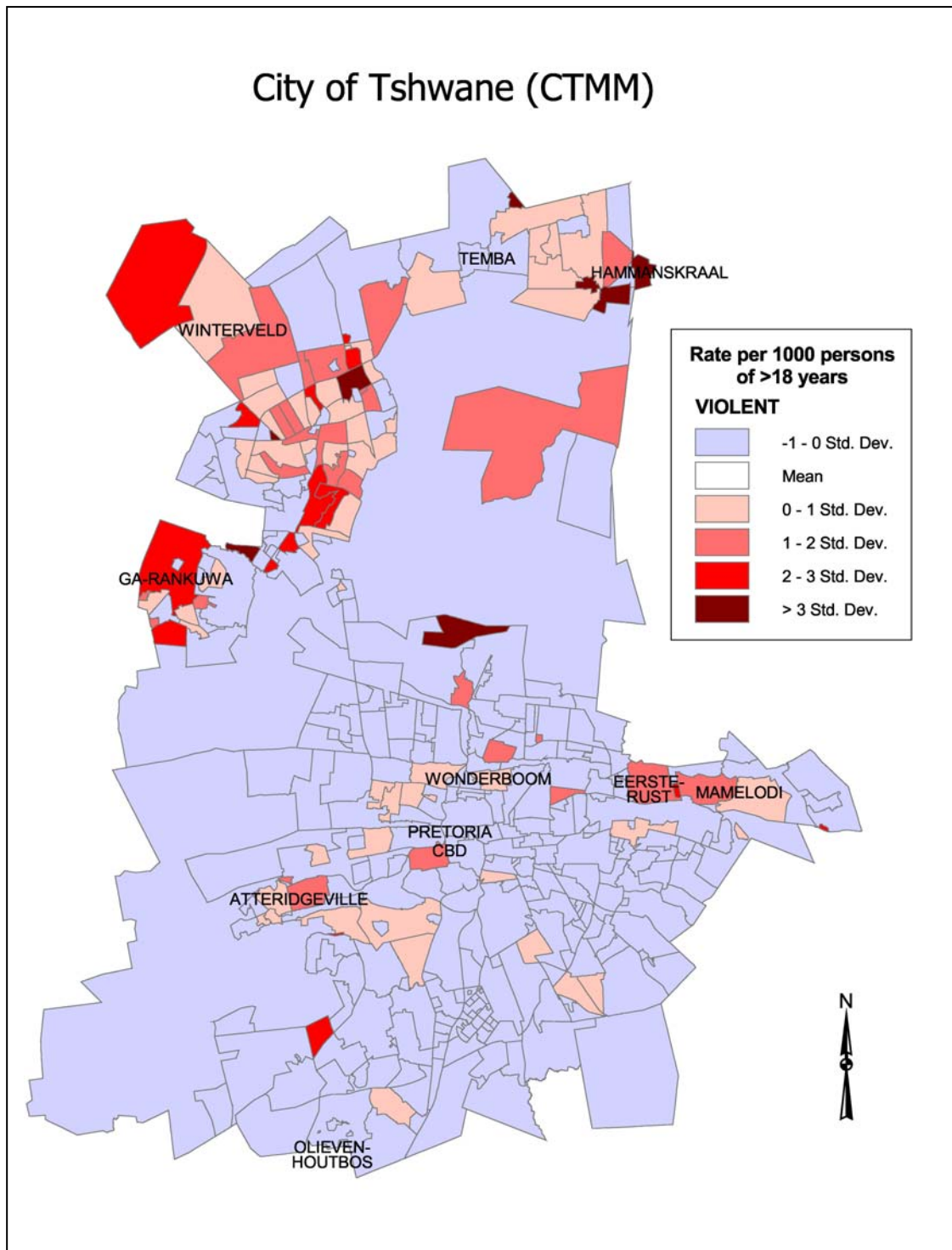


Figure 1a: Violent delinquency rate per 1000 population over 18

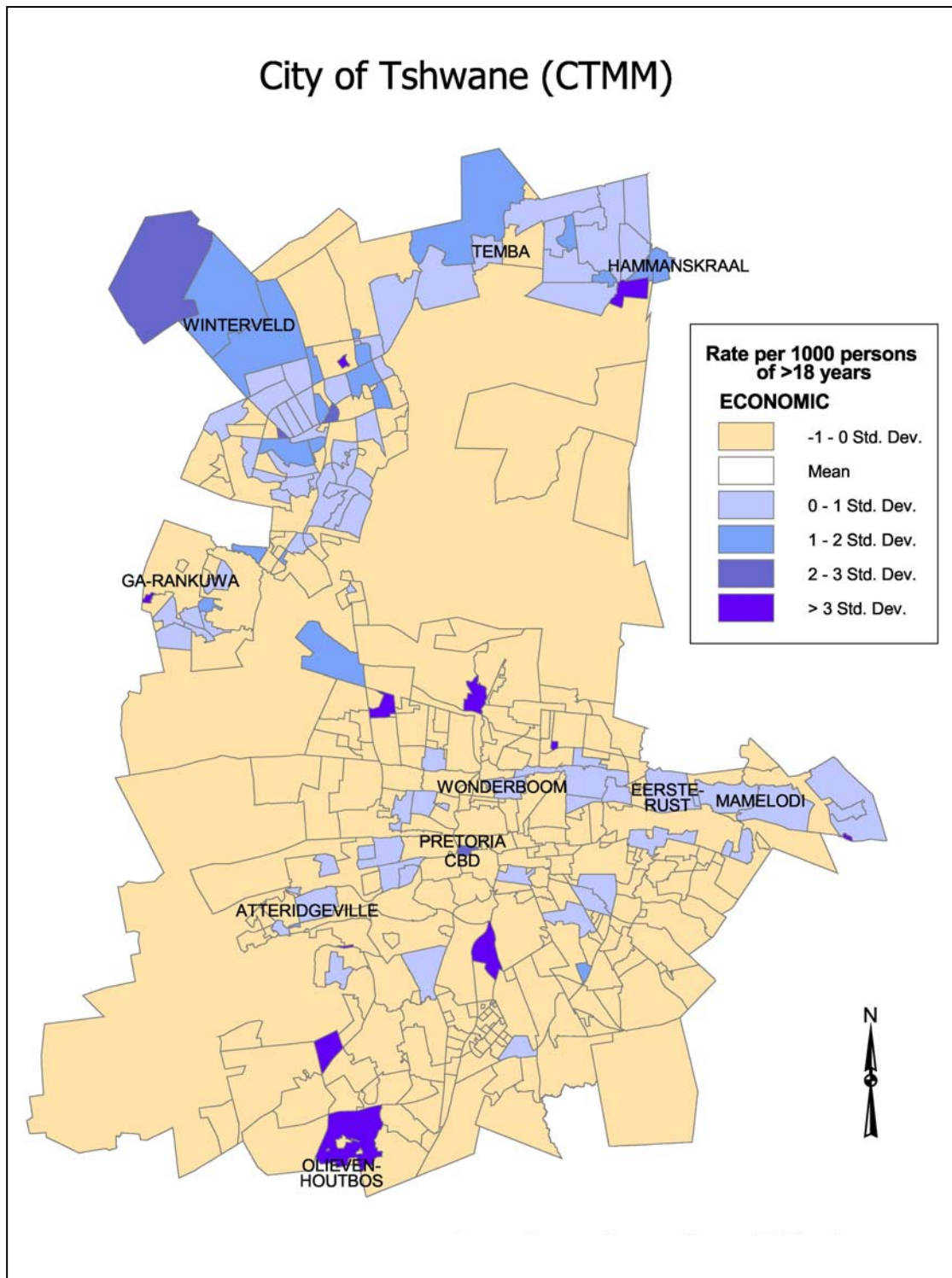


Figure 1b: Economic delinquency rate per 1000 population over 18

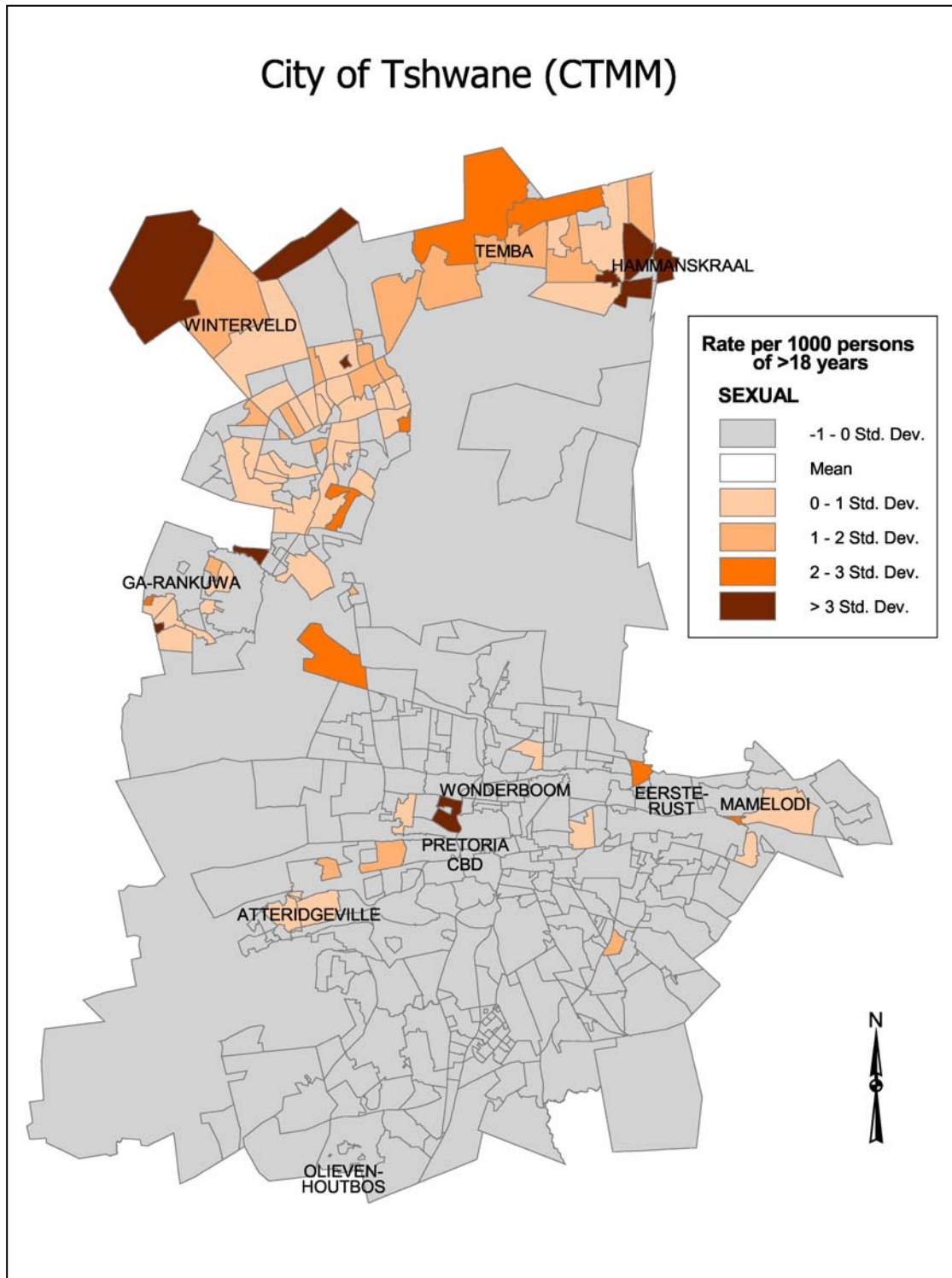


Figure 1c: Sexual delinquency rate per 1000 population over 18

Figure 1 shows a similar spatial pattern occurring across the three crime categories within Tshwane with the majority of suburbs on the periphery of the city exhibiting high delinquency rates. The majority of these suburbs are located in the far northern part of Tshwane and are examples of black African townships that emerged as part of the relocation policies instigated in accordance with the Group Areas Act. In fact 87% of offenders incarcerated within Tshwane emanate from suburbs located in these townships, which illustrates the highly skewed geographical distribution of offenders. The prevalence of violent offenders within the 371 suburbs varied between 0 to 5.75 offenders per 1000 population and its spatial distribution is comparable with the economic and sexual offenders in which high rates are again concentrated in the townships on the northern periphery of Tshwane. The violent offender distribution does however show a less sporadic pattern and contains more isolated suburbs exhibiting high rates. Existing prevalence of economic offenders within the 371 suburbs varied from 0 to 12.12 offenders per 1000 population. The economic crime category exhibited high rates in areas within Tshwane that are traditionally low-to-middle income black African township areas such as Winterveld, Hammanskraal, Soshanguve and Mamelodi. The prevalence of sexual offenders within the 371 suburbs varied from 0 to 11.24 offenders per 1000 population over 18.

### **Independent variables**

The socio-economic and demographic variables selected to represent social disorganization were obtained from the SSA 2001 census dataset. Ethnic heterogeneity, social/economic deprivation, family disruption and residential mobility are typical representations of social disorganization (Sampson and Groves, 1989; Sun *et al.*, 2004; Andresen, 2006). As far as possible, single variables were used to

represent each dimension, however in instances where a number of variables exist for the representation of a single dimension such as social/economic deprivation, an index was developed using Principal Components Analysis (PCA). The following variables/indices were used to capture each measure of social disorganization: *ethnic heterogeneity* is measured by the percentage of residents foreign born. This measure is consistent with social disorganization theory (see Sampson *et al.*, 1997) and represents the percentage of residents who were born outside South Africa. This measure should exhibit a positive relationship with the delinquency rates according to the social disorganization theory. The second dimension, *social/economic deprivation* is measured using two scores: first, the unemployment rate and second, a factor-analysed index based on the United Nations Development Program's (UNDP) (2003) parameters for deprivation in five dimensions: the percentage of residents living in informal housing, percentage of households with no flush toilet, the percentage of households with no water supply and no electricity, and the percentage of households with no refuse removal. A correlation matrix was constructed to examine the relationships between these five variables of social/economic deprivation, and expectedly revealed a high degree of inter-correlation (average  $r = 0.659$ ,  $P < 0.001$ ), resulting in the threat of multicollinearity. As a way to synthesize the variables and simultaneously deal with the problem of multicollinearity, a PCA with varimax rotation was employed to create a social/economic deprivation index. One component was retained explaining 80.2% of the variance. The third dimension, *family disruption*, is measured using the percentage of females as head of the household. In previous ecological studies the percent single-parent variable is commonly used as the measure of family disruption (see Rice and Smith, 2002; Andresen, 2006; Jacob, 2006). In South Africa however, this variable is not included in the census and similar



to previous social disorganization research, the percentage of female-headed households was used (see Freisthler, 2004; Oh, 2005; Krivo *et al.*, 2006). The fourth dimension, *residential mobility* is measured by three variables, the percentage of residents who have moved in the last 5 years, the percentage of residents who do not sleep at the same address for longer than four nights of the week, and the percentage of rental households. In accordance with the social disorganization theory, it is expected that high ethnic heterogeneity, high unemployment, a low social/economic index, high family disruption and residential mobility will all exhibit a positive relationship with the delinquency rates. The descriptive statistics for the measures used in the spatial regression analysis are provided in Tables 1 and 2.

Table 1: Descriptive statistics of social disorganisation measures

	Mean	SD
Ethnic heterogeneity	4.79	4.91
Percent unemployed (%)	13.99	13.98
Social/economic deprivation index	0.20	0.28
Female as head of the household (%)	32.26	12.07
Resident moved in last 5 yrs (%)	31.37	21.09
Residents don't reside in the same place (%)	2.53	8.35
Rentals (%)	22.97	21.65

NOTE: The spatial units are suburbs in Tshwane (n = 371), shown in Figure 1.

Table 2: Descriptive statistics of delinquency rates

Offender type <sup>a</sup>	Count	Mean	SD
Violent offender	294	0.17	0.52
Economic offender	501	0.35	1.07
Sexual offender	209	0.20	0.93
Overall offender <sup>b</sup>	1004	0.72	2.02

<sup>a</sup> Rate per 1000 population over 18

<sup>b</sup> A combination of violent, economic and sexual delinquency rates

NOTE: The spatial units are suburbs in Tshwane (n = 371), shown in Figure 1.

The descriptive statistics display some interesting findings most notably the fact that almost a third of all households in Tshwane have females at the head and almost a third of all residents having moved within the previous 5 years. This is indicative of a highly mobile population coupled with a disrupted family. The small sample sizes of the crime categories indicated in Table 2 does make the analysis vulnerable to outliers. However in an adjustment similar to Bukenya (2005), all observations which deviated by more than five standard deviations from the mean, were replaced with the mean values calculated only over the positive observations. The count for the economic crime category almost doubles the violent and sexual categories and could provide an initial indication of the possible economic motivation behind the majority of crime. In the violent crime category, 71 of the 371 suburbs had a number of offenders more than one-half standard deviation above the mean. These 71 suburbs (19.1% of the suburbs of Tshwane) account for 85.4% of violent offenders within Tshwane. In the economic crime category, 59 suburbs had a number of offenders more than one-half standard deviation above the mean. These 59 suburbs (15.9% of the suburbs of Tshwane) account for 64.3% of economic offenders within Tshwane while 35 suburbs had a number of sexual offenders more than one-half standard deviation above the mean accounting for 52.6% of sexual offenders within Tshwane. Also interesting to note is that 15 suburbs (4% of the suburbs of Tshwane) had delinquency rates one-half standard deviations above the mean across all three crime categories. These 15 suburbs account for almost 20% of the number of offenders across all categories and are again indicative of the highly skewed distribution of offenders within Tshwane illustrated in Figure 1.

### **Spatial regression estimation**

The general functional form of the spatial lag model is:

$$y = pWy + XB + \varepsilon$$

Where  $y$  represents the number of offenders of a particular crime category per 1000 population at risk,  $Wy$  is the weighted mean of the local values of  $y$  in neighboring areas,  $p$  is the parameter,  $X$  is the set of offender motivators,  $B$  is a vector of coefficients to be estimated and  $\varepsilon$  is the error term. Spatial autocorrelation is modelled using Rook's contiguity for census areas. The results from the spatial regression models are presented in Table 3.

Table 3: Spatial regression results for the city of Tshwane

<i>Variables</i>	(1)	(2)	(3)	(4)
	<i>All offenders</i>	<i>Violent offender</i>	<i>Economic offender</i>	<i>Sexual offender</i>
Constant	0.238 (0.191)	0.025 (0.051)	0.164 (0.114)	0.082 (0.056)
Ethnic heterogeneity	-0.010 (0.012)	-0.004 (0.003)	-0.005 (0.007)	-0.002 (0.004)
Percent unemployed (%)	0.021*** (0.007)	0.007*** (0.002)	0.013*** (0.004)	0.003 (0.002)
Social/economic deprivation index	0.062 (0.078)	-0.006 (0.021)	0.035 (0.047)	0.031 (0.023)
Female as head of the household (%)	0.005 (0.005)	0.002 (0.001)	0.001 (0.003)	0.001 (0.001)
Resident moved in last 5 yrs (%)	-0.005* (0.003)	-0.002* (0.001)	-0.003 (0.002)	-0.001 (0.001)
Residents don't reside in the same place (%)	-0.003 (0.006)	-0.001 (0.002)	-0.002 (0.004)	-0.001 (0.002)
Rentals (%)	0.002 (0.003)	0.000 (0.001)	0.002 (0.002)	-0.000 (0.001)
Observations	1004	294	501	209
Pseudo <i>R</i> -squared	0.179	0.190	0.138	0.191

NOTE: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ ; standard errors in parenthesis

## RESULTS AND DISCUSSION

A series of four spatial regression models were estimated, including an overall model to supplement the three crime category models. The results were not very encouraging with all models exhibiting a pseudo- $R^2$ , which approximates the amount of variation explained by the model, below 20%. The first model (overall crime category) used the total offender index as the dependent variable and accounted for 17.9% of the variation across suburbs for rates of offenders. The signs of the coefficients in the overall model are contrary to the expectations of the social disorganization theory with only the percentage unemployed - a proxy for social/economic deprivation - exhibiting a significant positive relationship. A comparison of the overall model with the models based on the three crime categories provides a similar, albeit discouraging picture. The sexual offender category provided the best result with 19.1% of its variation being explained by the variables representing social disorganization; this is followed by the violent offender (19%) and the economic offender (13.8%). Similar to the overall offender category, the only positive and significant coefficient for the economic and violent offenders were the percent unemployed, while the sexual offender category exhibited no positive relationships with any social disorganization constructs. A number of important observations and conclusions can be drawn from these findings.

**Ethnic heterogeneity**

It is not surprising that ethnic heterogeneity, measured as percent foreign born, was not significant in any of the regression models as the measure exhibits no correlation with the overall offender index ( $r = -0.407$ ). The lack of support for the ethnic heterogeneity measure is consistent with Jacob (2006) and, Rice and Smith (2002) who attribute this inconsistency to the differential development of urban areas in Canada as opposed to the US as well as the inability of the variable to capture neighborhood cohesion, respectively. Some researchers argue that increased ethnic heterogeneity may even lead to the lowering of crime as immigrants may lessen the impact of concentrated disadvantage and can lead to immigration revitalization (Lee and Martinez, 2002; Sampson and Wilson, 1995). While no local ecological studies have been conducted to assess the relationship between ethnic heterogeneity and crime to draw comparison, the results of the study contrast sharply with other local researchers who attest to the large number of illegal immigrants, particularly African-immigrants, being responsible for a significant proportion of crime in Tshwane (Strydom and Schutte, 2005). A recent report from the United Association of South Africa (UASA) (2006) estimated roughly 10 million illegal immigrants currently in South Africa from neighboring Mozambique and Zimbabwe as well as from other African countries such as the Democratic Republic of the Congo (DRC) and Nigeria. In a country of roughly 50 million people that constitutes 20% of the population. Over 200 000 illegal immigrants are deported annually in South Africa, compared with 186 000 in the US (Schussler, 2006). At least half of these illegals are from Zimbabwe where economic and social turmoil has engulfed the country since the establishment of the land redistribution scheme in 2000 (Chasan, 2002). The majority of illegal immigrants settle in former homeland townships on the periphery of urban centres and

having illegal status in the country would be undocumented. The strong negative correlation between the ethnic heterogeneity and the percent unemployed ( $r = -0.508$ ) and social/economic deprivation index ( $r = -0.181$ ) implies that documented immigrants in Tshwane are generally employed and experience a decent standard of living, while those illegally in the country are generally unemployed or are severely underpaid for their services and resort to crime as a means to survive (Strydom and Schutte, 2005).

A further difficulty in assessing ethnic heterogeneity in a South African context relates to its actual definition applied in a local context. During the apartheid era, the South African government used the idea of ethnicity for political and racial purposes by establishing language areas for each ‘ethnic or tribal’ group as classified by the government. During the 1950s and 1960s, these groups were assigned separate residential areas according to perceived ethnic identity (Emmett, 2003). Apartheid policies also empowered the government to forcibly remove black Africans from cities and to preserve the ‘ethnic character’ of neighborhoods in the black African townships that were created, legally and illegally, around the cities (Byrnes, 1996). As a result of these oppressive racial policies, many black Africans minimized the importance of their ethnic heritage, or disavowed it entirely (Byrnes, 1996). The dawn of democracy in 1994 however saw a reversal of this thinking with South Africans appearing to reclaim their ethnic heritage and to acknowledge pride in their ancestry (Byrnes, 1996). The new political leaders recognized the practical advantage of encouraging people to identify both with the nation and with an ethnic group or tribe that had a past older than the nation. The consequence being the elevation of eleven official languages and even more ‘official’ ethnic and tribal groups, resulting

in South Africa having one of the most complex ethnic patterns in the world (Byrnes, 1996). The fact that the variable representing ethnic heterogeneity, percent foreign born, was non-significant may therefore indicate that it is weak measure of ethnic heterogeneity. Further studies in the South African context should attempt to differentiate between local and international ethnic groups on the basis of language or race in an attempt to better represent this measure of social disorganization.

### **Social/economic deprivation**

Social disorganization theory suggests that suburbs characterized by high socio-economic status will have residents who are in a position to establish and maintain strong ties and more extensive social networks (Jacob, 2006). In this study the two measures of social/economic deprivation produced inconsistent results. The social/economic deprivation index on the one hand displayed no significance in any of the models despite exhibiting a low positive correlation with the overall offender index ( $r = 0.364$ ). The coefficient for percent unemployed on the other hand showed significance in all the models with the noted exception of the sexual offender model. In international tests of social disorganization, the social/economic deprivation measure is generally the strongest predictor of criminal activity. Andresen (2006) found economic deprivation, in the form of unemployment, to be greatest predictor of crime rates in an empirical assessment of social disorganization theory in Vancouver, while Freisthler (2004) found impoverishment to be linked with high rates of crime in a test of social disorganization in California. Other studies however display inconsistent findings (see Sampson and Groves, 1989; Wright *et al.*, 1999).



In the present study, percent unemployed - as a proxy for social/economic deprivation - was shown to be by far the strongest predictor of delinquency rates and illustrates the importance of addressing this issue within Tshwane. The first main policy document to govern policing in post-apartheid South Africa, the National Crime Prevention Policy (NCPS, 1996, p.18) in 1996 already identified “historically shaped unemployment” as providing a ready recruitment ground for criminal activity and as contributing significantly to increased levels of crime in the country. Unemployment has also been identified as one of the main motivations behind farm attacks in the country (Haefele, 1998; Strydom and Schutte, 2005), while other local researchers charge levels of unemployment coupled with high levels of inequality with the high crime rate (Brown, 2001; Blackmore, 2003; Hodgskiss, 2004; Demombynes and Özler, 2005).

Locally, researchers obtain a strong positive association between levels of unemployment and violent and economic crime (Wedge *et al.*, 2000; Maree and Prinsloo, 2003; Masango, 2004). In terms of the violent offender, Schwabe (2000) notes the emergence of a subculture of violence among an unemployed black juvenile cohort in South Africa. This cohort perceives itself to be deprived in terms of education, employment and socio-economic wealth relative to other groups in the country. These groups tend to be guided by values that prescribe violence as a means of solving problems and expressing frustrations (Schurink and Schwabe, 2000) and have created a climate of learning crime, whereby the youth are frequently associated with past and present violent offenders. Children are coerced into this violent subculture as they grow up in an environment in which violence becomes internalised and part of everyday living (Maree, 2003). In terms of the economic offender,

unemployed individuals are envisaged as being driven by a need to support their families or dependents and in doing so resort to such economic crimes as burglary, robbery, shoplifting and/or theft. High rates of economic offenders were found in the former homeland townships in the northern periphery of the city (Figure 1), which tend to reinforce the historical-based context of delinquency and collaborates the economic motivations driving these offenders.

Whereas all the other models exhibited a significant relationship with some measure of social disorganization, no significant coefficients were found for the sexual delinquency rate. This result suggests that alternate individual-level motivations possibly exist for sexual offenders within Tshwane, as the ecological determinants compiled were not significant.

### **Family disruption**

The use of the family disruption measure as an indicator of social disorganization has its historical antecedents in the work of Sampson and Groves (1989). The researchers extended the arguments of Shaw and McKay (1942) by identifying family disruption as an exogenous force contributing to social disorganization. A disrupted family would, according to Sampson (1995, p.197), “facilitate crime by decreasing networks of informal control.” The family disruption measure, in the form of percent female-headed household, was found to be conspicuously absent from all four models despite the fact that the measure exhibited a low positive correlation with the overall offender index ( $r = 0.277$ ). Whereas the rejection of this measure in the present study contrasts with other empirical tests of social disorganization (see Andresen, 2006; Sun *et al.*, 2004) it is consistent with Cahill and Mulligan (2003) who in a test of social

disorganization theory in Tucson, Arizona, found little support for the family disruption measure. In explaining this discrepancy the authors concluded that either the variables selected were not a good measure of family disruption or that family disruption did not play an integral role in affecting crime rates. While the same conclusions may be drawn in this study, two more poignant explanations may apply. First, as a partial result of the migrant labour system in the apartheid-era, black African males have traditionally been coerced into working away from their household and as such, according to the South African census, the household would be classified as female-headed even though the male resides periodically at the household. Although this may have a disruptive influence on the members of the family, the disturbance would not be as greatly felt if for instance, the male had abandoned the family. The second explanation revolves around local contextual discrepancies between international and local definitions of household head. Internationally, residing in a female-headed household would imply the physical absence of a male in the form of a husband or partner in the household. Locally, however in a country as diverse as South Africa, some members of the population base their definition of household head on gender, some on age, some on income-earning ability, and some on a combination of these variables depending on their cultural context. Lastly, an alarming finding by Budlender (2003) found that despite being characteristically poverty-ridden in South Africa children in female-headed households might be 'better off' than residing in male-headed households or two-parent households. The researcher found that women tend to spend much longer than men on caring for their children and that women are more likely than men to live with their children and so be responsible for seeing to their own material needs as well as those of the children. In fact the study even found that women with no children of

their own tend to spend more time on childcare than men who have their own children living with them. Racial differences between male and female head of households again characterized their researchers findings.

### **Residential mobility**

According to social disorganization theory residential mobility is hypothesized to impede the community's ability to informally control delinquency because residents in areas with high levels of instability undermine collective efficacy and social control processes (Nielsen *et al.*, 2005). While no South African studies have been conducted to measure the effect of residential mobility on crime and delinquency rates, a number of international studies illustrate its significance on the propensity to commit crime (see Freisthler, 2004; Andresen, 2006). The present study however found none of the variables representing residential mobility as being significant in any of the regression models. Incidentally, these variables also exhibited no correlation with the overall offender index (average  $r = -0.266$ ). In fact, negative and significant coefficients were exhibited on one proxy of residential mobility, namely the percent of people that moved in the last 5 years, for both the overall and violent category of offenders. This finding is supported by Nielsen *et al.* (2005) who found that increased residential turnover might not necessarily lead to increased crime levels since the cultural and social values of the new immigrants may positively affect their ability to develop relationships with existing residents. In the present study an explanation for this result is based on *a priori* knowledge of the recent political history of Tshwane. As previously mentioned, Tshwane is an example of a highly mobile society with almost of third of all residents having moved within the past 5 years. The end of apartheid not only resulted in the end of restrictions on the movement of its residents but also

positive year-on-year economic growth for ten consecutive years (Hesselink-Louw *et al.*, 2003). These combined factors have resulted in a highly mobile society where a change in residence is associated with a move up the social and economic ladder. An interesting implication of this finding is the fact that it is predominantly long-standing members of the community that are committing criminal offences, particularly violent offences. These long-standing members of the community would probably be older segments of the population and may have ‘missed out’ in the economic upsurge that South Africa has recently experienced. Witnessing what researchers have described as the ‘emerging black middle class’ in South Africa (see Lalloo *et al.*, 2004; Macozoma, 2007) these predominantly low-income black African residents would be frustrated at their stagnating socio-economic status more than a decade after the end of apartheid. The low number of renters in Tshwane is compatible with the current property boom prevalent in South Africa and well as the fact that many residents in poorer regions of Tshwane were given low-cost houses as part of the Reconstruction and Development Programme (RDP) of the late-1990s.

Overall little support is found for the social disorganization theory in the city of Tshwane. The positive relationship of the percent unemployed with some of the regression models lends support for the social disorganization theory; however, the predominantly negative and non-significant coefficients for the ethnic heterogeneity, social/economic deprivation, family disruption and residential mobility measures are counter to the expectations of the theory. It is difficult to place the study explicitly within existing international literature since ecological studies of crime have traditionally focussed on overall offenders and have neglected to study the contextual factors correlated with different types of offenders. In addition, no local studies of

delinquency have been used to assess social disorganization or any other ecological theories of crime in the country, hindering comparisons. Whilst social disorganization theory, among others, has been used to explain and interpret the distribution of crime locations in South Africa (see Schwabe and Schurink, 2000), the theory hasn't been empirically employed in ecological studies of delinquency.

This study is however not without limitations. First, the data utilised in the study reflects only incarcerated offenders and the results of the study are therefore representative of the approximately 8% of offenders in the country that are actually apprehended and incarcerated (see McCafferty, 2003). Second, the cross-sectional nature of the study implies that the findings of the study are applicable only to the sample of offenders at the time of data collection. Despite this fact no noteworthy interventions such as changes in parole policy or mandatory 'burstings' were taken by the DCS at the time the sample of offenders was drawn to make the sample unrepresentative. Longitudinal studies examining the influence of social disorganization constructs of delinquency rates in Tshwane would ideally provide a better picture of this spatial relationship. This would also allow researchers to address the reciprocal relationships between delinquency rates and social disorganization theory and thus allow causal inferences between the two to be drawn. While these issues place certain restrictions on the generalizability of the findings, the results nevertheless provide important information regarding the spatial distribution of offenders within Tshwane as well as highlight the need to understand 'historical circumstance' and local context when comparing and extending ecological theories of crime in a local context.

## CONCLUSION

The spatial distributions of violent, economic and sexual offenders were investigated using variables informed by the social disorganization theory and found little support for the theory. Similar to previous research on social disorganization (see Freisthler, 2004; Andresen, 2006), social/economic deprivation in the form of unemployment was found to be the greatest predictor of delinquency rates with no other measures proving significant. Despite South African society and cities historically experiencing social disorganization and community fragmentation, the effects of these constructs were shown to have little influence on the rates of offenders. To this end the author asserts that the ‘social disorganization of apartheid’ and its social and economic remnants contrasts with the social disorganization constructs of Shaw and McKay (1942). While it may be that social disorganization needs to be measured with different indicators than those used in the current study, the results do provide substantial support for the incorporation of local knowledge to account for any explanation of the distribution of offenders in Tshwane. For future research, it is recommended that an ecological analysis of offender origins using any number of socio-demographic variables be undertaken in Tshwane, or elsewhere in South Africa, in order to obtain more knowledge regarding the ecological causes of delinquency. Knowledge garnered from such a study would be invaluable as it would not only enable the development of a localized urban ecological theory of crime but also allow for the incorporation of additional ‘post-apartheid’ explanations in its make-up. Tests of other ecological theories of crime such as the routine activity theory at a neighbourhood level within a local context would also be of value.

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## **ENDNOTES**

<sup>1</sup> Data obtained from the MIS of the DCS was partially incomplete. The total number of incarcerated offenders residing within Tshwane is 1870 (this is the number indicated in subsequent chapters). The crime dockets for the remaining 866 offenders ( $1870 - 1004 = 866$ ) did not include the crime for which the offender was incarcerated. Numerous attempts to obtain this information proved futile as a result of an extreme lack of co-operation from DCS officials and, limited on-the-job knowledge by DCS officials of how the MIS actually works.



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