small arms survey

ARMED VIOLENCE

Issue Brief

Number 3 ■ October 2013

Geospatial Technologies and Crime

The Jamaican Experience

Introduction

While high rates of crime and violence afflict Latin America and the Caribbean in general, they are particularly acute in Jamaica. The country's homicide rate is high by international standards and the deleterious impact of crime on the economy is considerable (UNODC, 2011, p. 93; UNODC and World Bank, 2007). The costs of this violence are many, including weak investor confidence, high health and security costs, migration of the urban middle class, higher mortality and morbidity rates, reduced access to social services, dysfunctional families, and oppression of vulnerable groups (Moser and Holland, 1997, p. 2).

In view of such problems, policymakers are increasingly regarding crime prevention and public safety not as afterthoughts, but rather as essential to improving the quality of life of poor people (Levy, 2001, p. 4). Indeed, there is a growing recognition of the vital importance of enhancing human security as a pillar of Jamaica's larger social and economic development. Among others, Girvan (1997) identifies crime as one of the main impediments to economic growth. Meanwhile, the Jamaican population has expressed a severe lack of confidence in much of the country's security and justice sector, as well as strong support for building the capacity of the security forces to respond to crime (UNDP, 2012, p. 159).

Better use of technology is one way in which a range of stakeholders can more effectively use the limited resources at their disposal, while also scaling up the impact of their crime prevention initiatives. This *Issue Brief* examines one such tool: geospatial analysis.

The essence of geospatial analysis is the digital mapping of data onto physical locations. Crime data can be disaggregated by location, type of crime, date and time, demography of victims, and community assets. These variables can be analysed in isolation or cross-referenced. Moreover, geospatial mapping offers powerful insight into patterns of crime and violence as it allows analysts to place data on a

Residents of Trench Town follow street battles waging in the neighbourhood as troops search for an alleged drug kingpin, Kingston, May 2010. © Ratiba Hamzaoui/AFP Photo

map as specific points, then sort and query the data based on its location (Bernhardsen, 2002).

Taken together, datasets, technology, shared standards, an institutional framework, and stakeholders form the spatial data infrastructure (Blake, 2009, p. 4). Geospatial technologies include the use of maps and other location-based data as well as specialized technologies such as the Global Positioning System (GPS) and geographic information systems (GIS) software.

These tools are increasingly being used across the public and private sectors of Jamaican society, by both groups and individuals. In particular, Jamaica's security sector—including the police, the military, and private security companies—has made wide use of geospatial technologies. While GIS and other geospatial technologies were initially used as map-making tools, they are increasingly being woven into operational use. In addition to using GIS to map crimes and crime scenes, the police are beginning to use it in investigations. The military use it in their intelligence gathering and operational planning, as well as in training exercises. Meanwhile, private security companies offer clients GPS tracking systems as part of their services.

Civilian use of geospatial technologies has grown with the increasing availability of both GPS and access to high-resolution satellite imagery (through free services such as Google Earth and Bing Maps). Researchers are using these tools to help contextualize findings on crime trends and patterns, while evaluating both spatial and temporal relationships in crime data, as well as crime and non-crime data more broadly. Policy-makers benefit from geographic tools and strategies that help them to visualize and analyse critical data concerning needs, expenditure, performance, and compliance.

Data-driven decision-making has now become standard within the framework of national efforts. Individuals as well as governmental and extra-governmental agencies also increasingly demand more information beyond statistics on crime. Spatial data analysis provides such information, enabling diverse stakeholders to enhance crime prevention initiatives.

This *Issue Brief* chronicles the Jamaican adoption and use of this geospatial technology, the various modes and scales of its use, and how this approach has transcended routine mapping and other forms of primary-level use. It then examines the use of geospatial tools and analysis within Jamaica in three application areas: crime and security analysis; community profiles; and building social datasets and providing spatial analysis. It shows that geospatial technology is increasingly being used in crime control applications on a community scale, with a focus on social implications as a means of improving crime management initiatives.

The shift towards GIS

In medical epidemiology, the tradition of mapping disease outbreaks is well established (Smith, 2002). In the area of crime prevention, GIS technology has allowed similar electronic mapping techniques to gather data on crime, injury, infrastructure, and social determinants to inform crime reduction strategies.

Jamaica's Ministry of Health began to incorporate and apply GIS technologies to process crime data in 2002, when its Healthy Lifestyle Project started to look at violence and its impact on the health of communities and individuals (Ward et al., 2002; Lyew-Ayee, 2006). To inform its programming, the project collected direct (primary crime) data and indirect (social, economic, demographic, and infrastructural) data; in addition, hospital injury data was paired with police crime data to reveal patterns and trends. To facilitate data collection, the relevant government agencies formed key partnerships with community organizations, research groups, private sector foundations, and donors.

Increased police participation in the community-based solution to crime involves partnerships with a variety of interest groups, such as residents, the private sector, schools, tourism agencies, and farmers (McLean et al., 2008). In this context, state planning agencies supplied population and economic data (Smith, 2002); infrastructural data was collected from sources such as the survey department and the main public works agencies.

The Healthy Lifestyle Project culminated in the formation of a Crime Observatory, which is composed of representatives of the Ministry of Health, the University of the West Indies, the Mona GeoInformatics Institute (MGI), the Violence Prevention Alliance, and the Kingston Western Police Division of the Jamaican Constabulary Force (JCF).[1] Through the formalization of geospatial data and information sharing, the Observatory continues to plan, implement, and monitor anti-crime interventions in Jamaica (Crime Observatory, 2006).

In response to this initiative, the police started to improve its data collection system and to maintain its own crime data for analysis.[2] Specifically, they have begun to use GPS mapping devices at crime scenes to record crimes spatially. They have also introduced ways to examine crime data within a spatial context, rather than relying exclusively on statistical analysis. The police report that the GIS approach has been especially useful in the planning of strategic operations, but that it has also been integrated at the tactical and administrative levels as well as in operating procedures and asset management strategies (Heywood, 2009).

Having incorporated GIS in crime data collection and analysis, the police inevitably sought to integrate high-end uses of GIS, such as in closed-circuit television data, traffic information, and digital forensics—the collection and investigation of electronic data for use in a court of law. GIS and GIS-derived analysis became integral in many dimensions of crime-fighting activities, including through the following approaches:

- satellite imagery and detailed community plans to ensure a higher level of direct participation and communication in community engagement;
- critical information systems for enhanced information sharing

across different agencies within and outside the direct national security apparatus; and
- detailed simulation models—from 3D models to operational models—of social conditions and the impacts of different types of interventions, ranging from police–military to social engineering[3] and job creation, all at different scales.

Such tools allow crimes to be modelled according to their severity and to be juxtaposed with social infrastructure (community assets), as discussed below. Yet, although geospatial tools and technologies have been shown to improve the ability to reduce crime and violence levels (Mackey and Levan, 2011), challenges continue to hamper their application. Indeed, their integration requires a shift towards more effective collaborative processes and away from the silo thinking that is often characteristic of larger institutions (McLean, 2009).

Stakeholders must begin to develop frameworks not only to develop partnerships, but also to assess the efficacy of those partnerships. Such a reconfiguration requires strong leadership, internal change managers, and cultural change.

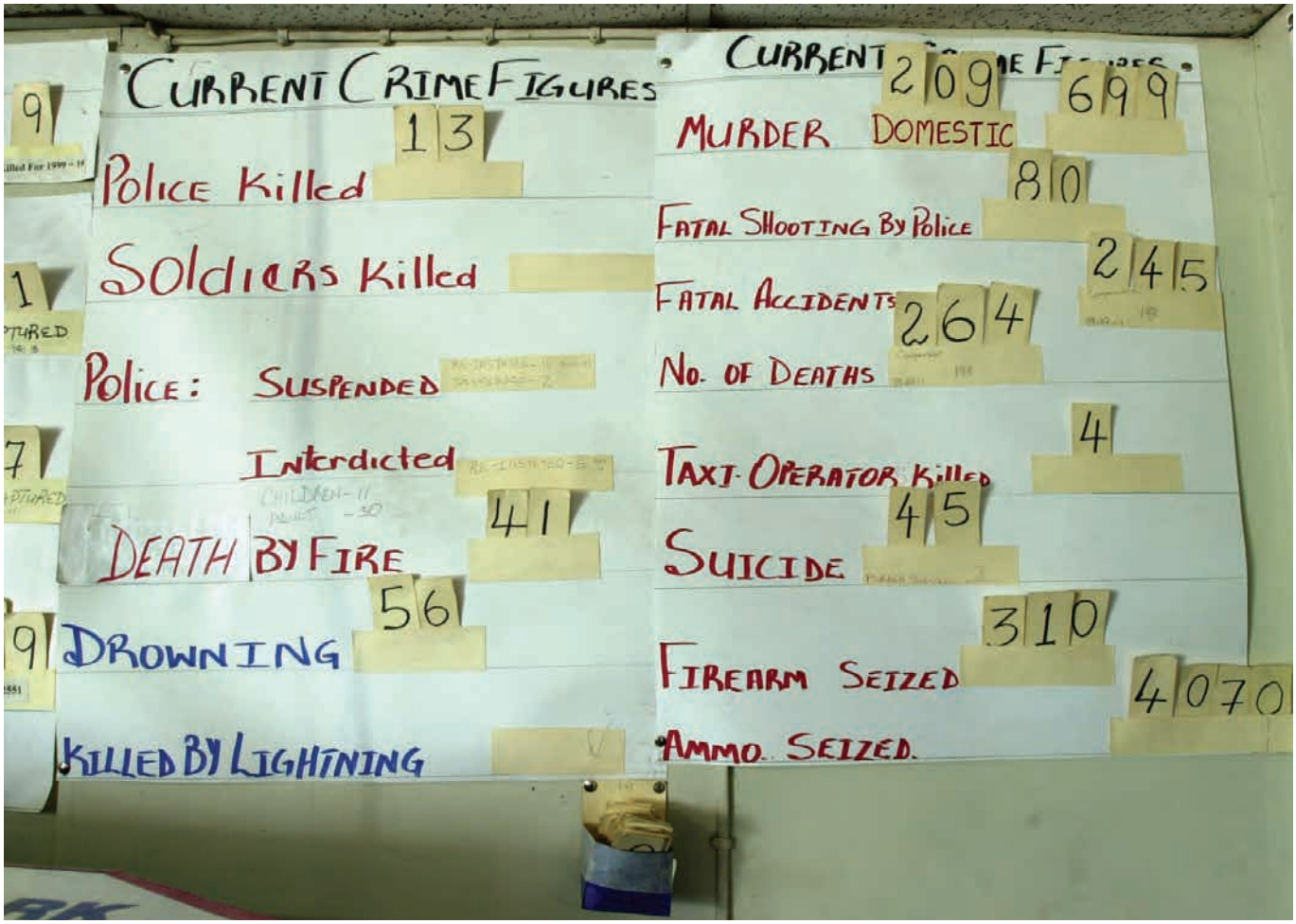
Even within the JCF, not all officers were immediately aware of the availability of GIS technology. In fact, some JCF members who stood to benefit the most from the geospatial data requested that the National Land Agency produce certain maps for them, not realizing that the JCF itself could produce them. Meanwhile, some JCF members who were aware of the GIS capability had not been trained to use the new tools effectively. The JCF has been able to promote awareness and teach the necessary skills by integrating GIS sensitization into the training of operational commanders, but important deficiencies remain. Most routine crime reports, for example, still do not include maps or charts (Heywood, 2009).

Crime and security analysis

Geospatial technology can be applied to crime control at the analytical and operational levels. The provision of analytical depth in a short time frame enables the design of highly targeted interventions that are intelligence-led and problem-focused, unlike routine police deployment. Such interventions may rely on location information, including details on specific community assets, as well as on digital forensics and cellular phone tracking (Green and Haines, 2012; Volonino, Anzaldua, and Godwin, 2007).[4] Findings that emerge based on the analysis of spatial data, including the identification of crime patterns, can be of use across the security services—ranging from the police, army, and the Ministry of National Security to private security companies.

The starting point for geospatial analysis usually involves the creation of base maps at different scales. Regardless of whether they reflect parish bound-

Police officers learn how to use GPS handheld devices to map crime scenes and collect data. © Mona GeoInformatics Institute (MGI)



Crime figures recorded on a police station wall in Kingston, January 2010. © Jim Rankin/Toronto Star/Getty Images

Box 1 The distribution of police stations vs. crime

The distribution of police stations is a critical element in crime control. In addition to providing patrolling services, stations can act as rapid response bases in the case of emergencies and as resource centres for mediation and counselling services. Some Jamaican police stations even serve as homework and after-school centres (Johnson, 2000).

GIS technology can be used to assess and track the distribution of crime around police stations. That distribution can then be used to gauge the effectiveness and responsiveness of each police station—and to allocate resources such as the required workforce, firepower, and operational equipment.

An assessment of 2010 crime data indicates that some police stations respond to far more crimes than just those reported in their immediate vicinity; indeed, some are responding to crimes that are committed closer to other police stations (Lyew-Ayee, 2010; see Table 1). These findings suggest that the general public is not aware of these closer police stations or that the stations closer to crimes are unable to respond to them.

Table 1 **Selected data from the crime-police station distribution analysis, 2010**

Police station	Number of crimes in vicinity	Mean distance of crimes to police station (m)	Number of crimes responded to	Response rate based on crimes in vicinity
Half-Way-Tree	245	940	437	178%
May Pen	215	1,801	293	136%
Hunts Bay	209	745	405	194%
Olympic Gardens	203	1,027	90	44%
Montego Bay	196	887	507	259%

Source: JCF (n.d.) as processed by MGI

aries, police divisions, communities, or other demarcations, such maps generally do not contain much more detail than roads and some landmarks. The same applies to thematic maps, which show particular objects of interest recorded through asset mapping. Green and Haines (2012) point out that asset mapping involves the gradual discovery of resources and deficits in a given community. Positive and negative assets—such as schools, churches, vacant lots, and entertainment locations—can provide vital information to the police as they plan their field operations, be it to fight local gang crime or broader organized crime syndicates that engage in the trafficking of guns, narcotics, or people.[5] In counter-narcotics operations, for example, security forces may target hidden bays and coves; meanwhile, satellite imagery can allow for the ongoing surveillance of marijuana-growing areas.[6]

GIS technologies can also serve to evaluate and enhance the operational efficiency of the police. In a study of the distribution of crimes in relation to

Table 2 **Major crime statistics, 2008–10**

Year	Total crimes		Murders		Shootings		Robberies	
	Jamaica	Kingston	Jamaica	Kingston	Jamaica	Kingston	Jamaica	Kingston
2008	5,806	2,409	1,618	590	1,528	660	2,660	1,159
2009	6,367	2,590	1,682	584	1,664	670	3,021	1,336
2010	5,762	1,913	1,428	418	1,497	513	2,837	982

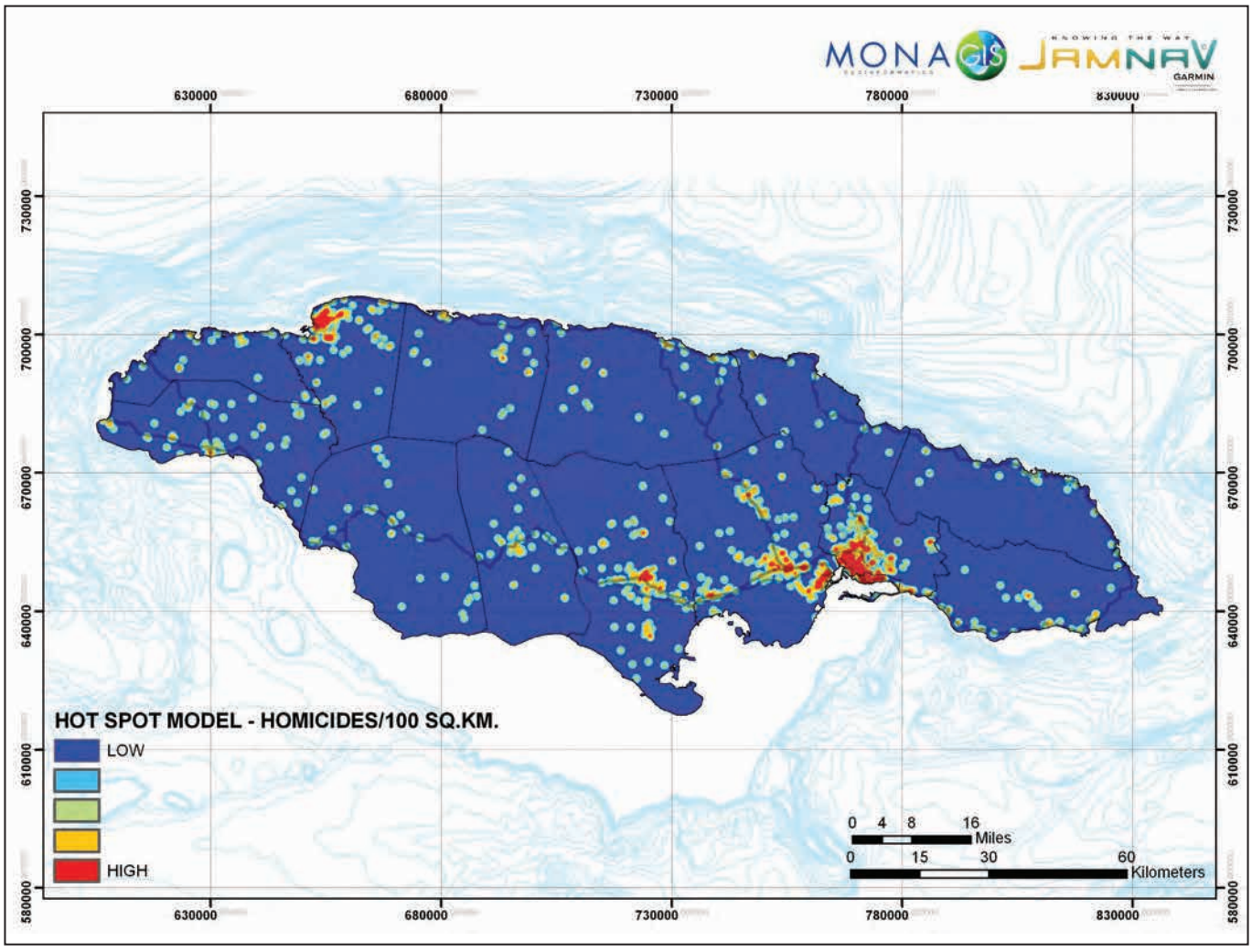
Source: JCF (n.d.)

the distribution of police stations and hospitals, MGI finds that Jamaicans do not necessarily report crimes to the nearest police station, and that the responding police stations are not always those closest to the locations of reported crimes (see Box 1). These findings are relevant given that local police stations are meant be the first responders to reported crimes, except, perhaps, in more unusual situations, such as a hostage crisis or bomb scare. The MGI study thus permits the police to identify ways to enhance their resource deployment to improve efficiency.[7]

By extracting information from both internal and external datasets, geospatial technologies can create maps on which crime data is presented as points, each of which represents a specific crime location, or as polygons, each of which stands for the number of crimes per community. The same technology makes it possible to generate models, such as hot spot models.[8]

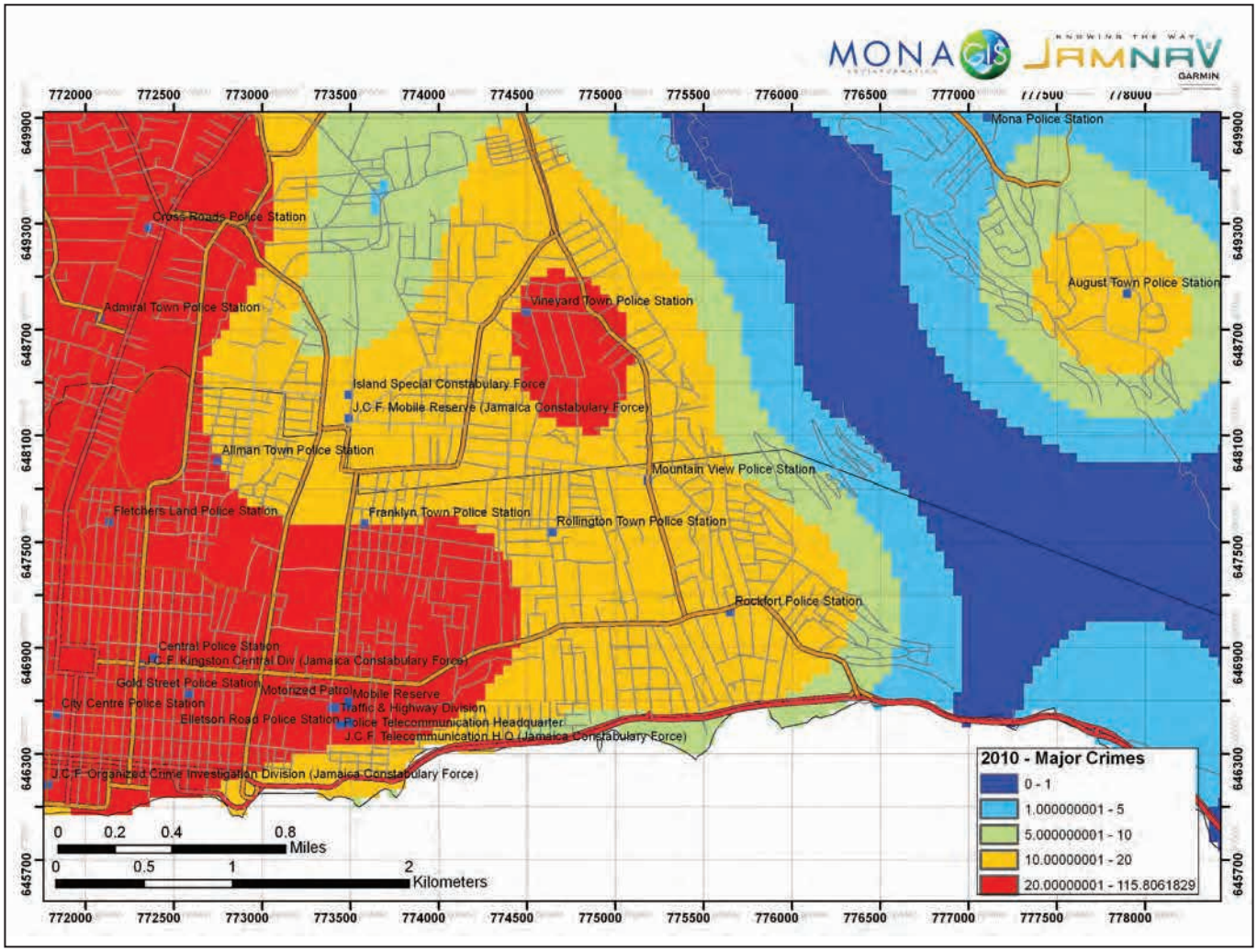
The scale of such maps and models is selected based on the desired level of analysis, whether it is at the national, parish, divisional, station, community, or individual level. If an analysis is to be undertaken at the national level, the parishes of Kingston and St. Andrew may emerge as hot spots (see Map 1); at the community or individual level, however, only specific parts of Kingston and St. Andrew will appear as hot spots (see Map 2).

Map 1 **Homicide hot spots in Jamaica, 2007**



Source: MGI

Map 2 **Major crime hot spots in eastern Kingston, 2010**



Source: MGI

Lyew-Ayee (2006) postulates that hot spot distribution will vary for different crimes. Shootings and murders may have similar patterns. Robberies, however, reveal different patterns that generally follow concentrations of commercial activity. Different types of murder (such as gang-related or domestic) and robberies (such as aggravated robberies or break-ins) also have different hot spot patterns. Adding a temporal dimension to this type of analysis can shed light on patterns in crime movements and inform effective anti-crime initiatives.

Centrographic analysis is one of several modelling approaches (Lee and Wong, 2001).[9] By revealing the geographic centres of point distributions, such analysis has been able to show that the geographic centre of crime in Kingston and St. Andrew has barely shifted over the past ten years, and that it has been steadily hovering in the Cross Roads region. The geographic centre of Kingston and St. Andrew is the community of Half-Way-Tree, to the north of Cross Roads, with the high density of crimes in downtown and western Kingston skewing the distribution southwards; at the same time, crimes in Grant's Pen towards the north keep the distribution from being exclusively in the former locales. That the centres of crimes have not moved suggests that the overall pattern of crime has not changed, although local variations may still occur (Lyew-Ayee, 2006).

Modelling can also be used to track the effectiveness of policies and policing initiatives over time and across locations. This approach can assist in monitoring both long-lasting and temporary changes in local crime levels, whereas more general statistics may only record broader increases or decreases in crime, thereby masking local variations (see Table 2).

Community profiles

At the community scale, a map can reveal a great amount of detail on the crime situation. Through the separate initiatives of the Ministry of Health and the Jamaica Social Investment Fund, comprehensive 'asset mapping' of all physical assets of several communities in Jamaica has been carried out. This includes not only mapping each building and street furniture (such as light poles, stop signs, and fire hydrants), but also their physical condition (such as whether a feature is working properly).

This type of information can be of use to various stakeholders. The Ministry of Health, for instance, may use this data to evaluate public health risks, while the Jamaica Social Investment Fund, which assists in poverty alleviation, may use it to determine the degree of engagement required on its part.

Yet a defining advantage of geospatial analysis is the ability to sharpen the focus on crime patterns in particular locales, which is especially important to organizations tackling far-reaching problems with limited budgets. Security forces are able to use this information to process field intelligence and correlate crimes with negative community assets, such as vacant lots and derelict buildings, which may encourage the proliferation of crime; the identification of correlations can then inform the design of effective community policing strategies.

One such correlation emerged in a recent study, which found that the spatial distribution of crime in Jamaica reveals a pattern of concentration in the communities of the urban poor; this pattern overlays areas of social exclusion almost perfectly (Harriott, 2009, p. 9). Similarly, research has identified a spatial correlation between more severe crime and the presence of vacant lots and abandoned buildings in some communities. Specifically, MGI modelled crime in relation to the physical conditions of a community—assuming that vacant lots and derelict buildings are more crime-prone than newly built schools or well-maintained homes, as suggested by the broken windows theory.[10]

A simulation of the restoration of these assets—for example, the conversion of a vacant lot into a playground area—predicted a reduction of the crime weight in that area (Lyew-Ayee, 2006). The same technology can be used to gauge the effects of restoration over time. This approach inherently reduces a very complex problem to a simple linear relationship between crime and physical assets; it is based on the premise that transforming negative assets may reduce crime in a community, and that modelling can help to determine the critical limit beyond which social transformation will have a positive impact.[11]

By providing spatial representations, geospatial technologies have been extremely useful in the process of engaging communities. Such mapping allows for a more immediate appreciation of the nature and extent of crime-related problems, while simultaneously facilitating communication among the security forces, community members, political representatives, non-governmental organizations, and the media. As a result, geospatial outputs promote relatively swift development of neighbourhood-specific solutions, ranging from the planning of playgrounds and the restoration of derelict buildings to coordination with corporate and governmental interests in community revival efforts.

In community meetings organized by the Crime Observatory, for example, residents were given a chance to validate crime data displayed on GIS maps of their communities and neighbourhoods. The coordinators of this

A member of MGI presents a detailed map of the JCF West Kingston Division to Senior Superintendent of Police Delroy Hewitt, the division's former commander, in 2007. © MGI

exercise observed that the residents readily related to the maps and openly discussed the causes of displayed crimes.[12] Given that miscommunication and misunderstandings in volatile areas often have deadly consequences, this ease of interaction is particularly valuable.

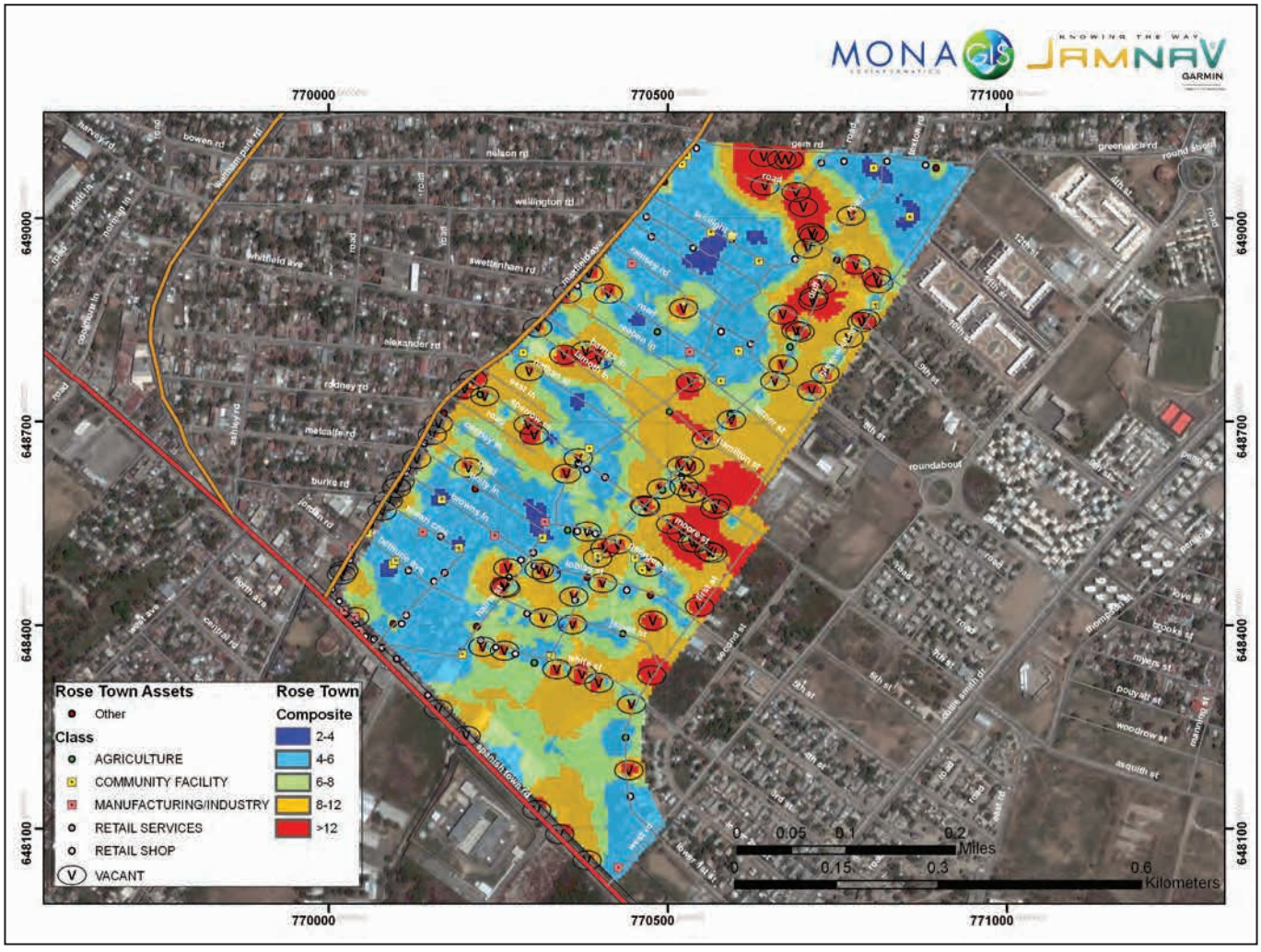
In addition to benefiting from individual input from residents, geospatial mapping can also gain depth and accuracy from the insight of community-based organizations (CBOs). CBOs often serve as front-line responders to local conflicts, providing dispute resolution and problem solving services, especially in politically volatile areas and where the police are not trusted. These CBOs can thus provide critical information regarding incidents referenced—or omitted—on maps and in datasets.[13]

The S-Corner Clinic in Rose Town is one CBO that has used GIS to engage communities beyond general conversations on crime prevention. The Clinic used geospatial technologies to understand community boundaries, to identify stakeholders and key informants, and to coordinate with similar programmes in the community.[14]

Map 3 shows the Rose Town community-scale modelling of crimes against community assets. These assets, which range from schools to bars and vacant lots, are mapped, weighted, and cross-referenced against crimes. The map reveals that there are greater crime concentrations in areas with high-weight assets, namely those that are more prone to criminal activities, such as derelict buildings, vacant lots, and run-down bars. A separate study subsequently corroborated the positive correlation between high-weight assets and crime concentrations; the same study helped to determine the impact of conversion and improvements of physical assets on the community's crime situation (Lyew-Ayee, 2009).

Given that security forces alone cannot ensure community security, citizen engagement is key to crime reduction efforts. To be sure, security outcomes that are shaped by communities broaden the local sense of ownership of crime prevention strategies. While they may represent a diverse set of institutions and agendas, the people who have participated in multi-stakeholder engagements have generally understood the data in similar ways and thus formed the basis for consensus, which is indispensable to collective action. Shared responsibility among the police, the National Housing Trust, and local communities has meant that all actors have gained deeper insight into crime patterns while simultaneously creating feedback loops and ensuring that activities are responsive.

Map 3 **Rose Town: community-scale modelling of crimes against assets, 2008**



Source: MGI

Building social data and spatial context

Many criminologists and social scientists, such as Nagle and Spencer (1997) and Rice and White (2010), have begun to examine the relationship between crime and geography. This development has prompted an increase in the use of GIS for the identification of patterns and to guide resource deployment. An example is CompStat, a GIS-oriented approach to investigations, problem-solving, resource management, and accountability for police patrol routines in the United States. CompStat uses innovative tools in crime fighting and allows for the integration of crime and geographic data to inform policy, signalling a shift in strategy and tactical decision-making. This approach fuses socio-economic and demographic datasets with built environment data, in keeping with the private sector practice of site suitability determination (Rice and White, 2010; see Box 2).

Basic crime data—usually on robberies, shootings, violence-related injuries, and murder, although sometimes also on crimes such as trafficking, kidnapping, or arson—often lacks details regarding information such as the setting, motivation, relationship between victims and perpetrators, and time of day. Even when base data—such as roads and community boundaries—are overlaid on a map showing crime data, the full potential of geospatial technologies generally is not attained (despite the economic investments made to acquire them).

Socio-economic data may contain population characteristics that can be used in conjunction with the crime data. The data may include the overall population count, sex, age, education levels, poverty, employment, and many other variables. These may be scaled up to enumeration district scale, allowing for greater resolution of local demographic and socio-economic dynamics in comparison to crime data.

Comparisons are the key to establishing meaningful statistical relationships between crime and other variables. Different types of crimes may follow different socio-economic patterns. For example, gang-related murders have a distinctly different (clustered) pattern associated with lower-income communities than do domestic murders, which are more random (Lyew-Ayee, 2006).

Box 2 **Spatial contextual data**

Spatial contextual data can be separated into two broad categories and their sub-categories, as follows:

I. Socio-economic data

- a. Population
- b. Income and employment
- c. Demographics
- d. Political data

II. Built environment data

- a. Road and traffic information
- b. Retail and business locations
- c. Housing
- d. Schools and community assets
- e. Police and other security asset infrastructure
- f. Telecommunications assets

Police officers engage with residents of areas identified–using geospatial analysis–as crime 'hot spots', at the annual 'Peace for Champs' sports event, University of the West Indies, Mona, Kingston, September 2012. © Stewart Reeves

Anti-gang initiatives should therefore target key areas based on relevant metrics, regardless of whether the programmes are led by security forces or CBOs.

The analysis of crime relationships can also make use of political data. Typically, garrison politics are involved wherever one of Jamaica's two main political parties claims exceptionally high margins of victory, usually in depressed communities. Garrison communities are usually defined as areas with a close intertwining of political and criminal activities that are strictly controlled by gang leaders known as 'dons', who have strong political allegiances (Kalunta-Crumpton, 2012). In these garrisons, opposition to the main party is not tolerated and some insubordinates are even subjected to property damage or bodily harm; the loss of life is not unusual. Where adjacent constituencies or electoral subdivisions have very high margins of victory for different political parties, the potential for border conflict is very high, with die-hard political supporters often escalating tensions to physical violence. MGI has used GIS to overlay crimes along these frontiers to assess the relationship between garrisons and crime, and to determine what other factors are at play.

The distribution of infrastructure also plays an important role in explaining crime activity and patterns, as well as their mitigation and control (Rice and White, 2010). Infrastructure may provide routes and pathways for the spread or control of crime via road networks; meanwhile, housing developments can prevent crimes from festering, as can the presence of police stations and social infrastructure.

Local authorities usually aim to control or eliminate the presence of squatters and informal settlements, many of which have limited or no access to government services and infrastructure. In Jamaica, the Ministry of Transport, Works and Housing is currently undertaking the development of a squatter management plan. While informal settlements are sometimes perceived as dangerous, there is no evidence to suggest that they experience more violent crime than other communities. Indeed, Gelderblom and Kok (1994) posit that the stigmatization of informal settlements and their residents has created two intertwined cycles. The process begins when outsiders develop negative perceptions of informal settlements, which leads to greater feelings of insecurity and fear in adjoining communities, and eventually to decreases in property values. These effects, in turn, strengthen the stigmatization of informal settlements.

State of emergency, 2010: an example of the targeted use of GIS

A state of emergency was declared in Jamaica in May 2010, when a major joint police and military operation took place to apprehend Christopher Coke, a criminal sought by the United States in connection with the trafficking of narcotics and firearms. In the process, there were major community upheavals and displacement, revealing the depth of the problems that exist in the inner cities, where most security incursions took place.

Coke, a powerful community leader who was heavily involved in criminal activities, was considered one of the country's most powerful 'dons'. He controlled the community of Tivoli Gardens and prevented the Jamaican security forces from gaining access to this neighbourhood without his consent. Then Prime Minister Bruce Golding delayed Coke's extradition order for months but eventually bowed to international pressure and allowed his arrest in early May 2010. In an attempt to thwart Coke's arrest, residents converted Coke's stronghold, and the nearby community of Denham Town, into a fortress. Barricades of debris were mounted across the West Kingston communities as the Jamaican police and soldiers surrounded Tivoli Gardens to arrest the gang leader (Schwartz, 2011).

Among the main problems identified in the Planning Institute of Jamaica post-event assessment was the need for job creation in the community, and for the direct engagement of the private sector in providing solutions to unemployment. Two main areas for job creation emerged—manufacturing and construction (ECLAC, PIOJ, and UNDP, 2010). GIS technology was used to map all major commercial enterprises in the area and to correlate these with the socio-economic community profiles.

It turned out that, although the entire region was ringed by commercial centres to the north, east, and west, with Jamaica's main industrial belt to the south, there was very little economic activity within the inner-city communities surrounding Western Kingston. In fact, socio-economic data showed very high unemployment and poverty levels in these areas (Ward, 2012).

The same data was provided to potential investors for their planning purposes, both for direct engagement or employment of inner-city residents, and for use in corporate foundation projects, such as sponsorships of community centres or schools. Further, satellite imagery and remote sensing was used to identify areas that could be slated for greenfield or brownfield development, such as through the creation of playgrounds or housing complexes.[15] In this example, GIS was used as a socio-economic planning tool, with implications for crime reduction, as postulated by Nahoun and Vellani (2001).

Conclusions

This *Issue Brief* illustrates how geospatial technologies—ranging from GPS hardware to GIS software—are currently used to fight crime in Jamaica. Extending well beyond the capacity to create static maps, these tools allow for modelling and other types of high-end analysis. In particular, they enable stakeholders to overlay various types of data—be it socio-economic or infrastructural information—on crime data to inform policies and activities designed to fight crime.

This technology has been used not only by the security forces, but also by researchers, policy-makers, community-based organizations, and private sector actors. Moreover, it has empowered communities to become active partners

in violence reduction initiatives. While general awareness of and capacity levels regarding geospatial technologies have yet to be raised, their utility is likely to grow for individuals and organizations that are seeking to enhance security at the local level and beyond. ■

List of abbreviations

CBO
Community-based organization

GIS
Geographic information systems

GPS
Global Positioning System

JCF
Jamaican Constabulary Force

MGI
Mona GeoInformatics Institute

Notes

1 Within the JCF, the GIS Unit—a sub-unit of the Statistics and Data Management Unit—is the GIS nerve centre.

2 Astley Henry telephone interview with Norman Heywood, Senior Superintendent of Police, Jamaica Constabulary Force, 2 March 2012.

3 See Podgórecki, Alexander, and Shields (1996).

4 Geospatial technology can play a role in the tracking of both real-time and historical case data employed in digital forensics. In cellular phone tracing, signals are identified and triangulated using cellular towers; in combination with map information, this process allows security actors to locate precisely where they need to intervene (Volonino, Anzaldua, and Godwin, 2007).

5 Astley Henry interview with Parris Lyew-Ayee, director, Mona GeoInformatics Institute, Kingston, 27 February 2012.

6 Information based on the authors' fieldwork using GIS in collaboration with the security forces.

7 Astley Henry interview with Parris Lyew-Ayee, director, Mona GeoInformatics Institute, Kingston, 27 February 2012.

8 Hot spots may be defined as 'geographic areas that experience higher than average levels of crime for a consistent period of time' (Paynich and Hill, 2009, p. 193).

9 Centrographic data has two-dimensional correlates that include the basic statistical moments of a single-component distribution of statistical operations, such as mean and standard deviation (Harries, 1999).

10 The broken windows theory holds that urban disorder and vandalism can exacerbate crime and, by extension, that the process of maintaining and monitoring urban areas can curb crime. See Kelling and Wilson (1982) and Kelling and Coles (1998).

11 In contrast to this linear approach, many academic studies on crime—such as Figueroa and Sives (2002) and Levy (2001)—discuss the complexities of Jamaica's crime landscape, highlighting relationships between crime and politics, economic status, employment, housing, education, and other factors. Still other studies, such as Bernard and Kn'Ife (2011), look at operational problems, including resources and equipment, training, and the degree of force required when executing an operation.

12 Astley Henry interview with Elizabeth Ward, chair, Violence Prevention Alliance, Kingston, 29 March 2012.

13 Astley Henry telephone interview with Wendy-Jo Williams, social development manager, National Housing Trust, 20 April 2012.

14 Astley Henry interview with Angela Stultz, executive director, S-Corner Clinic, Kingston, 13 February 2012.

15 *Greenfield* projects involve previously undeveloped sites for commercial development or exploitation whereas *brownfield* projects relate to previously developed urban development sites.

References

Bernard, Allan and K'adamawe Kn'Ife. 2011. *JFC Benchmarking & Performance Indicators Youth Survey*. Kingston: Market Research Services Limited/United States Agency for Development. <http://www.synisys.com/cbsi/resourceProfile.jsp?rId=166>

Bernhardsen, Tor. 2002. *Geographic Information Systems: An Introduction*, 3rd edn. New York: Wiley.

Blake, Cecile. 2009. *Making Geospatial Data, Products and Services Available and Accessible in Jamaica*. Ninth United Nations Regional Cartographic Conference for the Americas, New York, 10–14 August.

Crime Observatory. 2006. *Newsletter*, Vol. 1, Iss. 1. Kingston: Violence Prevention Alliance.

ECLAC, PIOJ, and UNDP (Economic Commission for Latin America and the Caribbean, Planning Institute of Jamaica, and United Nations Development Programme). 2010. *Report of the Macro Socio-Economic Effects of the Events in Western Kingston Area, 22 May–7 June 2010*. <http://www.pioj.gov.jm/Portals/0/Sustainable_Development/final%20report- tivoli.pdf>

Figueroa, Mark and Amanda Sives. 2002. 'Homogenous Voting, Electoral Manipulation and the "Garrison" Process in Post-Independence Jamaica.' *Commonwealth and Comparative Politics*, Vol. 40, No. 1, pp. 81–108.

Gelderblom, Derik and Pieter Kok. 1994. *Urbanisation: South Africa's Challenge*, Vol. 2. Pretoria: HSRC Publishers.

Girvan, Norman. 1997. *Poverty, Empowerment and Social Development in the Caribbean*. Kingston: Canoe Press, University of the West Indies.

Green, Harry and Anna Haines. 2012. *Asset Building and Community Development*. London: Sage Publications.

Harries, Keith. 1999. *Mapping Crime: Principle and Practice*. Washington, DC: National Institute of Justice, United States Department of Justice.

Harriott, Anthony. 2009. *Controlling Violent Crime: Models and Policy Options*. Kingston: Grace Kennedy Foundation.

Heywood, Norman. 2009. *Geographic Information System in Crime Fighting: An Examination of the Use of Geographic Information System as a Crime Management Tool within the Jamaica Constabulary Force*. Unpublished thesis submitted to the University of the West Indies, Mona Campus.

JCF (Jamaica Constabulary Force). n.d. 'Major Crimes in Jamaica, 2008–2010.' <http://www.jcf.gov.jm/sites/default/files/JCF_Stats_2008_2010.pdf>

Johnson, C.P. 2000. *Crime Mapping and Analysis Using GIS*. Geomatics Conference on Geomatics in Electronic Governance, Pune University, India, January.

Kalunta-Crumpton, Anita, ed. 2012. *Race, Ethnicity, Crime and Criminal Justice in the Americas*. New York: Palgrave Macmillan.

Kelling, George and Catherine Coles. 1998. *Fixing Broken Windows: Restoring Order and Reducing Crime in Our Communities*. New York: Martin Kessler Books.

Kelling, George and James Wilson. 1982. 'Broken Windows: The Police and Neighborhood Safety.' 1 March. < http://www.theatlantic.com/magazine/archive/1982/03/broken-windows/304465/?single_page=true>

Lee, Jay and David Wong. 2001. *Statistical Analysis with ArcView GIS*. New York: John Wiley and Sons, Inc.

Levy, Horace. 2001. *They Cry Respect! Urban Violence and Poverty in Jamaica*. Kingston: Centre for Population, Community and Social Change, University of the West Indies.

Lyew-Ayee, Parris. 2006. *Crime Mapping, Analysis, and Strategies for Crime Mitigation: Special Report to the Ministry of Health*. Kingston: Promotion and Protection Division, Ministry of Health. Unpublished report.

—. 2009. 'Spatial Tools for Fighting Crime: The Use of Geospatial Technologies in Crime-Fighting in Jamaica.' In Basil Reid, ed. *A Crime Solving Toolkit: Forensics in the Caribbean*. Trinidad and Tobago: University of the West Indies Press, pp. 75–91.

—. 2010. 'Analysis of the Distribution of Crimes and VRIs against the Distribution of Police Stations.' Unpublished data.

Mackey, David and Kristine Levan. 2011. *Crime Prevention*. Massachusetts: Jones & Bartlett Publishers.

McLean, Andrew. 2009. *Community Security and Social Cohesion: Towards a UNDP Approach*. Geneva: Bureau for Crisis Prevention and Recovery, United Nations Development Programme. < http://www.undp.org/content/dam/thailand/docs/CommSecandSocialCohesion.pdf>
McLean, John, et al. 2008. *Jamaica: Community-Based Policing Assessment*. Commissioned by the Jamaica Constabulary Force and the United States Agency for International Development. March. <http://pdf.usaid.gov/pdf_docs/PNADT846.pdf>
Moser, Caroline and Jeremy Holland. 1997. *Urban Poverty and Violence in Jamaica*. Washington, DC: The World Bank.
Nagle, Garrett and Kris Spencer. 1997. *Geographical Enquiries: Skills & Techniques for Geography*. Cheltenham: Nelson Thornes.
Nahoun, Joel and Karim Vellani. 2001. *Applied Crime Analysis*. Woburn, MA: Butterworth Heinemann.
Paynich, Rebecca and Bryan Hill. 2009. *Fundamentals of Crime Mapping: Principles and Practice*. Sudbury, MA: Jones & Bartlett Publishers.
Podgórecki, Adam, Jon Alexander, and Rob Shields, eds. 1996. *Social Engineering*. Ottawa: Carleton University Press.
Rice, Stephen and Michael White. 2010. *Race, Ethnicity, and Policing: New and Essential Readings*. New York: New York University Press.
Schwartz, Mattathias. 2011. 'A Massacre in Jamaica.' *New Yorker*. 12 December. <http://www.newyorker.com/reporting/2011/12/12/111212fa_fact_schwartz?currentPage=all>
Smith, George. 2002. 'Commentary: Behind the Broad Street Pump: Aetiology, Epidemiology and Prevention of Cholera in Mid-19th Century Britain.' *International Journal of Epidemiology*, Vol. 31, No. 5, pp. 920–32. <http://ije.oxfordjournals.org/content/31/5/920.full.pdf>
UNDP (United Nations Development Programme). 2012. *Caribbean Human Development Report: Human Development and the Shift to Better Citizen Security*. New York: UNDP.
UNODC (United Nations Office on Drugs and Crime). 2011. *Global Study on Homicide 2011: Trends, Contexts, Data*. Vienna: UNODC.
— and World Bank. 2007. *Crime, Violence, and Development: Trends, Costs, and Policy Options in the Caribbean*. Vienna and Washington, DC: UNODC and World Bank.
Violence Prevention Alliance. n.d. Website. <http://www.vpajamaica.org>
Volonino, Linda, Reynaldo Anzaldua, and Jana Godwin. 2007. *Computer Forensics: Principles and Practices*. New Jersey: Pearson/Prentice Hall.
Ward, Elizabeth. 2012. 'Linking National Data Collection to the Development Agenda in the Caribbean Region.' Presentation made at the conference on 'Knowledge for Change: Data and Research to Inform Policy Making and Strengthen Children's Protection from Violence.' Sätra Bruk, Sweden, 21 June.
—, et al. 2002. 'The Establishment of a Jamaican All-injury Surveillance System.' *Injury Control and Safety Promotion*, Vol. 9, Iss. 4, pp. 219–25.

About the authors

Parris Lyew-Ayee is director of Mona Geoinformatics Institute (www.monagis.com) and head of the Geography and Geology Department, both of which are located at the University of the West Indies, Mona Campus.

Lisa-Gaye Greene is projects manager at MGI.

Acknowledgements

The authors would like to thank Elizabeth Ward of the Violence Prevention Alliance (www.vpajamaica.org) for her assistance and ongoing support.

About the Small Arms Survey

The Small Arms Survey serves as the principal international source of public information on all aspects of small arms and armed violence, and as a resource centre for governments, policy-makers, researchers, and activists. In addition to Issue Briefs, the Survey distributes its findings through Research Notes, Occasional Papers, Special Reports, a Book Series, and its annual flagship publication, the *Small Arms Survey*.

The project has an international staff with expertise in security studies, political science, international public policy, law, economics, development studies, conflict resolution, sociology, and criminology, and works closely with a worldwide network of researchers and partners.

The Small Arms Survey is a project of the Graduate Institute of International and Development Studies, Geneva. For more information, please visit: www.smallarmssurvey.org.

About the Geneva Declaration on Armed Violence and Development

The Geneva Declaration on Armed Violence and Development is a high-level diplomatic initiative designed to help states and civil society actors to achieve measurable reductions in the global burden of armed violence and tangible improvements in human security worldwide. To date 112 states have endorsed the Declaration.

The Small Arms Survey hosts the Geneva Declaration Secretariat, and provides policy-relevant information to support armed-violence prevention and reduction.

For more information, visit www.genevadeclaration.org.

Credits

Authors: Parris Lyew-Ayee and Lisa-Gaye Greene
Copy-editor: Tania Inowlocki
Proofreader: Donald Strachan
Design and layout: Richard Jones (rick@studioexile.com)

Contact details

Small Arms Survey
47 Avenue Blanc, 1202 Geneva, Switzerland

t +41 22 908 5777 **f** +41 22 732 2738
e info@smallarmssurvey.org