Journal of Geomatics Vol 10 No. 1 April 2016

Crime mapping analysis of Ajmer city -A GIS approach

Ravi Sharma, Sarvesh Palria and Parul Bhalla
Department of Remote Sensing and Geo-informatics, M.D.S. University Ajmer – 305009
Email: ravisharma.rs08@gmail.com

(Received: Jan 23, 2015; in final form: Mar 18, 2016)

Abstract: Due to unemployment, the crime is increasing. Criminal acts like murder, rape, kidnapping, home breaking, theft, robbery are prohibited but exists all around the world. India is one major country where crime is increasing. The present study deals with the crime mapping of Ajmer city with GIS approach. The study is having objectives to generate crime maps to identify the crime pattern of Ajmer city. It is based on time series analysis to identify crime direction and hotspots of crimes. It also analyses type of hotspot, proximity of crimes to police stations, displacement of crime across time, crime rate of each ward and the socio-economic characteristics of city. This analysis provides insight to police with a view to decreasing crime rate.

Key Words: Crime rate, GIS, Hotspot, Land use/land cover, Crime map

1. Introduction

Crime is a human tendency, therefore, its distribution across the landscape is not geographically random. Place plays a vital role in understanding crime. To reduce crime, geography of crime needs to be understood as crime has an inherent geographical quality. When a crime occurs, it happens at a place with a geographical location (Chainey and Ratcliffe, 2005). For someone to commit a crime, one must come from a place (such as their home, work or school). This place could be the same location where the crime is committed or is often close to the place where crime occurred.

Jaishankar et al. (2004) showed that use of GIS provides a convenient tool for crime pattern analysis due to its geographic referencing capabilities. It provides valuable information concerning property of crimes including data on the social and physical characteristics of areas that contribute to localized criminal activity. Thangavelu et al. (2013) discussed about the importance of GIS, as it can be used as a tool to identify factors contributing to crime and thus allow police department to proactively respond to the situations before they become problematic. Crime analysis mapping is a valuable problem solving tool because it can lead to the identification of new problems facing law enforcement, lend a visual perspective to an analysis, assist in the development of an effective response, aid in the formation of partnerships by providing a common point of reference and assist evaluation procedures (Velasco and Boba, 2005).

A study of GIS based Decision Support System (DSS) for crime mapping in Ahmedabad city was conducted by Patel et al. (2014). They found that GIS based DSS is important as it uses geography and analysis as an interface for integrating and accessing massive amounts of location-based information. GIS based DSS allows police personnel to plan effectively for emergency response, determine mitigation priorities, analyze historical events and predict future events. GIS based DSS can also be used to get critical information in tactical planning and response. GIS helps to identify potential suspects of crime and thus leads to decrease the crime rate.

The present study focuses on the creation of the database of spatial and non-spatial attribute, calculation of crime rate and crime density in Ajmer city and identification of hotspots of different crime occurring in Ajmer city. Temporal crime pattern of Ajmer city is also analysed and illustrated using GIS tools.

2. Study area

Ajmer is the district of Rajasthan state. Ajmer city is the head quarter of the district. Ajmer city has a population of 542321. Ajmer city is a religious and tourist place. It is surrounded by NH-8, NH-14, NH-79 and NH-89. Ajmer city is surrounded by the Aravali hills. Ajmer city stretches from 26˚23’ North to 26˚23’ North and 74˚36’ East to 74˚40’ east. It has nine Police Stations (PS) and one Mahila PS. All nine PS boundaries of Ajmer city have been selected for study. Figure 1 shows the location map of study area.

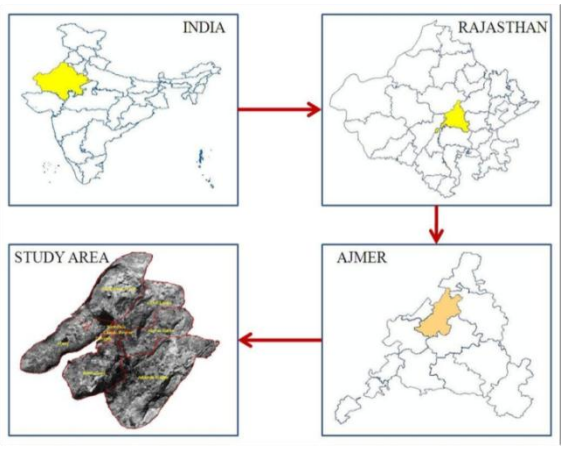


Figure 1: Location map of study area

3. Data used and methodology

The IPC crime incidents data is collected from the SP Office, Crime Branch & each PS of Ajmer city from 2009 to 2014 (Up to March 2014). Crime type data about murder, attempt to murder, rape, kidnapping, robbery, home breaking day and night, automobile theft and other theft are given in table 1. IPC crimes in different police stations of Ajmer city are given in table 2.

Table 1: Statistics of crime types in Ajmer city for various year

Crime Type	Year						Total
	2009	2010	2011	2012	2013	2014 (Upto March)	
Murder	11	7	16	14	12	0	60
Home breaking	82	75	55	58	134	32	436
Robbery	16	6	9	5	8	5	49
Kidnapping	27	18	17	22	64	7	155
Rape	10	11	20	13	35	14	103
Automobile theft	143	155	129	162	286	53	928
Other thefts	112	67	98	72	134	30	513
Attempt to murder	13	11	16	8	14	2	64
Total	414	350	360	354	687	143	2308

Table 2: IPC crimes in different police stations of Ajmer city

S.No.	Police Station Name	Year						Total
		2009	2010	2011	2012	2013	2014(Upto March)	
1	Civil Lines	75	52	43	42	101	18	331
2	Clock Tower	56	21	29	25	49	11	191
3	Ganj	9	14	7	26	52	15	123
4	Dargah	31	19	31	26	25	5	137
5	Alwargate	29	36	46	39	78	13	241
6	Kotwali	71	67	77	64	81	13	373
7	Adarshnagar	26	27	22	33	82	16	206
8	Christianganj	73	83	80	62	157	33	488
9	Ramganj	44	31	25	37	62	19	218
	Total	414	350	360	354	687	143	2308

For spatial data analysis, Cartosat-I data and toposheets were used. Non-spatial attribute data were collected from all PS and crime branch office. GPS was used to collect geographic locations of crime incidence. Census data and ward map were collected from Statistical department and Nagar Nigam of Ajmer.

Thematic maps were generated on the yearly basis and year-wise maps were prepared for the period 2009- 2014 (upto March). Year-wise maps help to show the change detection of crime pattern and the direction of crime. Crime wise and crime type maps were prepared. These thematic maps were analyzed to find out the hotspot areas and then spatio-temporal crimes were identified. The methodology is given in figure 2.

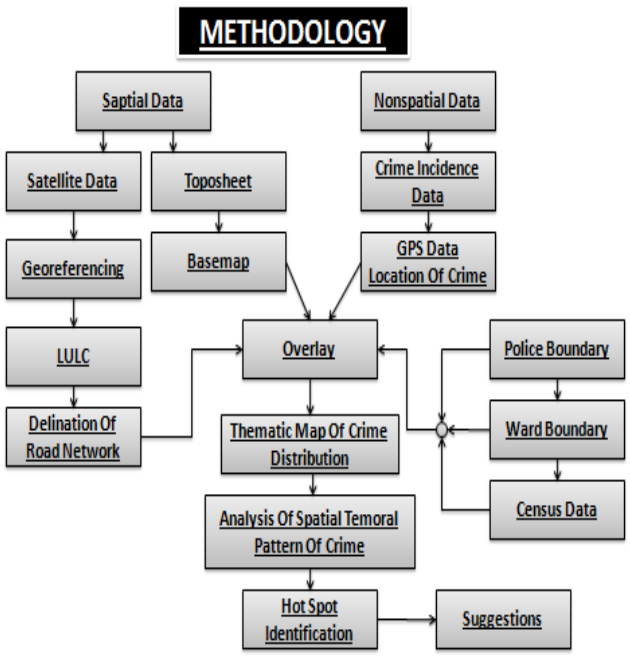


Figure 2: Flow chart of methodology

4. Result and discussion

Crime map of Ajmer city for the period 2009 – 2014 with PS boundary overlaid is given in figure 3. Location map of PS of Ajmer city according to municipal boundary is given in figure 4. Cartosat-I data was used for road network delineation and base map preparation from toposheet.

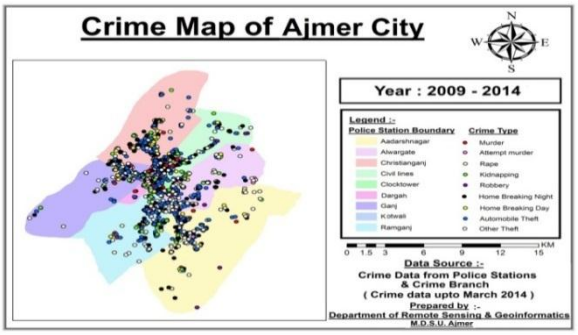


Figure 3: Crime map of Ajmer city (2009 – 2014) with police station (PS) boundary

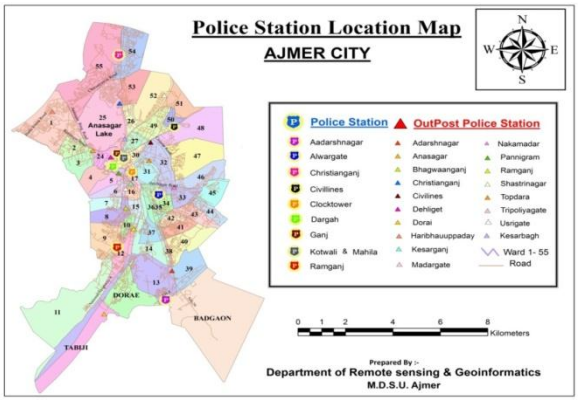


Figure 4: Location map of Police Stations (PS) of Ajmer city according to municipal boundary

By observing and analyzing the crime data of Ajmer city's nine PS, crime maps for various years as well as for various PS were prepared. Four illustrative such maps given in figure 5 (a – d). Composite crime map of Ajmer city (2009 - 2014) with municipal boundary of Ajmer city is given in figure 6. The PS-wise result and patterns are discussed below.

4.1 Aadarsh Nagar PS

After studying about 2009–2014 map of Aadarsh Nagar PS, it was observed that –murder and attempt to murder both were not found in the category of hotspot areas. Kidnapping had mainly occurred near Sethi colony. Home breaking and night crimes took place in Sethi colony and the 500 meter buffer zone of Aadarsh Nagar outpost police station. Robbery was mainly seen in Ricco industrial area, where mainly the official people visited.

Two wheelers and four wheelers were mainly stolen from the industrial area near Aadarsh Nagar and Pravatpura circle and Hatundi circle.

In the year 2009, permanent hotspot can be seen at Pratapura circle. In the year 2010, hotspot is shifted to Aadarsh Nagar colony, near Balupura road.

The Aadarsh Nagar colony development was at peak this year. Criminals are attracted at high density population area. In the year 2011, Pratappura circle (North and South) can be seen as major hotspot. Makupura circle can also be seen as the major Hotspot.

4.2 Civil Lines PS

After studying about 2009–2014 map of Civil Lines PS, it can be seen that –murder and attempt to murder both were not found in the category of hotspot area. Kidnapping mainly occurred near Lohakhan bus stand. Home breaking at Civil Lines area (Near Shastrinagar road). Two wheeler thefts happened at parking areas of Ajmer hospital, roadways bus stand, near Mission school, old RPSC, Civil Lines hospital, Collectorate parisar, and at Ajmer club park. Other theft area occurred at bus stand, Session court, Rajasthan Board, Lohakhan, Civil Lines and Ajmer club. Hotspots were found in 500meter buffer zone of Civil Lines PS and Out Post (OP) Civil Lines.

4.3 Clock tower PS

After studying about 2009–2014 map of Clock tower PS, it was found that murder and attempt to murder both are not found in the category of hotspot area. Kidnapping mainly occurred near Trambe station and Home breaking night at Janta market.

Two wheeler thefts occurred at Sant Francis hospital, Babu colony, Vimla market; Outside Jain namkin, GCA parking, Apna market. Four wheelers were mainly stolen from Sant Francis hospital and Babu colony. Other thefts occurred at Padav. Robbery occurred at Martin Bridge.

Hotspots were found in 100 meters buffer zone of Clock tower PS and OP Kesarganj were at high rate. No other hotspot was found in buffer zone of OP Usarigate.

4.4 Ganj PS

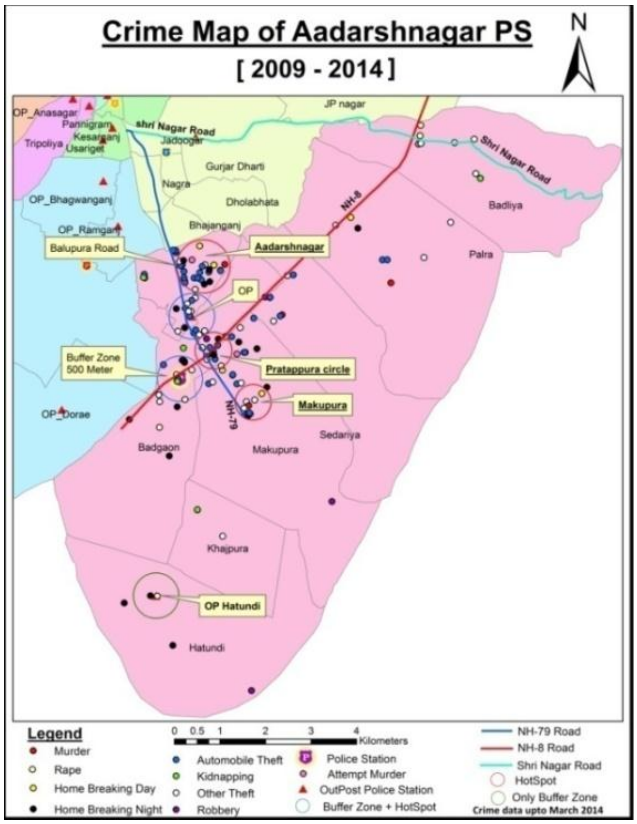
After studying about 2009–2014 map of Ganj P.S., it was found that murder and attempt to murder both were not found in the category of hotspot area. Kidnapping occurred at mainly 300 meter buffer zone of Ganj PS. Home breaking night, two wheeler theft and other theft crimes mainly occurred in 300 meter buffer zone of OP Anasagar and PS Ganj. Home breaking occurred mainly near Dehli gate and two wheeler theft mainly at Ramprashad ghat.

Proximity of crime with PS and outpost police station is very high and all hotspots were found 300 meter buffer zone to PS and OP.

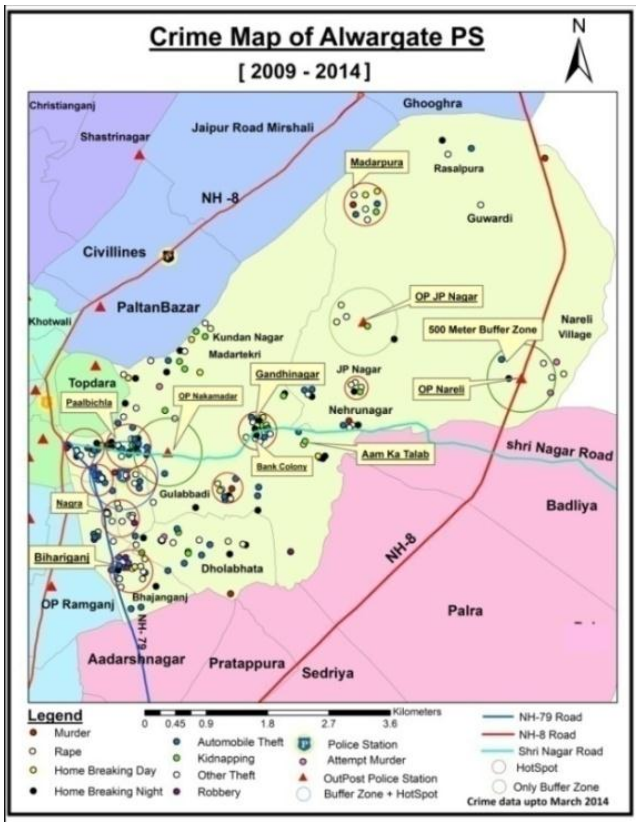
4.5 Dargah PS

After studying about 2009–2014 map of Dargah PS, it was found that murder and attempt to murder both were not found in the category of hotspot area. Terrorist prefer a place where crowd is present because in such area one bomb blast may damage life of many people. Due to this reason an explosion occurred near courtyard outside the Dargah of Khawaja Moinuddin Chishti in Ajmer (11 Oct 2007). Dargah is sensitive area for terrorist attack so CCTV camera and metal detectors are essentially required in such area.

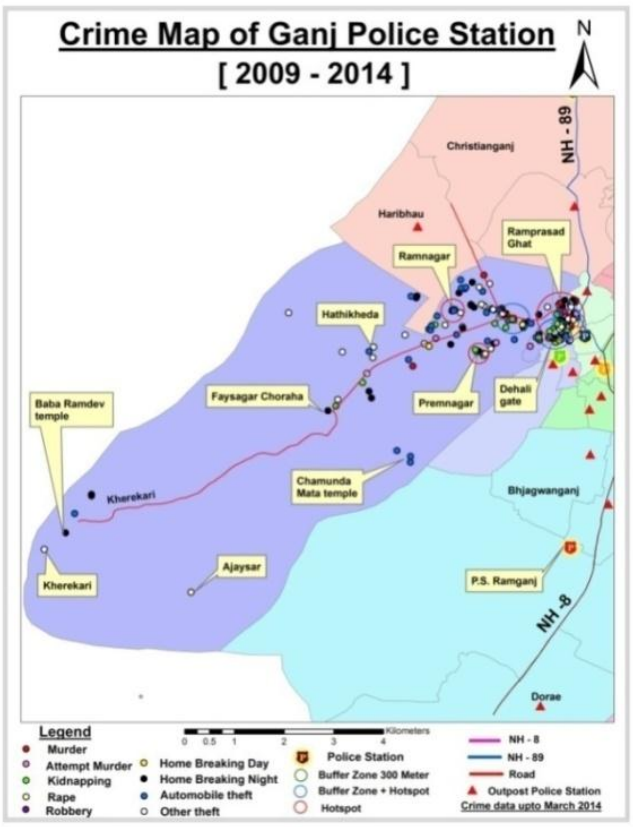
No robbery and four wheeler theft case was found in last 5 years in Dargah PS. area because of high crowd



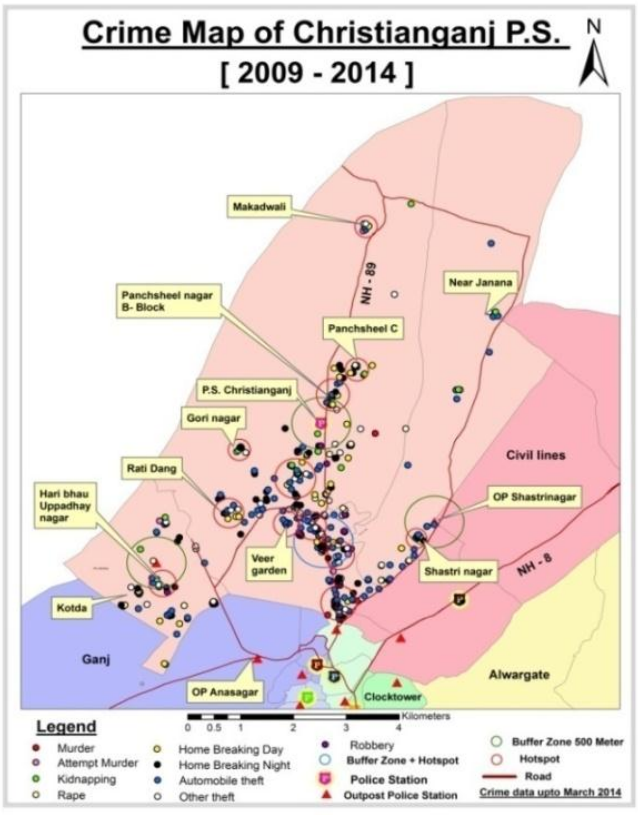
(a)



(b)



(c)



(d)

Figure 5: Crime map (2009 – 2014) of four Police Stations (PS) viz., (a) Aadarsh Nagar, (b) Alwar gate, (c) Ganj and (d) Christianganj

and place shorting for parking area. Other theft hotspot was found at Khwaja Mohinidin Chishti Dargah parisar because of high crowd. Home breaking occurred at night at Holidara. Two wheeler theft occurred at Nala market and Dhanmandi. Violence crime mainly occurred at Andarkot.

4.6 Kotwali PS

After studying about 2009–2014 map of Kotwali PS, it was found that murder and attempt to murder both were not found in the category of hotspot area. Home breaking at night mainly occurred near Information centre circle and Ajmer tower.

Two wheeler thefts mainly occurred at outside JLN hospital, K.C. complex, Swami complex, Bhesa complex, Ajmer tower, Amar plaza, Prabhat cinema, HDFC bank, Near G.P.O., near P.N.B. Kachhari road, P.R. marg, near Jagdamba bar and near Mango masala. Four wheeler thefts mainly occurred at J.L.N medical college and outside Swami complex. Other theft mainly occurred at JLN Hospital, PNB (Kachhari road) and 100 meter distance to PS at near P.R. marg.

Proximity of crime with Kotwali PS and OP Madar gate was very low because no hotspot area was found in 100 meter buffer zone. Hotspots are found in 100 meter buffer zone of OP Kesar bagh.

4.7 Alwargate PS

After studying about 2009–2014 map of Alwargate PS, it was found that murder and attempt to murder both were not found in the category of hotspot area. Kidnapping were mainly occurred near Kundannagar. Home breaking during day occurred at Gandhi nagar and night time crimes took place in main Alwar gate area near Srinagar road.

Robbery was mainly seen in the area of Martin bridge and Aamka talab. Two wheeler thefts occurred at main Alwargate area, Convent school, Shiv temple, LIC parking and 9 no. petrol pump. Four wheelers were mainly stolen from Heena garden and near Shrinagar road (main Alwargate area). Other theft area occurred at Martin bridge and near P.N.B.

Hotspots were found in 500 meters buffer zone of Alwargate PS and proximity of crime with outpost police station was low, crime occurred 500 meters away from the OP Nakamadar, OP J.P. nagar and OP Nareli. Some crime cases were found at Nagra, Bihariganj, Gokulnagar, Jadugar ,Vinaynagar and Madarpura.

4.8 Ramganj PS

After studying about 2009–2014 map of Ramganj PS, it was found that murder and attempt to murder both were not found in the category of hotspot area. Kidnapping mainly occurred near Pahadganj and Shubhas nagar. Rape and kidnapping at Shashibasti area. Home breaking during day occurred at Ajaynagar, Satguru colony and night time crimes took place in Chandverdai, Jhulelal colony and Ajaynagar.

Two wheeler thefts mainly occurred at Sabzi mandi, Railway hospital, Shiv temple (Ajay nagar), HMT parisar and Chungi naka. Other theft occurred at Rambag circle, near OP Ramganjand in Dorai at Hastivihar colony.

Hotspots were found in 500 meters buffer zone of OP Ramganj and OP Dorai and proximity of crime with PS Ramganj and OP Bhagwaanganj was found to be low.

4.9 Christian Ganj PS

After studying about 2009–2014 map of Alwar gate PS, it was found that murder and attempt to murder, kidnapping were not found in the category of hotspot area but criminal comes at Anasagar lake for hiding dead body so installation of CCTV camera is required at this place.

Home breaking during day occurred at Panchsheel nagar, UIT, main Christian ganj area and night time crimes took place in main Panchsheel A and B block, RPSC Colony, Aanandnagar and in 500 meters buffer zone area of Christian ganj OP. Two wheeler theft occurred at Anasagar chaupati, Reliance fresh, Miraj mall , Sagarvihar colony and Shastrinagar.

Proximity of crime with outpost police station was found to be high because Hotspot areas were found in 500meters buffer zone of OP Christian ganj, OP Shastrinagar and OP Haribhau Updhaynagar. No hotspot was found in buffer zone of Christian ganj PS.

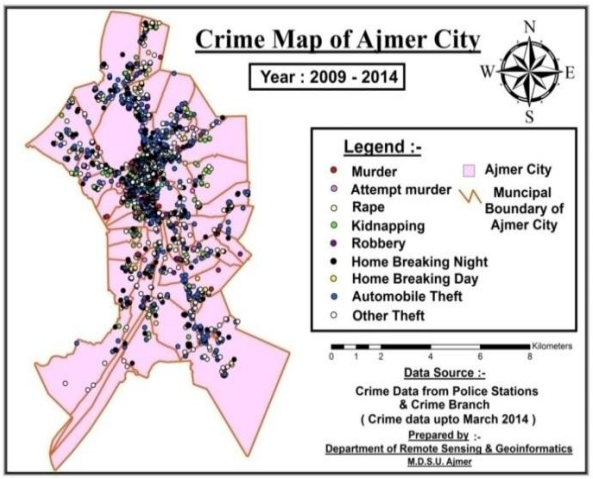


Figure 6: Crime map of Ajmer city (2009 - 2014) with municipal boundary of Ajmer city

Some examples of crime wise map

Different crimes maps of each PS were generated for identification of crime type of hotspot area and compared hotspots of different crimes.

Similarly, crime maps of other crime types such as murder, attempt to murder, rape, kidnapping, robbery, home breaking during day and night, two wheeler and four wheeler thefts and other theft for all nine PS of Ajmer city were generated. Crime data were classified

into four time periods of the day viz. 06:00 to 12:00, 12:00 to-18:00, 18:00 to 22:00, and 22:00 to 06:00.

These types of maps were very useful in understanding the relationship between the geographical location, crime type and timing. The respective PS has started using this relationship knowledge against the criminals to reduce the crime. This knowledge has been obtained though GIS.

Crime rate per ten-thousand population, defined as

$$\text{crime rate} = \frac{\text{number of crime in area}}{\text{population of the area}} \text{X10000}$$

for Ajmer city was 37 per ten-thousand population.

Based on the analysis, some suggestions regarding crime were given to the police department in terms of where different types of crimes are occurring and whether these hotspot areas were covered by police force and CCTV camera. These suggestions will help to decrease crime rate.

5. Conclusion

In this study of crime mapping, year-wise and crime wise maps of the PS were generated. This was followed by in-depth analysis to identify hotspot of overall criminal activities and to understand relationship between geographical location, crime types and time of the crimes. Crime rate for Ajmer city was 37 per ten-thousand population.

After conducting the whole research, finally we conclude that police department should know which type of crimes are increasing and in which direction so as to reduce crime rate and to establish law and order in the city.

References

Chainey, S. and J. Ratcliffe (2005). GIS and crime mapping. A Journal of John Wiley and Sons, Ltd.

Cohen, L.E. and M. Felson (1979). Social change and crime rate Trends: A routine activities approach., American Sociological Review 44:588-608.

Fajemirokun, F., O. Adewale, T. Idowu, A. Oyewusiand and B. Maiyegun (2006). A GIS approach to crime mapping and management In Nigeria: A case study of was Victoria islandlagos, shaping the change. XXIII Congress Munich, Germany, October 8 – 13, 2006.

Gupta, R., K. Rajitha, S. Basu and S.K. Mittal (2012). Application of GIS in crime analysis: A gateway to safe city.7-9 February, 2012, India Geospatial Forum.

Jaishankar, K.S., Shanmugapriya and V. Balamurugan (2004). Crime mapping in India: A GIS implementation in Chennai city policing. Journal of Geographic Information Science, Volume 10, No. 1, 20-34.

Kumar, D.L.B., K. Selvavinayagam and S. Suresh Babu (2014). Assessment of crime and its mapping using remote sensing and 3D geo-spatial model for Chennai city. IJSETR Vol 9(8), 418-425.

Patel, K., P. Thakkar, L. Patel and P. Chandresh (2014). GIS based decision support system for crime mapping, analysis and identify hotspot in Ahmedabad city. International Journal of Modern Engineering Research Vol. 4 (1), 32 – 35.

Polvi., N., T. Looman, C. Humphries and K. Pease (1990). Repeat break and enter victimisation: Time course and crime prevention opportunity. Journal of Police Science and Administration 17:8-11.

Thangavelu, A., S.R. Sathyarai and S. Balasubramanian (2013). Assessment of spatial distribution of rural crime mapping in India: A GIS perspective International Journal of Advanced Remote Sensing and GIS, Volume 2, Issue 1, pp. 70-85.

Velasco, M. and R. Boba (2005). Manual of crime analysis map production. Journal of Community Oriented Policing Services, US Department of Justice, November.

Wilson, J.Q. and G.L. Kelling (1982). Broken windows: The police and neighborhood safety. The Atlantic Monthly 249(3): 29-38.