Analysis of Spatial Patterns of Urban Street Crimes by using GIS: A Case Study of Faisalabad City

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Summary

The Geographic Information System have become an important and useful tool in the implementation of crime control and monitoring activities in crimes affected areas and it has the ability to examine spatial relationships of phenomena. The present study has been taken up for detecting the hotspots of street crimes and developing the crime control strategies in the Faisalabad city of Pakistan. The spatial patterns of urban street crimes were analyzed. The crime reports of 2012 were geocoded and the crime maps were prepared in ArcGIS 10. The strategic crime analysis was done in a series of meetings with police department and crime controlling strategies were built. The *Compstat* model with some modifications was followed for the accountability and performance management of police department. Operational analysis were carried out for resource allocations and deployment. After implementing crime control strategies it has been observed that there was a remarkable reduction in the street crimes. The crime data of 2013 was plotted on map and the hotspot changing patterns were observed.

KEYWORDS: Crime Mapping, hotspot shifting, operational analysis

1. Introduction

The crime rate in Pakistan has been increasing for many years and the events of crime are being done with additional excellence and complexity. Because the Pakistani security personals have not latest, adequate technology and enough manpower, therefor they cannot tackle the problems or crime events more effectively. They lack on many frontiers but the major missing ingredient is the use of technological tools which enable law enforcement agencies to address the urban crimes in an advanced manner. GIS is the main idea to deliver the information required to the administrative staff to analyze and make a quick decision by providing the final product with graphic information permitting the law enforcement agencies to understand where crime events are occurring, where the crime rate and density of crime is high (Cakar, 2011). Mapping crime hotspots can assist the law enforcement agencies to protect the inhabitants of that area where crime rate is very high. Crime hot spot is an area that has a greater than average number of criminal or disorder events, or an area where people have a higher than average risk of victimization. Mapping crime hotspots has been proved to be useful to the law enforcement agencies in dealing with crime incidents. Changing patterns of crime hotspots tells the story of shifting of criminal activities from one place to another. With the help of maps a crime analysts can easily understand where and why crime is occurring in a specific area. Crime events are a major problem of present society and are increasing with the development of industry. The degree of crime events occurrence is higher in the major cities of Pakistan. Many of the crime incidents have locational significance, and commonly a positional element is attached to them. The old-age and outdated method of intelligence and keeping of criminal record maintenance cannot fulfill the needs of crime scenario of the real world. And this outdated method results in lower

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production and ineffectual utilization of police personals, Solution to this ever-increasing issue lies in the effective practice of Information Technology (Ezra, Philip, & Monika, 2002; Ferreira, João, & Martins, 2012). The data needed to the decision makers and managerial staff for quick response and decision making to understand where the density of criminal act is on rise can be obtained through crime mapping and GIS. Our main purpose is to minimize and prevent crime to occur and minimize the misery of victims, and proper use of our limited resources where they needed most.

2. Methodology

The project was undertaken to help the Faisalabad police department to overcome the street crimes. The work was done into four phases. In the first phase of data collection the GPS survey was performed for the police stations, precincts and police check points. ArcGIS 10 was used for the data analysis. In the second phase the crime reports of 2012 were geocoded and the crime hotspots maps were prepared. Kernel density estimation was used for crime hotspot maps. The data of most prevalent type of street crimes, i.e. motor bike theft, car theft, robbery and snatching were mapped. Network analysis was performed for patrolling and shortest routes. In the third phase, *Compstat* model was followed with some modifications for the accountability and performance management. In a weekly meetings with police commanders the operational analyses were performed and new plans were made for resource allocation and deployment. The crime hotspots maps for 2013 were created and the changing patterns of hotspots were observed.

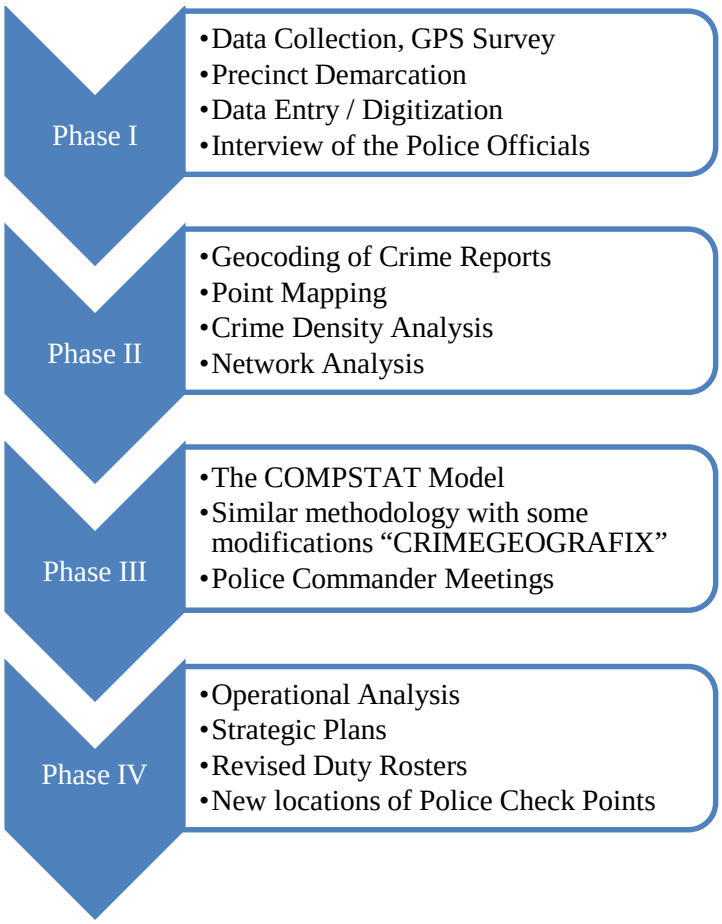

Figure. 1. Methodological Framework

3. Crime Mapping and Hotspots Detection

The cartographic work was done and the crime maps for each police station in the city were prepared. Kernel density estimation was used for crime hotspot identification. The comparative analysis of 2012 and 2013 shows that there was a shift in street crime hotspots. Table 1 shows the street crime incidents in Faisalabad city. A remarkable reduction in street crimes, 41.74 % was observed. In 2012 bike theft was the most prevalent type of crime in the city. The bike theft hotspot was detected in the commercial area of Peoples colony along the *Satiana road* and *Madina* town. Another major hotspot was near the *Clock Tower*, *Katchehri Bazar* and *Jinnah garden.* The bike theft was observed along the busy roads and the temporary parking lots. In 2013 a decrease of 37.94% was observed and the bike theft hotspots were shifted from the Peoples colony and *Madina* town to the *Clock* tower commercial area. The car theft hotspot in 2012 was also on the same location while in 2013 it was shifted towards the *Press market*. A decrease of 25.6% was observed in the car theft incidents.

Table. 1. Street Crimes in Faisalabad City

Crime Type	Crimes 2012	Crimes 2013	Total	%age	Percent Change
Bike Theft	543	337	880	42.74	-37.94
Car Theft	121	90	211	10.25	-25.62
Robbery	283	197	480	23.31	-30.39
Snatching	354	134	488	23.70	-62.15
Total	1301	758	2059	100.00	-41.74

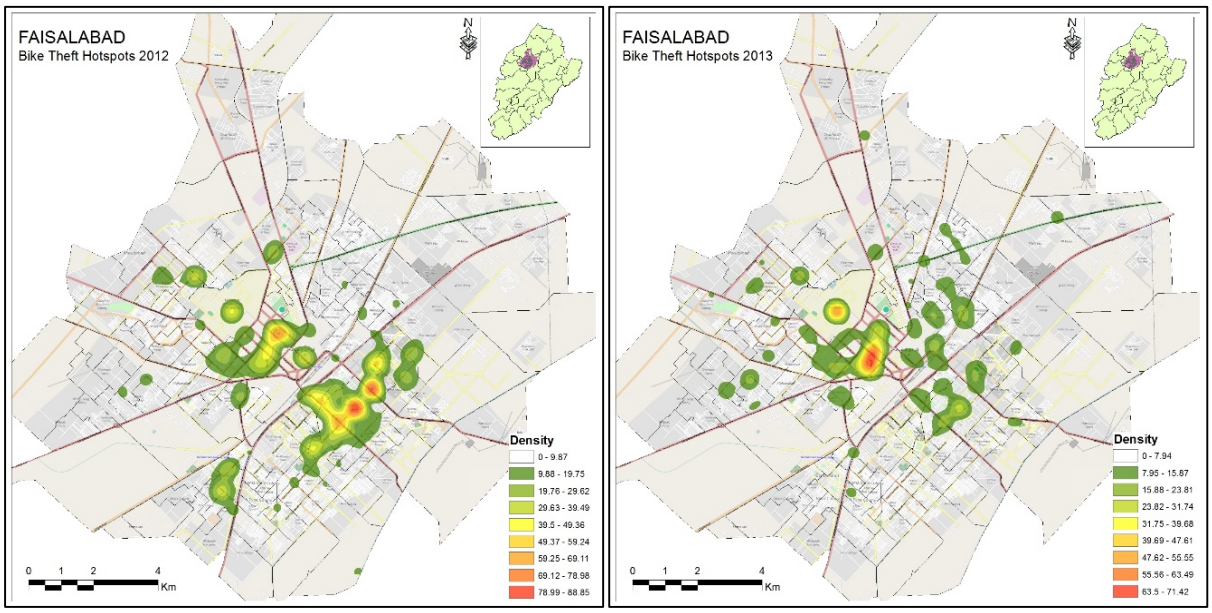

Figure 2. Bike Theft Hotspots

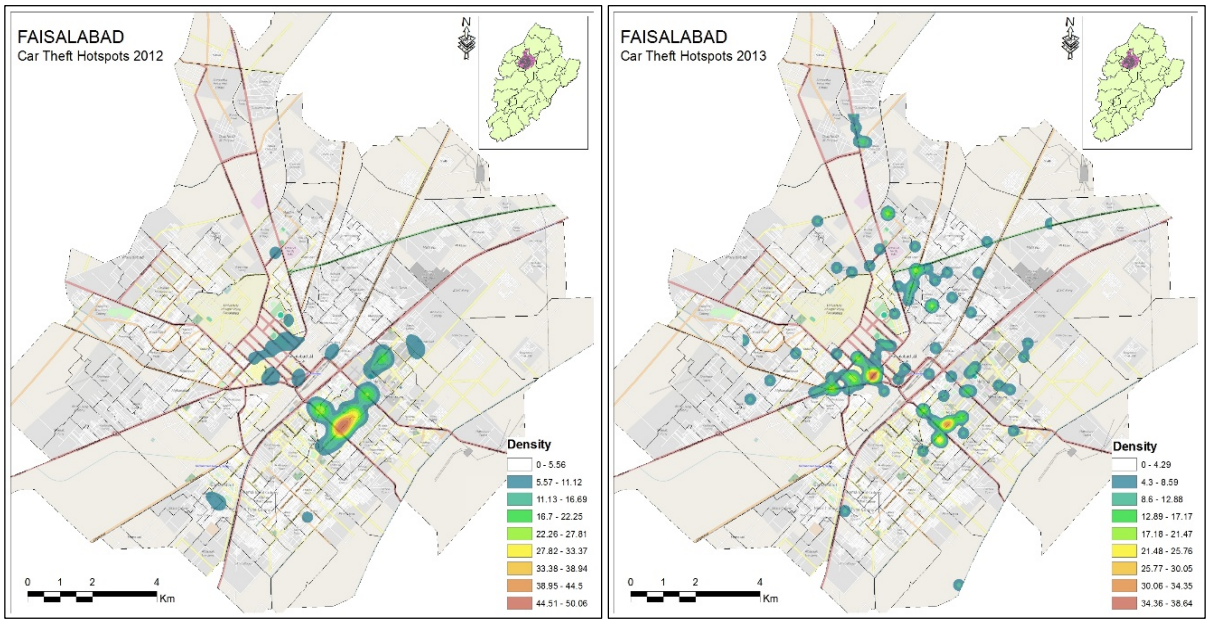

Figure 3. Car Theft Hotspots

The hotspot of armed robberies in 2012 was observed in the residential areas of *Abdullahpur*, *Peoples colony No.2*, *Madina town* and *Karim Town.* In 2013 the robberies hotspots were shifted towards the *Haseeb Shaheed colony*, *Jaranwala road* and *Sargodha road* (figure 4). A decrease of 30.3% was observed in the incidents of robberies.

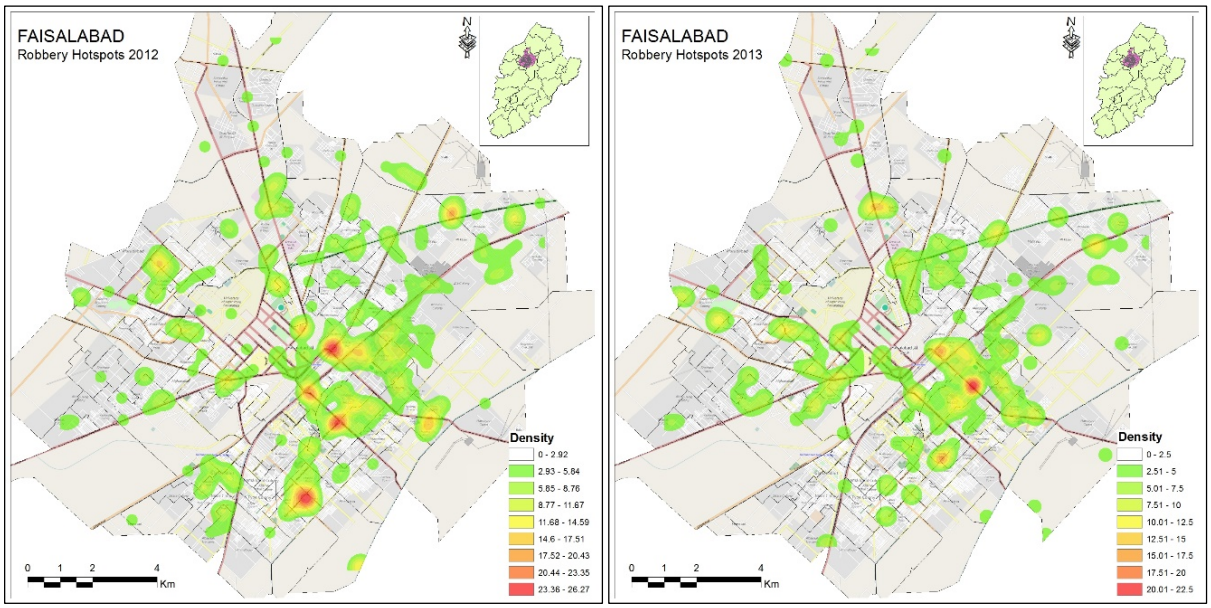

Figure 4. Robbery Hotspots

The snatching hotspots were mainly seen in the *D type colony*, *Samanabad*, *Siddiqia Mills Colony*, *Peoples Colony and Jinnah Colony*. The snatching incidents were observed in the evening in the residential areas and during the daytime in commercial areas. The major reason of these street crimes was the increasing unemployment rate in Faisalabad i.e., 6.3%. In 2013 the snatching was largely overcome by police and a significant decrease of 61.15% was observed. The snatching hotspots were shifted towards the *Madina town* and *Khayaban colony*. The major reasons of street crimes in the Faisalabad was the increasing unemployment rate. There was a shutdown of industries due to power outage in 2012 leaving a huge labor force unemployed. The unequal precinct areas of police stations is another factor of high crime rate. Previously the police force was deployed according to the city's administrative setup instead of need.

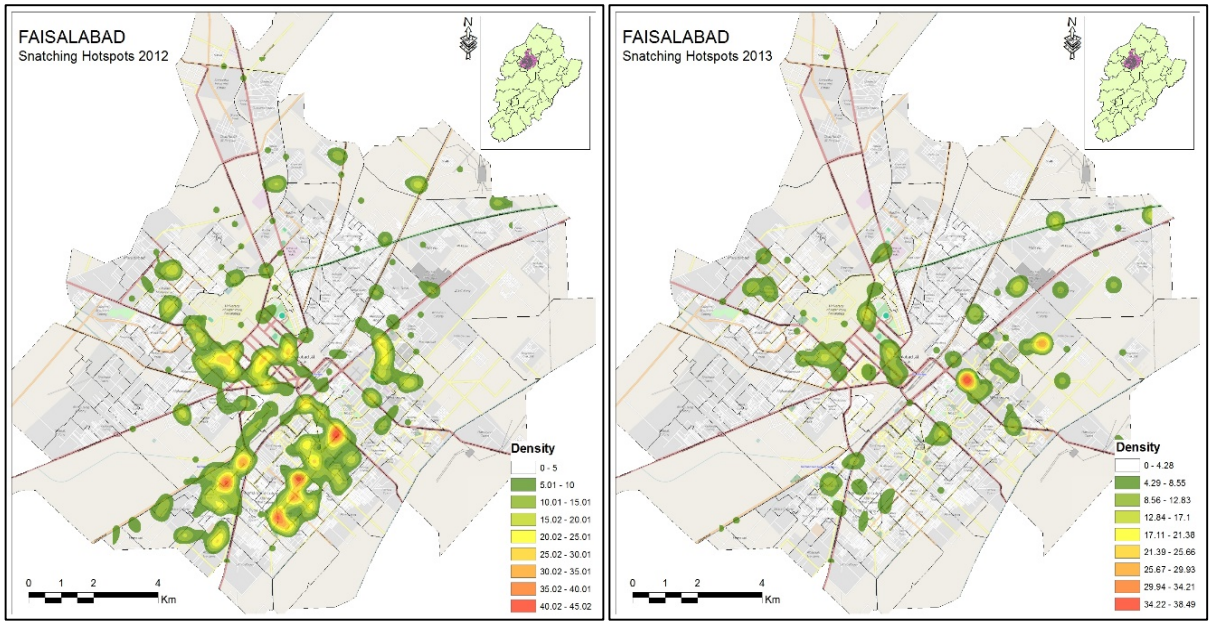

Figure 5. Snatching Hotspots

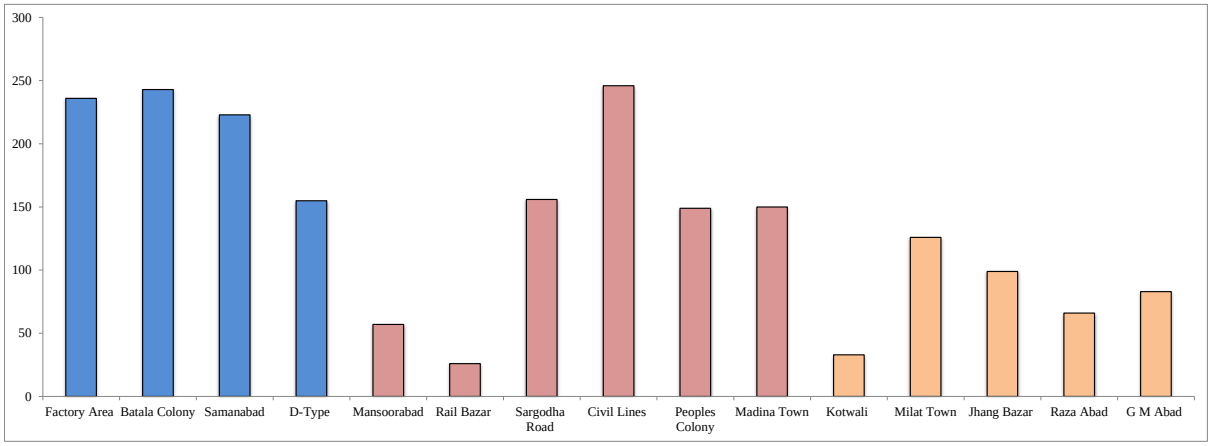

Figure 6. Crime rate in Police Precincts

4. Conclusion

Faisalabad is third major city of the Pakistan, and has a very high street crime rate in the city. The majority of the street crimes were found in commercial and in densely populated areas. The bike and car theft hotspots were observed in the commercial area parking, hospital parking and on roadsides. Snatching hotspot were found in the densely populated areas of the city lacking the street lights and the hotspots of robberies were observed in the posh areas of the city. The data shows the shift in crime hotspots due to the change in operational procedure of police department.

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7. Biography

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References

Andresen, M. A. (2011). The Ambient Population and Crime Analysis. *The Professional Geographer, 63*(2), 193-212.

Cakar, B. (2011). *Factors Affecting Police Officers' Acceptance of GIS Technologies: A Study of The Turkish National Police*. Doctoral Thesis, University of North Texas, Texas.

Casady, T. (2011). Police Legitimacy and Predictive Policing: A Quarterly Bulletin of Applied Geography for the Study of Crime & Public Safety. *Geography & Public Safety, 2*(4), 1-15.

Ezra, B. Z., Philip, C. M., & Monika, B. (2002). Crime Analysis Geographic Information System Services: Advanced Tools Report (pp. 1-91). New York, USA: Environmental Systems Research institute.

Ferreira, J., João, P., & Martins, J. (2012). GIS for Crime Analysis: Geography for Predictive Models. *The Electronic Journal Information Systems Evaluation, 15*(1), 36-49.

Gilmour, A., & Barclay, J. (2008). Developing Geographical Information Systems and Crime Mapping Tools in New Zealand *Crime Mapping Case Studies* (pp. 1-7): John Wiley & Sons, Ltd.

Saegert, S., Winkel, G., & Swartz, C. (2010). Social capital and crime in New York City's low-income housing. *Housing Policy Debate, 13*(1), 189-226.

Zhang, H., Suresh, G., & Qiu, Y. (2012). Issues in the aggregation and spatial analysis of neighborhood crime. *Annals of GIS, 18*(3), 173-183.