

Crime mapping using Geospatial technologies: A case study of NCT Delhi

Amarjeet Kaur^a, Tarun Ghawana^a, P. C. Khanduri^b, Nakul Tarun^a, C.R. Garg (DANICS)^c, B. C. Nayak, IPS (Retd.)^d

^aCentre for Disaster Management Studies, Guru Gobind Singh Indraprastha University, Delhi ; ^bCrime Branch, Delhi Police;

^cDeputy Commissioner, West District, Delhi; ^dFormer Director (IB)

Abstract:

Crime Mapping is although relatively a new concept in India but in developed countries such hotspot mapping is now a tradition almost. Geospatial technologies help to capture the spatial heterogeneity of the different types of criminal activities and security resources and thus to establish a spatial relationship between the incidents in a particular area of interest. GIS software, such as Spatial Analyst of ESRI in ArcView / ArcMAP, has provided suitable tools which can help security agencies to categorize certain areas as hotspots for certain types of criminal activities as well as to optimize the distribution of their human and other physical resources to respond. Delhi being the capital is a hub of employment activities for people from different states since India became independent. Over the years, migration to Delhi has continued and people have settled in different settlement areas. These settlements have expanded the urban area of Delhi and has resulted in several densely populated colonies, authorized and unauthorized both. With this urban expansion and increase in population, Delhi Police faces certain challenges to maintain law and order situation in control. With this study, we present a case study of Delhi, NCT. The case study shows how using basic GIS mapping of resources & criminal activities in terms of GPS based navigation, GIS based asset management, and route optimization can help police to keep a check on crime and to formulate strategies to tackle criminal activities. The study further recommends to create a GIS based Integrated Command System (ICS) for each district in Delhi NCT which can be used to identify, track and capture the patterns of criminal activities and thus help in spatially informed decision making by Delhi Police Officials. Such system can always have backward and forward relations in terms of GIS based inputs and outputs. On local level, it can be connected to Beat Constables and PCR Vans while on national scale, it can be directly linked with National Crime Bureau.

KeyWords: GIS, Crime Mapping, Police, Delhi, Hot Spots, Optimization

About the Author:



Prof. Amarjeet Kaur

Dr. (Mrs.) Amarjeet Kaur did Ph.D. from Haryana Agriculture University, Hisar. She has more than 22 years of experience in research and training. Her areas of specialization are applications of Remote Sensing Technology in Environmental Management, Disaster Management, and Environmental Biotechnology. Currently, she is the Director of Centre for Disaster Management Studies, Guru Gobind Singh Indraprastha University, Delhi, India.

Mr. Tarun Ghawana

Mr. Tarun Ghawana is a M.Sc. (GIS) from International Institute of Geoinformation Science and Earth Observation, The Netherlands. He has 14 years of experience in GIS. Currently he is a visiting faculty with CDMS, GGSIPU.

Mr. P. C. Khanduri

Mr. P. C. Khanduri is an MBA (Disaster Management) from CDMS, GGSIPU. He is currently working with Crime Branch, Delhi Police.

Mr. Nakul Tarun

Mr. Nakul Tarun has 12 Yrs experience in executing various projects in the field of Disaster Management pertaining to State Governments and Ministry of Home Affairs (MHA), Government of India.

Mr. C. R. Garg (DANICS)

Mr. C. R. Garg an MBA (Disaster Management) from CDMS, GGSIPU. He is currently Deputy Commissioner, West District of Delhi.

Mr. B. C. Nayak, IPS (Retd.)

Mr. B. C. Nayak is a Master's in Political Science and MBA in Disaster Management. For 26 years, he served in the Intelligence Bureau during which he handled several sensitive assignments relating to National Security besides personally overseeing the functioning of Jammu & Kashmir.

Introduction

Crime is a human phenomenon which violates the law and is punishable by the state. Modern world has seen an upsurge in the recording of criminal activities since the global urban process began in the early 19th Century and formal police institutional arrangements began (L. John, 2004; Urbanization of America). In today's world, it is important to analyze the pattern of criminal activities in a certain area to tackle the crime. In developing and less developed countries, crime data is not highly organized and is maintained in many places on hardcopies by manual efforts. Data repository is not standardized (UNDA, 2011). Usually, crime maps are not available in context of crime locations, police station jurisdiction areas, administrative boundaries etc. This makes crime analysis a tedious task with no provision for hot spotting, zonation, navigation facilities, criminal profiling, landuse patterns, terrain conditions etc.

There is a spatial element associated with criminal activities analysis since their distribution is geographically coded (R. Jerry, 2010; B. Donald et. al). The spatial analysis between crime and other factors such as demography, housing and socio-economic conditions can lead to the understanding of the place and crime relationship based on the compared conditions. Operational and tactical aspects of law and order enforcement require developing a (spatial) system by examining patterns that can predict future criminal events and their probable location. Once such pattern is established, it can help timely allocation of resources to promote quick response. Spatial Science based GIS technologies are now advanced enough to capture these patterns in a spatial manner using scientific algorithms. GIS software, such as Spatial Analyst, Network Analyst etc. of ESRI ArcGIS / ArcMap suite, provides specific tools to perform such analysis (ESRI). With this study, we present a case study of Delhi, NCT. The case study shows how using basic GIS mapping of resources & criminal activities in terms of GPS based navigation, GIS based asset management, route optimization can help police to keep a check on crime and to formulate strategies to tackle criminal activities.

Crime Tackling by Police- Potential Strategies

To tackle criminal activities, police agencies of an area require making strategies and taking operational decision, which could be:

- Integrated Command System
- Immediate and effective respond to public distress calls
- Dispatching respond vehicles quickly and at accurate location
- Shortest path to incident location
- Requirement to know real-time availability and location of Patrol vehicles prior to dispatch
- Map based decision support system to aid decision making and planning by authorities

Geospatial Technologies and Crime Mapping

There is a need for a GIS based system for identifying, tracking, visualizing and analyzing the occurrences of criminal activity. GIS could be a tool which could be used for Crime location maps, jurisdiction maps, hot-spot maps, crime spectrum analysis, crime reasoning, zonation and modelling etc. (IACA, 2012; O. David, 2006)

For a crime mapping and analysis system, spatial and non-spatial information can be collected, collate, analyzed and disseminated using Geospatial technologies in context of three major categories:

- Tactical Analysis

To provide information to assist in identification of specific and immediate problems with a view to promote quick response. The system, by examining patterns, can forecast possible dates, time and location of future criminal events. Once the pattern is established the information is further disseminated for action and planning.

- Administrative Analysis

It is carried out to prepare special reports like periodical crime reports and statistically summaries for internal and public issue. Once marked in GIS, often reported jurisdiction disputes can be solved easily and quickly.

- Operational Analysis

This involves operation analysis of policing practices and work load indicators with respect to resource location. The details and recommendations can then be presented to decision makers to take a decision for more effective resource utilization including planning and budgeting.

Some of the mentionable benefits of GIS in crime analysis are:

- Information on any kind of crime occurring in the region will be available on clicking at the feature on the digital map
- Police Department can pose queries to the system and get response, both in terms of maps and database table. For example, the system can be queried to display all regions where crime rate against SC/ST is above 70%.
- Display the map with all the details like police station, jail location, buildings, railway lines, roads etc.
- Click and find out information of an Event / Accident and get a report describing its type, location, date, time etc.
- Easy location identification / verification

Delhi Police and Zonal Integrated Police Network (ZIPNET) Project

ZIPNet (Zonal Integrated Police Network) was introduced in the year 2004 of ACP, Crime, Delhi, INDIA. The main objective of the Project is to share Crime and Criminal Information in real-time. Project is approved by the MHA, INDIA. It provides Search Engines to match information from Central repository in online environment. Initially, it was brought forward with the collaborative efforts of Delhi, Haryana, Uttar Pradesh, Rajasthan Police. Subsequently, in the year 2008, Punjab and Chandigarh Police also joined it. Uttarakhand Police has also joined it in the month of October, 2008. Himachal Pradesh Police joined the project on 25.1.2012. It contains various modules for public/police domain such as FIR(Heinous Cases : Murder, Dacoity, Robbery & Snatching; Most Wanted Criminals; Missing Children; Un-identified Dead Bodies; Stolen Vehicles; Jail Releases(Authenticated Users Only)

ZIPNET Data Extraction

Under the Victims category, on clicking “Missing Children”, it provides you the link to the website launched by Ministry of Women and Child Development where “Missing and Recovered” link can be used (Figure 1).



Figure 1: National Tracking System for Missing and Vulnerable Children; Source: Ministry of Women and Child Development



Figure 2: Data browsing, filtering and search methods of ZIPNET

Other categories of victims and stolen items can be searched through 3 different data browsing, filtering and search methods available at the ZIPNET website (Figure 2 and 3).

- Browse All – It provides a complete list of the data for the crime category selected, reverse sorted on date.
- Filter – It provides option to select all the records pertaining to a particular state, district or police station, reverse sorted on date.
- Search – It allows extracting required information from the central databank by providing available information about the selected crime category.

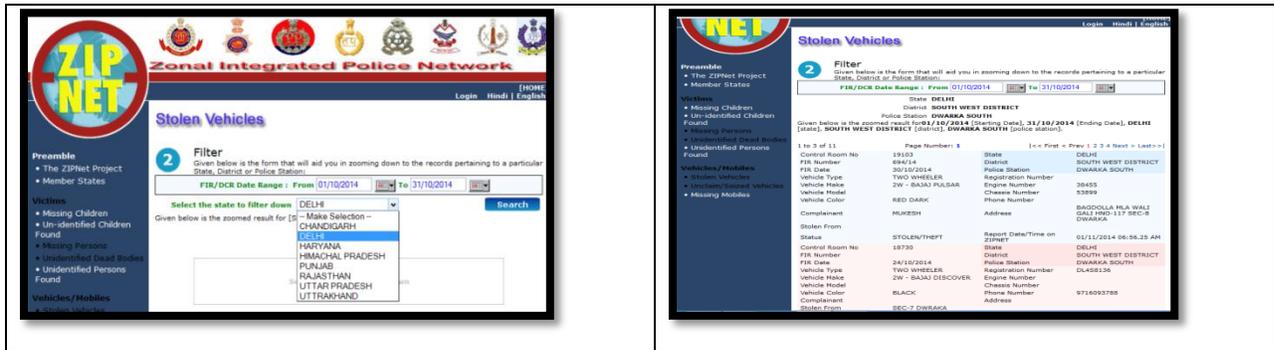


Figure 3: ZIPNET Data Extraction Option “Filter”

Discussion- Spatial-Temporal Aspects of Crime Data on ZIPNET

ZIPNET provides crime data covering spatio-temporal aspects for various criminal activities. For each category of criminal activity, data can be extracted for a particular date or a certain time period on various spatial scales such as state, district and then police station. Through “Filter” mechanism, it allows to find out the spatial and statistical attributes of First Hand Information Report for each extracted result.

To understand the criminal activities patterns, along with the ZIPNET data, crime location identification, landuse pattern, terrain and infrastructure data including roads, streets, police stations, Mobile units locations etc. can be used for route optimization, service area zone, hot spots.

As an Example, we have taken data from ZIPNET for criminal activity category of ‘Stolen Vehicles’ between 1 October and 30 October 2014, under the jurisdiction of a police station “Dwarka South” in Delhi and plotted it on high resolution global imagery. This is done to show the geospatial technology potential using ZIPNET data. Figure 4 shows various possibilities of using ZIPNET FIR summary sample data (4B). Figure 4A shows the nearby location of some vehicle theft incidents reported. Location of the incident for the FIR summary sample data obtained from ZIPNET is circled. Figure 4C shows the location of the Police Station “Dwarka South” and the reported vehicle thefts. It also shows a representative “Optimized Route” to reach the incident location. Similar way, other GIS analytical features can be used for hotspot mapping, service area (zoning) coverage, finding nearby facility etc. as shown in Figure 5.

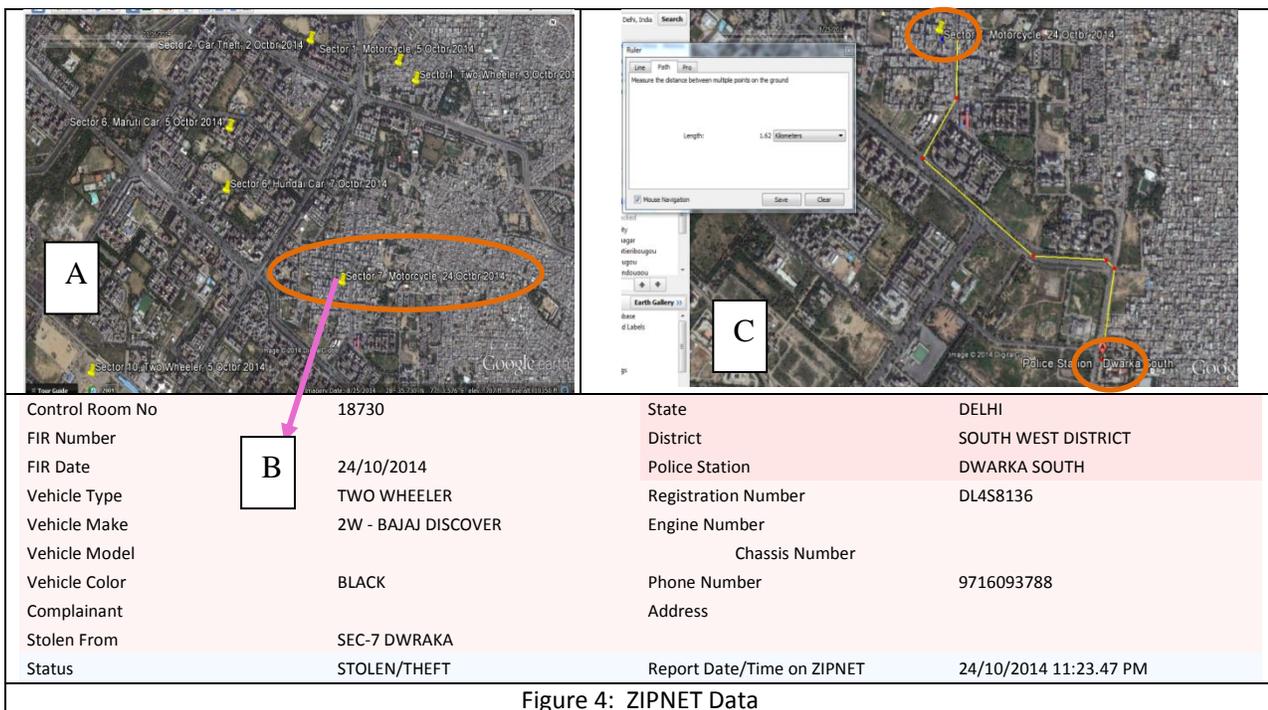
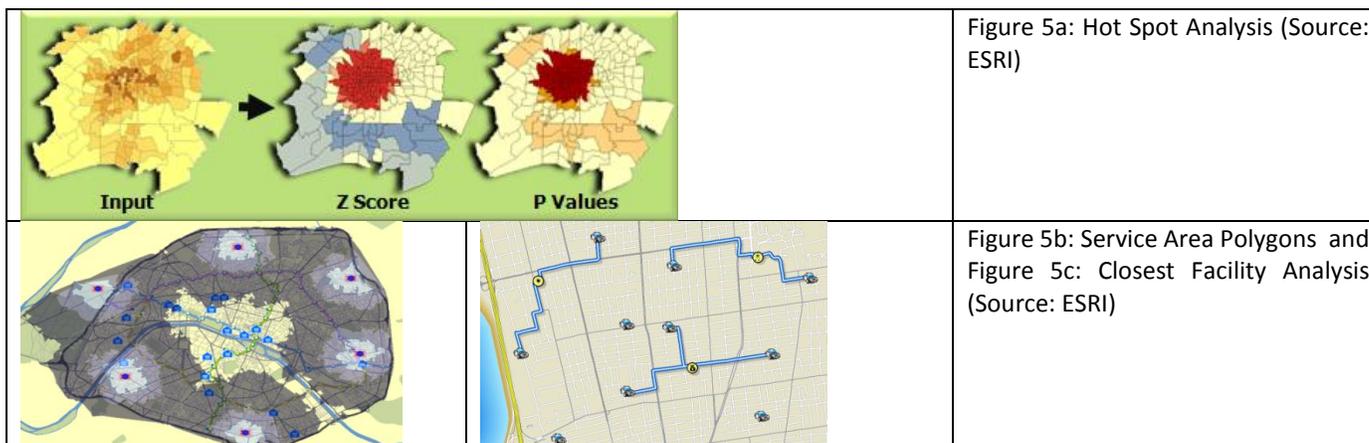


Figure 4: ZIPNET Data

ArcGIS Suite from ESRI is a popular GIS Software which provides tools (Figure 5) which can be easily used to perform such analysis. Using such user-friendly tools, many types of spatial patterns can be detected from the integration of crime data available on ZIPNET and landuse planning. Using landuse planning data, crime-tackling agencies such as Delhi Police can understand the local conditions of infrastructure, potential movement /escape route and hideouts of criminals. Latest landuse change information over a period can provide the potential for new hot spots, routes etc. Based on other details of crime, along with jurisdiction boundaries spatial data, different types of categorization maps can be created such as car theft variations in a particular time period in a particular police station or district or state jurisdiction.



Conclusion and Recommendations

The study further recommends creating a GIS based Integrated Command System (ICS) for each district in Delhi NCT which can be used to identify, track and capture the patterns of criminal activities and thus help in spatially informed decision making by Delhi Police Officials. Such system can always have backward and forward linkages in terms of GIS based inputs and outputs. On local level, it can be connected to Beat Constables and PCR Vans while on national scale, it can be directly linked with National Crime Bureau. ZIPNET is serving currently more as an online central data repository with open and restricted access to various types of crime activity data. We recommend making it geospatial enable so that it can provide location information as well as relation between various parameters data through different maps as per the user requirement. It is important to conduct a detailed research study to understand how the geospatial technologies can best utilize the information available with ZIPNET and thus help police of Delhi NCT in better informed decision making.

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