

Original Paper

Urban Crime Mapping: A Review

Dukiya J. J.¹

¹ Centre for Disaster Risk Management and Development Studies, Federal University of Technology, Minna, Nigeria

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Abstract

The imperfection of man is the banes of all criminal activities worldwide. More so, global urbanization and technological advancement seem to catalyze the frequency and complexity of criminal activities generally. Crime in its entire ramification is a critical issue that has gained significant attention in most countries of the world Nigeria inclusive. In view of the alarming rate of crime globally and the GIS utilities, this paper therefore carried out a review of the principles and theories of crime mapping, types of crime mapping and the nexus between poverty and urban crime. The paper further examined the relationship between urban design and spatial dimension of urban crime, and the implication for Urban and Regional Planning professional education as one of the key players in environmental management. It is therefore recommended that the teachings of Urban and Regional Planning in educational institutes should include the key theories within environmental criminology. While national and international conferences and workshops around urban and regional planning should presently revolve around settlement safety and urban governance.

Keywords

crime, mapping, poverty, sustainability, urban design, and environmental criminology

1. Introduction

The depravity and carnality of man is the banes of all criminal activities worldwide and this is been aggravated by global urbanization and technological advancement that seem to catalyze the frequency and complexity of criminal activities generally. The key focus and requirement of good governance is the creation and sustenance of a society that is safe, functional and egalitarian, and this is to be achieved through an effective environmental management and policing. Crime in its entire ramification is a critical issue that has gained significant attention in most countries of the world Nigeria inclusive. In ordinary language, a crime is an unlawful act punishable by a state or other authority; or an offence that merits community condemnation and punishment, usually by way of fine or imprisonment. The

term “crime” is said not to have any simple and universally accepted definition in modern criminal law, though statutory definitions have been provided for certain purposes (Dent, 2000; Charmad, 2002; Elizabeth, 2003; Weisburd & Lum, 2001). In most popular view, something is a crime if declared as such by the relevant and applicable law. It is therefore defined as an offence or an act harmful not only to some individual but also to a community, society or the state (a public wrong). Such acts are forbidden and punishable by law (Easton, 2010). Under the common law of England, crimes were classified as treason, felony or misdemeanour, with treason sometimes being included with the felonies. This system is still being used in the United States but the distinction between felony and misdemeanour is abolished in England, Wales and Northern Ireland. In countries with common law, crimes may be categorised into common law offences and statutory offences (Police Foundation, 2000). While in the US, Australia and Canada (in particular), they are divided into federal crimes and under state crimes.

Internationally, criminal law is a body of public international law designed to prohibit certain categories of conduct commonly viewed as serious atrocities and to make perpetrators of such conduct criminally accountable for their perpetration. The core crimes under international law are: genocide, war crimes, crimes against humanity, and the crime of aggression, while crimes against international law include:

- i. Crimes against peace
- ii. Crimes of apartheid
- iii. Forced disappearance
- iv. Genocide
- v. Piracy
- vi. Sexual slavery
- vii. Slavery

Crime management and analysis is more of the duties of the law enforcement agents in any country particularly the police force (Chamard, 2003; Mamalian & La Vigne, 1999). Criminal activities are spatial in nature with some peculiar attributes that calls for professional analysis using Spatial Decision Support System (SDSS). Mapping on the other hand is the act of displaying natural and man-made features or activities on the maps by the aid of convectional symbols that are geo-referenced by cartographers. Crime mapping is as old as human geography and mapping reading. It is therefore the display of analytical result of spatial distribution of criminal activities within a given locality (Harries, 1999). The works of sociologist in Chicago since 1900s have revealed that crime is to a large extent caused by community- and neighbourhood-level variables, such as land use, infant mortality rates, mental disorders, tuberculosis, and the percentages of minorities and families on social assistance. Hence the continuous challenge for physical planners even in the contemporary time.

1.1 Reviewed Literature

Crime mapping is a term used in crime management particularly in urban policing to refer to the process of conducting spatial analysis within a given geographical space and time, in another word, it is the process of using a Geographic Information System (GIS) tool to conduct spatial analysis of crime problems and other police-related issues (Canter, 1997). Crime analyses involve clarifying where different types of crime and other incidents occur. Because of the unique nature of the spatial analysis software used and the prominence of geographic data in crime mapping, this type of analysis is often discussed as though it is distinct from general crime analysis. Crime mapping is complementary to all forms of crime analysis in that it plays an important part in almost every analysis (Jinadu et al., 2012). In reality, crime mapping is a sub-discipline of crime analysis that helps to facilitates visual and statistical analyses of the spatial nature of crime and other types of events and allows analysts to link unlike data sources together based on common geographic variables (e.g., linking census information, school information, and crime data for a common area) (Rich, 1995). It also provides maps that help to better communicate analysis results to lowest end users. As illustrates in Figure 1, crime mapping does not stand alone; rather, it is a process that occurs within the larger process of crime analysis. The following are some examples of how crime mapping is used within the three types of crime analysis:

- i. In tactical crime analysis, crime mapping is used to identify immediate patterns for crimes such as residential and commercial burglary, auto theft. For instance, spatial analysis of auto theft incidents may reveal clusters of activity at specific locations that might indicate a crime pattern.
- ii. In strategic crime analysis, crime mapping is utilized in long-term planning and policy formation as it relate to the relationship between criminal activity and indicators of service inadequacies that calls for temporal allocation of resources, such as patrol officer scheduling and determination of patrol areas. It also helps to examine patterns of crime at or around specific locations, such as schools, bars, or drug treatment centers; to calculate crime rate information, such as numbers of residential burglaries per household; and to incorporate crime data with qualitative geographic information, such as information on teenage hangouts, student pathways to school.
- iii. In administrative crime analysis, crime mapping is a valuable tool used by police, researchers, and media organizations to convey criminal activity information to the public. Websites operated by police departments and news organization routinely post maps that depict areas of crime, along with corresponding tables and definitions. For example, a police agency can reduce citizen requests for neighbourhood crime information by placing monthly or weekly crime maps on a Website that members of the public can access.

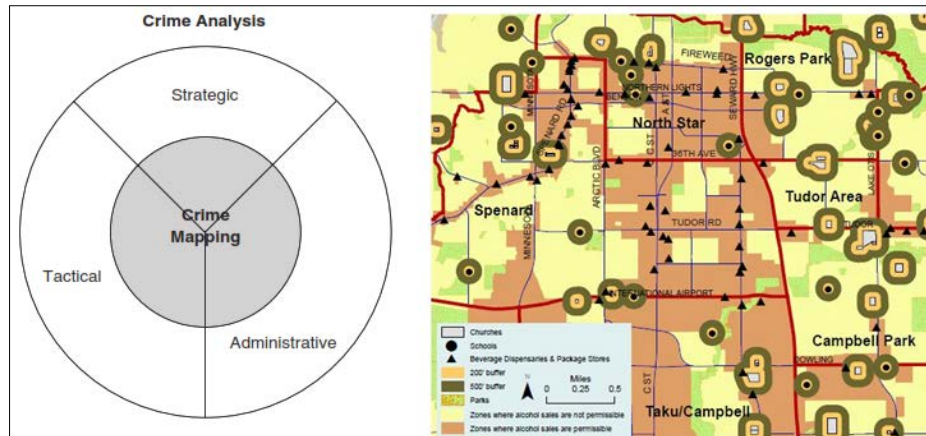


Figure 1. Crime Management and Spatial Buffering Mapping in Crime Analysis

2. Background of Crime Mapping

The evolution of crime mapping can be traced to the work of Geographer Borden Dent titled “Brief History of Crime Mapping,” which traces the origin of crime mapping to France, where in 1829, Adriano Balbi and André Michel Guerry created maps that showed the relationship between violent and property crimes and educational levels. After a few decades, this approach—visually displaying differences in crime across geographic units—had spread to England and Ireland. In 1849, Joseph Fletcher created maps that showed the rate of male incarceration for serious property and violent crimes across counties in England and Wales, and in 1861, Henry Mayhew presented a number of maps displaying the English and Welsh county rates for a variety of crimes: rape, assault, bigamy, and abduction, among others (Chamard, 2006). These early maps display quantities of things in areas called choropleth maps in which geographical areas are divided into multisided figures (polygonal), that are then shaded depending on the value of the variable being displayed.

In 1912, Sociologists like Sophonsiba Breckenridge and Edith Abbott that are associated with the University of Chicago, mapped where delinquent children had lived in Chicago over the period of 1899 to 1903 using dots to represent houses as an example of a point map—that is, a map in which points representing particular geographical locations, be they addresses or XY coordinates, are the main data element. In fact, the best known maps in criminology were created by the Chicago School sociologists Clifford Shaw and Henry McKay, who constructed a choropleth map using aggregations of addresses of close to 3,000 male delinquents in Chicago for the period 1927 to 1933. The map featured polygon shading to indicate rates of delinquency. It was also believed that Like Breckenridge and Abbott, Shaw and McKay constructed point maps of the locations of the homes of about 10,000 male delinquents who had come before the juvenile court of Cook County in the years 1934 to 1940. Shaw and McKay noted that the spatial distribution of juvenile delinquents’ homes remained fairly constant over these differing time spans, despite the fact that there was a high degree of residential mobility in various

areas of Chicago. According to Chamard (2006), their work, with that of others, gave rise to the social ecology approach to studying crime.

The story of crime mapping can be seen as an idea that arose before its time, that is, before the relevant computer technology was available because the earlier crime maps were manually produced and that could take many hours of tedious labour. This was corroborated by what Sean Gilfillan in his article “The Sociology of Invention” defined as the uselessness of premature invention—“an invention which for any reason did come before its time remains underutilized until its proper day dawns.” The right time for crime mapping is the computer age with series of GIS software.

Prior to the widespread use of desktop computers, the few police departments who did crime mapping relied on primitive techniques such as sticking thousands of pins into large maps attached to the wall. In an essay written by Philip Canter on “Geographic Information Systems and Crime Analysis in Baltimore County, Maryland,” the county’s pin-mapping efforts requires about twelve maps and 70 square feet of wall to cover the entire area of the jurisdiction. While these maps were reasonably good for detecting clusters of criminal activity, they did not permit more sophisticated analyses that incorporated other, nongeographic factors, such as modus operandi or time of offense. Such labour intensiveness meant that few police departments could afford to produce computerized crime maps. It wasn’t possible for most agencies to afford crime mapping until desktop computers became widely available in the mid-1980s to early 1990s and microprocessor speed increased.

The advent of GIS software like Idrisi, ArcInfo, MapInfo, ArcGIS, Ilwis, Elders Images, TNT, etc., has transformed the entire operation to minutes of operation where the input data are in digital form. More so, the introduction of mobile mini computers and mobile apps has further quickened the analytical process and decision making process worldwide.

2.1 Principles and Theories of Crime Mapping

Crime can be seen as a mutation in human reasoning and character that has manifestation in all human societal development. Much labour and research have been carried out to unravel why some people engage in criminal behaviour and other do not; there are therefore surfeit theories under the school of criminology that attempt to give explanation to it. While some view crime as normal and parts of any society, the conflict reasoning argue that crime is the result of group conflict and unequal distribution of power. The Macro-level theories made assumptions about societal-level variables that include governmental structures and the economy. While the Micro-level theories make assumption about individual characteristics (Mental state, IQ, temperament and finances) and how they influence a person’s propensity to commit crime. Criminological theories have however expanded to consider the impacts of other variables like victim behaviour, and the physical environment (Brantingham & Brantingham, 1981, 1993). Crime therefore is the interaction among the victims, offender and their environment. It is this examination of crime in time and space together with crime events variables that initiated crime mapping and even the application of GIS.

In the view of Shaw and Mckay (1942) in their social disorganization theory, opine that economic composition of a community contribute to crime by affecting neighbourhood order, and that higher juvenile delinquencies rate tends to cluster in certain neighbourhoods with poverty and residential inequalities that impact on the psychomotor of the youths in the urban areas following bandwagon pull. According to Jones and Bartlett Learning LLC, there are three primary theoretical perspectives been built upon Shaw and Mckay's discovery in the explanation of crime in the spatial context, which are: Routine and Activities theory, Rational Choice Theory, and Crime Pattern Theory, all of which are housed within the Environmental Criminology which serve as a pathfinder to crime prevention in design. For instance, in the Routine Activities Theory, there may always be a suitable target, a motivated offender, and the absence of a capable defender or guardian come together at the same time and place. Clark and Eck (2005) in their bid to expatiate Routing Activities Theory developed the problem analysis triangle (crime triangle) to include the 'controllers' who are handlers, managers, and guardians as illustrated in Figure 2.



Figure 2. Problem Analysis Triangle

Source: After Clarke and Eck (2005).

2.3 Types of Crime Mapping

Several types of mapping are used routinely in crime analysis depending on the technical knowhow of the officers and the nature of the attribute data to be depicted. The following are some of the mapping approaches:

Single-symbol crime maps: In this, individual uniform symbols represent features such as the locations of stores, roads, or states. An important feature of single-symbol maps is that a GIS places all points on such a map that share the same address directly on top of one another, making it impossible for the map to show how many points really there. So there is no way someone looking at the map can see all the objects in the area.

Buffering mapping help in crime analysis by illustrating the relative distances between features on a map by specifying areas around a feature on a map which can be set at small distances, such as 15.24m, or larger distances, such as 800km, depending on the purpose and scale of the map as in Figure 3.

Graduated crime maps—these are maps in which different sizes or colours of features represent particular values of variables. Figure 4 is an example of graduated maps, In a graduated size map, the sizes of the symbols used for point and line features reflect their value. As noted earlier, single-symbol maps are not appropriate for displaying data about crimes that occur at the same locations repeatedly. Analysts use graduated size maps for this purpose, because these maps can account for multiple incidents at the same locations.

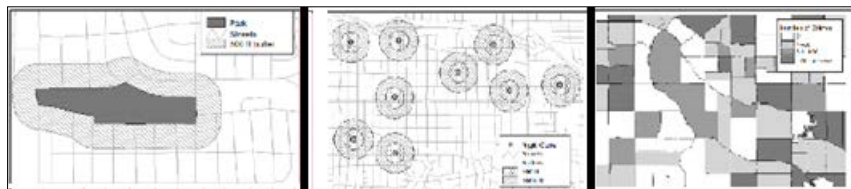


Figure 3. Buffering Map

Figure 4. Graduated Buffers

Density mapping, in this analysts use point data to shade surfaces that are not limited to area boundaries. In their basic form, density maps are shaded according to the concentration of incidents in particular areas. The darker colours represent areas in which the incidents are more concentrated, while the lighter colours represent those in which the incidents are less concentrated.

Interactive crime mapping is simplified geographic information systems made available to novice users over the Internet. Many police departments have interactive Websites where citizens and police officers can conduct basic crime mapping themselves like the East Valley COMPASS (Community Mapping, Planning and Analysis for Safety Strategies) interactive Website, which is hosted by the Redlands, California, Police Department. These applications may not be flexible or sophisticated enough to be useful to crime analysts.

3. Result

3.1 Poverty and Urban Crime Relationship

One major issue that has attracted the attention of most criminologists and others in the field of urban settlement studies is the extent to which crime influence poverty and vis-à-vis. The spate of rural-urban migration in African countries ant the formation of urban-rural dichotomy that has created a phenomenal in which marginal elite is benefiting disproportionately and the majority poor and unemployed are being left behind. It is within the context of economic growth and urbanization that urban crime is noted to be on the rise in Africa largely due to weak governance systems and limited infrastructure and services, including policing (Abrahamsen & Williams, 2007, Obeng-Odoom, 2013; Oteng-Ababio & Melara, 2014; Agyei-Mensah et al., 2015). Although, there seem not to be a universal

conclusion on the relationship between crime and socio-economic conditions due to the varied and, cultural specificity and differences regarding the definition, classification and societal reaction to the crime problem according to Owusu (2016) citing Arthur (1991) and Rose (2006). More so, concepts of what constitute well-being and poverty are highly subjective and definitions vary across countries and regions.

In spite of the above, Owusu (2016) opine that there is a widely-held hunch in crime studies that “crime and fear of crime are unequally distributed across cities, and that areas of higher poverty are likely to be areas of high crime incidence as well”. This aphorism is based on the view that poor areas of cities that are characterized by high unemployment rates, family breakdowns, delinquencies and general social disruptions tend to produce alienation and consequently criminal behaviour (Sampson, 2006). These prevailing conditions of poor areas usually produce criminal behavioural tendencies create teething problems for law enforcement agencies such as the police. In addition, some experts have pointed to social controls (including strong social cohesion) as having a depressing effect on crime incidence (Plumer, 2010, Frimpong, 2016; Oteng-Ababio, 2016; Owusu et al., 2016a). Pare and Felson (2014, p. 435) argue that “most scholars assume that living in poverty increases the likelihood of criminal behaviour”.

Many crime theories have explored the extent to which individual and group characteristics as well as the environment influence crime. To explain the possible association between poverty and crime, Pare and Felson (2014) provide three sets of theoretical explanations:

- i. Discrimination and the lack of legitimate opportunities limit poor people’s access to legitimate societal resources and widely shared goals. This situation therefore forces poor people to access these things illegitimately most often through crime;
- ii. lower social controls, particularly those associated with disadvantaged neighbourhoods, with lower levels of collective efficacy, enhance risks of violence and aggressive behaviours and;
- iii. tendency of people of low socioeconomic status to participate in crime as a results of their socialization experiences leading them to have attitudes that are conducive to crime.

3.2 Relationship of Urban Crime to Planning Profession

Urban and Regional Planning that can be simply defined as the “art and science of the ordering of space for developmental activities for safety, convenience, and functional flow of human interaction” is pivotal to crime management, mapping and prevention activities. Davey et al. (2015) reported that in the late 1990s, the European Committee for Standardization (CEN) set up an international working group to establish criteria on “Crime Prevention through Urban Planning and Building Design”; and that The European Union has also for decades supported the development and implementation of Crime Prevention through Environmental Design (CPTED) across Europe. It is believed that CPTED approaches has help to reduce opportunities for offending behaviour in urban contexts by making crimes harder to commit, less rewarding, etc., thereby helping to reduce victimisation across Europe

(van Dijk et al., 2012; van Dijk, 2013). However, efforts to implement a standardised approach to CPTED delivery across Europe have not been successful (Stummvoll, 2013).

In US, Second Generation CPTED has also been proposed to help tackle domestic abuse, a crime that is usually perpetrated against women and within the home (DeKeseredy et al., 2005, 2009). In Vienna, CPTED has been implemented within gender mainstreaming and urban planning to improve women's feelings of safety in the city (Stummvoll, 2004). Experts in this field collectively pioneered four approaches adapted from the EU researches which can be adapted in other continents to include:

- i. A standardised approach to CPTED delivery across Europe—European Standard for Urban Design and Planning
- ii. A national scheme to embed safety and security criteria into urban development like the Dutch Police Label for Safe and Secure Housing that was inspired by the UK's Secured by Design scheme and first piloted in North Holland.
- iii. Police architectural liaison service redesigned to better meet the needs of architects, developers and planners in Greater Manchester (UK) like the Greater Manchester Police Design for Security service.
- iv. A safety partnership in the German federal state of Lower Saxony that is at the forefront of efforts to integrate safety and security into urban planning, design and management.

One of the key tools of urban planning that appear to project urban inequality is the zonal ordinances. The zoning of urban residential areas into the three major hierarchy of Low, Medium and High Density land use subdivision actually promote socioeconomic discrimination and deprivation that incubate criminal tendencies. According to Owusu (2016) quoting Berrisford (2013, p. 1), planning is very critical for inclusive and sustainable urban development as it offers opportunity to “regulate land use and land development, provide a sound basis for infrastructure planning, secure the rights of investors [and citizens], protect environmental resources and mitigate environmental risks”.

For instance, most site-and-service schemes, the occupation is on cash-and-carry bases that tend to screen off the low income earners, hence the development of urban sprawl and ghettos. However, as Watson and Agbola (2013) pitifully noted, African cities are growing and rapidly getting urbanized without appropriate planning, leading to an increasingly chaotic, and unsustainable urban development. A widely shared view in the criminology literature is that unplanned neighbourhoods and cities with their socio-economic manifestations of poverty and deprivation that facilitate crime and the fear of crime (see Sampson, 2006; Lersch, 2007; Brunton-Smith & Jackson, 2012; Landman, 2012). It adds that this leads to a situation where slums or shanty towns grow, overcome and swallow the already crumbling infrastructures of the urban nucleus, further compounding the challenges of security and crime.

At the same time, the unplanned nature of cities consequently overstretching not only basic infrastructure and services but also policing services of the state (Owusu et al., 2015, 2016a, 2016b). Davey and Wootton (2016) in their own study observed that innovative approaches to integrate crime

prevention into urban design, planning and management have been generated by multi-agency partnerships and collaborations at European, national and city levels. Methods and procedures developed by the European Committee for Standardization (CEN) Working Group on “Crime Prevention through Urban Planning and Building Design” are pioneering. However, findings show that implementation is best achieved at a local level using methods and procedures tailored to the specific context.

4. Discussion

Urban and regional planning profession is one of the key environmental managers that are charged with the responsibility of creating a liveable environment that is safe and function. But according to Paul (2011), at a time of ever-increasing urbanization, research consistently indicates that crime and the fear of crime are key concerns for society and that safety is a vital feature of what is considered a high-quality sustainable environment. It follows that the environment design of human settlement has a significant impact on crime level at a point in place and time; and more important were attributes of the physical and social environment at the city attraction locations. For instance, low guardianship and poor visibility at the focal points together with mixed land-uses in the surrounding areas induced crime rate, Kennedy, 2002; Paul Van, 1996). It is therefore suggested that intervention to improve safety conditions at those critical activity areas should focus on a holistic approach, taking into account the human traffic convergent zones and surrounding areas, while taking cognizance of crime variation on specific cultural believes at a place and time.

Dempsey (2008) lists a range of features that have long been promoted in urban planning and design as socially beneficial, including high residential densities, mixed land uses, accessibility, connectedness and permeability, legibility, attractiveness, inclusiveness, maintenance, safety and character. In the USA and Australia, such ideas are promoted within the general concept of “new urbanism”. Crucially, Dempsey (2008) asserts that such claims are not underpinned by any systematic empirical evidence and that the promotion of one “quality built environment” aspect competes with another, or indeed, against several others. While Paul (2011), argued that the sponsorship of permeable neighbourhoods, mixed-use residential developments and higher densities can come into conflict with the promotion of safety from crime in particular.

It has become more imperative to expand the scope of the teachings of Urban and Regional Planning to include the key theories within environmental criminology that will further enhance those specific features of good qualitative environment which is a paradigm shift in modern urban studies that encourage a more informed dialogue across the disciplines of planning, architecture, urban design and criminology. Sustainability protocols arguably do not adequately represent realistic or appropriate indicators of the levels of crime or the fear of crime (Cozens, 2007a, 2008a). It is therefore argued that; a sustainable urban environment is one where the inhabitants “should not have to fear for their personal safety and the safety of possessions” (Du Plessis, 1999, p. 33). Obviously, the level of crime and

violence in a community are powerful indicators of social sustainability and an “unsustainable” community is commonly characterized by notions of poverty, homelessness and increased levels of crime.

5. Conclusion

Crime mapping as a tool in urban security management especially in the police force is not new but the development of human capacity in crime analysis that leverage on “Big Data” and GIS software is the challenge. Although in recent times, the advancement in IT and GIS software has transformed the complexity and dynamism of crime mapping globally. The planning profession will have much to offer in urban crime management if planners will start to specialize in sociology of urban planning and urban criminology and planning, and the time is now.

It is therefore recommended that the teachings of Urban and Regional Planning in educational institutes should include the key theories within environmental criminology. While national and international conferences and workshops around urban and regional planning should presently revolve around settlement safety and urban governance. In the same vein, the professional Mandatory Continuous Development Programmes (MCDP) of the planning profession and professional curriculum examinations should in-cooperate key theories within environmental criminology that will further enhance those specific features of good governance. This is the essence of professional dynamism that is current and amenable to societal needs.

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