GEO-EYE

RESEARCH ARTICLE

Geostatistics and Geoinformatics in the analysis of 'crime against women' in Tiruchirappalli city, Tamil Nadu

P Mary Santhi[1], Balaselvakumar[2], K Kumaraswamy[3]

1 *Research Scholar, Department of Geography, Periyar E.V.R. College (Autonomous), Affiliated to Bharathidasan University, Tiruchirappalli, 620 023*
2 *Assistant Professor, Department of Geography, Periyar E.V.R. College (Autonomous), Affiliated to Bharathidasan University, Tiruchirappalli, 620 023*
3 *CSSR Senior Fellow, Department of Geography, Bharathidasan University, Tiruchirappalli, 620 024*

OPEN ACCESS

Received: 27.06.2018
Accepted: 12.11.2018
Published: 15.12.2018

Citation: Mary Santhi P, Balaselvakumar , Kumaraswamy K. (2018). Geostatistics and Geoinformatics in the analysis of 'crime against women' in Tiruchirappalli city, Tamil Nadu. Geo-Eye. 7(2): 32-37. https://doi.org/10.53989/bu.ge.v7i2.8

Funding: None

Competing Interests: None

Copyright: © 2018 Mary Santhi et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Published By Bangalore University, Bengaluru, Karnataka

ISSN
Print: 2347-4246
Electronic: XXXX-XXXX

Abstract

The purpose of the study is to understand the relationship between demographic parameters and crime occurrences against women in Tiruchirappalli city. Seven variables of crime against women have been incorporated by statistics factor analytical technique with the 2011 census of population, sex ratio, literacy ratioand work participation rate. Four components have been derived namely Gender component-I, Personal Crimes and Literacy component-II, Molestation and Total Population component – III and Work Participation and Sex Ratio- component - IV. Woraiyur police station in Srirangam range followed by Palakkarai police station in Fort range have associated with the components of I, II & III determine the high rate of crime against women in the city. The occurrences of cruelty by husband were of great concern, especially in Srirangam range.

Keywords: Crime against women; Demographic parameters; statistical components; police stations; Geostatistics and Geoinformatics

Introduction

"Violence against women is perhaps the most shameful human rights violation and it is perhaps the most pervasive. It knows no boundaries of geography, culture or wealth. As long as it continues, we cannot claim to be making real progress towards equality, development and peace." - (Kofi Annan, General Secretary, United Nations 2006). Crime against women has been unrestrained in our society from ancient times. Violence against women occurs at numerous levels namely physical violence, mental agony, poignant abuse, familial abuse and public embarrassment. Crime against women has its origins in the poor standard of women in maximum countries of the world. Women are the most oppressed and tormented section of society.

The occurrence of crime against women is subjected to demographic parameters as the crime itself has strong spatial components. Identifying the demographic components of crime against women is a prerequisite to making a judgment as to how far the social state of the city proceeds from them.

Hackett, M (2011) examined the general patterns in domestic crime against

women across India by multivariate linear regression; Mota, J.C.D et al. (2008) applied Multivariate and cluster analysis for crimes in Rio de Janeiro, Brazil; O'Donnell, C. J.et al (2002) examined the demographic risk factors influence the incidence of some women's experiencing violence by statistical support; comparative analysis of population-based data on violence against women in Latin America and the Caribbean by Bott, S et al. (2012); The threat of suffering a crime is not homogeneously distributed over a region (Johnson 2010) and nor is it equivalently distributed across the members of the same community (Grove et al. 2012), with some sections and some population groups more affected by crime than others (Farrell 2015); the spatial patterns of types of crime and their relationship with neighbourhood characteristics in the City of Omaha, Nebraska by using the least square regression methods (Zhang, H., & Peterson, M. P. (2007); demographic reasons and criminal occurrences were applied by Li and Juhola 2013; Li 2014; multilevel models (Beirne 1987); econometrics of crime quantity (Raudenbush and Sampson 1999); spatial econometrics (Anselin 1988); link between group of people and crime (Bursik and Grasmick1993); crime threat estimate with suburban population (Lucy Mburu and Marco Helbich 2014); multivariate spatial statistics for crime pattern (Friendly 2007); relationship between population characteristics and crime rate (Vijaykumar and Chandrasekar 2011); Chang, Y., et al. 2018 to test the super linear relationship between number of crimes and population size; demographic factors such as age, sex and race to understand the variation in crime rates with regard to temporal and spatial elements by South & Messner 2000; Andresen, M. A. (2006) investigates the spatial aspect of criminal activity in Vancouver, Canada, utilizing a spatial regression technique. Geoinformatics were used for crime mapping, hotspots, the proximity of crimes to police stations, the crime rate of each ward and the social-economic characteristics of the city by Ravi Sharma et al. 2016; Ratcliffe and McCullagh 2001; Harries 1999; Murray et al. 2001 and Mafumbabete et al. 2019. These studies on crime against women has been abstracted imprecisely and meant in unstructured terms mainly the consequence of various events in society. Hence, this study also has examined the relationship between demographic parameters and crime against women by using factor analysis.

Study area

The base map of Tiruchirappalli was drawn from the Survey of India (SOI) Toposheets Nos. 58 J/9, 10, 13 and 14. The city lies between the latitudes 10° 43' 40"- 10° 53' 00" North and the longitudes 78° 38' 14" - 78° 48' 50" East (Figure 1). The Cauvery delta starts to form 16 km west of the city where the river splits into two the Cauvery and the Kollidam to form the island of Srirangam.

The topography of Tiruchirappalli city is relatively flat and its average elevation is 88 metres from mean sea level. Some isolated hillocks are rising beyond the surface, the topmost of which is the Rockfort. Its estimated age is 3,800 million years and it is marked as one of the ancient rocks in the world. Other famous hillocks include the Golden Rock, Khajamalai, Uyyakondan Thirumalai and Thiruverumbur.

The river Cauvery and its distributary Kollidam facilitate Tiruchirappalli city also the city is fertilised by the Uyyakondan, Kudamuritti and Koraiyar canals. The land adjacent to the Cauvery River, which crosses Tiruchirappalli city from west to east, consists of fertile alluvial soil deposits on which crops such as paddy, banana and sugarcane are cultivated and in dry soil, finger millet and maize are cultivated nearby. Further south, the surface is enclosed by poor quality black soil. A belt of cretaceous rock known as the Trichinopoly group extends to the northeast and the southeast of the city. There are layers of Achaean rocks, granite and gneiss covered by a thin bed of conglomeratic laterite.

Database and Methodology

The current study is based on secondary data sources. The crimes, which have been reported and registered in the FIRs of police stations, were collected from the City Crime Records Bureau (CCRB) Tiruchirappalli City Commissioner of Police Office, for the years 2012 to 2017. Only those crimes against women (Rape, Dowry Death, Molestation, Kidnapping, Cruelty by Husband, Dowry Prohibition Act, 1961 and POCSO Act, 2012) totaling 345 as classified by CCRB have been incorporated by factor analytical technique with basic data from Census of India 2011 population, sex ratio, literacy ratio, and work participation rate collected from the City Municipal Cooperation.

About 11 variables for the crime against women have been used to extract the factors by using statistical factor analysis. Based on the eigen-values and cumulative percentage of variance, four components have been identified. Based on those components, the variables were mapped and analyzed by adopting geoinformatics to understand the correlation between demographic parameters and crime occurrences in Tiruchirappalli City.

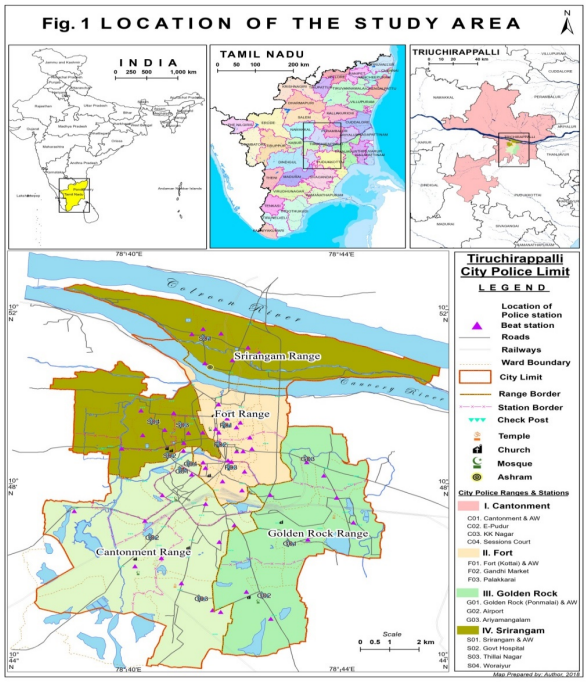

Fig. 1. Location map

Results and Discussion

Factor analysis of crime against women

Factor analysis was conducted on the crime against women in Tiruchirappalli city to determine the factors that best represent the data. Simple component analysis was carried out to study the Eigenvalues for all scales. Reliability of the factors was decided by counting Cronbach alpha coefficients. All factors were found to have a reliability of 0.853 which is greater than 0.60 (α>0.60).

The results of the factor analysis on the crime against women in the study area were found to have four factors. The cumulative variance explained by the above factors was found to be 82.06%.

The overall significance of the correlation matrix with Bartlett's test, considering the data in this research, the correlations, when taken overall, are significant at the 0.000 level according to Table 1 which is 149.102 for the crime against women in Tiruchirappalli city.

Data on these 11 variables for each of the 18 police stations have been entered and analysed using SPSS 19.0 version to extract factors by using the Varimax method. The output of the factor analysis is obtained by Principal Component Analysis and specifying the interpretation. There are two stages in factor analysis. Stage-I is the factor extraction process, where the objective is to recognize the number of factors that are to be extracted from the data. The most popular method is known as principal component analysis. There is also a rule of thumb based on the computation in Eigenvalue to determine how many factors to extract. The greater the Eigenvalue of a factor is the more amount of variance explicated by the factor. Since four factors were taken out in which 82.06% of the variance was explained. It is found that the four factors acted together account for 82.06% of the total variance (Table 2). Hence, the number of variables is reduced from eleven to four underlying factors.

Table 1. KMO and BARTLETT'S test statistics for the crime against women in Tiruchirappalli city

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.559
Bartlett's Test of Sphericity	Approx. Chi-Square	149.102
	df	55
	Sig.	.000

The first component accounts for 38.11% of the variance while the second component accounts for 16.63% of the variance, the third component accounts about 14.49% of the variance and the fourth component explains 12.83% of the variance.

Gender component – I

The analysis shows that the crimes against women variables such as cruelty by husband, rape, crimes under Dowry Prohibition Act 1961, crimes under POCSO Act and dowry death have loading of 0.986, 0.957, 0.946, 0.892 and 0.597 on factor 1 indicating that it is a combination of these five variables and are called 'Gender Component'. AWPS Cantonment, Fort and Srirangam come under the very high category; AWPS Golden Rock comes under high category; Cantonment, Sessions Court, Golden Rock, Ariyamangalam, Palakkarai, Gandhi Market and Government Hospital police stations belong to medium category; and the remaining Edamalaipattipudur, K.K. Nagar, Airport, Fort, Srirangam, Thillainagar and Woraiyur police stations belong to low category (Figure 2).

Table 2. Total Variance Explained (CAW).

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	Percentage (%) of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.192	38.110	38.110	4.192	38.110	38.110
2	1.830	16.633	54.743	1.830	16.633	54.743
3	1.594	14.487	69.230	1.594	14.487	69.230
4	1.411	12.826	82.057	1.411	12.826	82.057

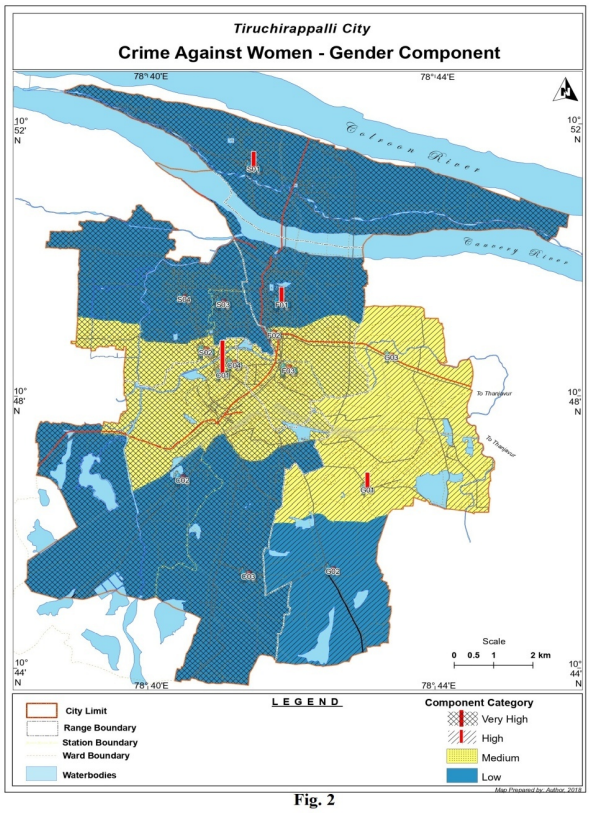

Fig. 2. Crime against women- Gender component

Personal crimes and literacy component – II

The exploration shows that the crime against women variable of kidnapping has the loading of 0.711 and the demographic parameter of literacy ratio has the loading of 0.772 on factor 2 indicating that it is a combination of these two variables and are called 'Personal Crimes and Literacy Component'. K.K. Nagar, AWPS Golden Rock and Government Hospital police stations come under the high category; Cantonment, Sessions Court, AWPS Cantonment, Golden Rock, Airport, Fort, Palakkarai, AWPS Fort, Srirangam and Woraiyur police stations belong to medium category; and the remaining Edamalaipattipudur, Ariyamangalam, Gandhi Market, Thillainagar and AWPS Srirangam police stations belong to low category (Figure 3).

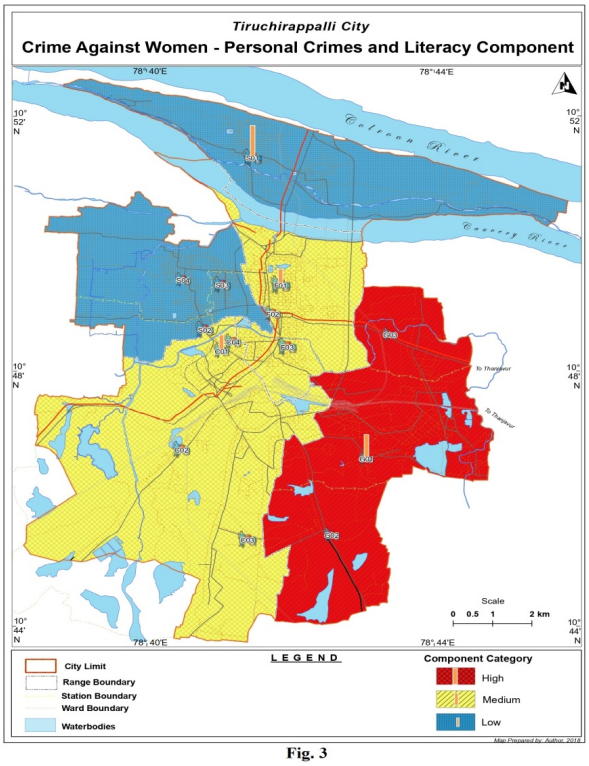

Fig. 3. Crime against women- Personal crimes and literacy component

Molestation and total population component – III

The crime against women variable molestation has the loading of 0.878 and demographic parameter of the total population has the loading of 0.730 on factor 3 indicating that it is a combination of these two variables and are called 'Molestation and Total Population Component'.

Fort, AWPS Fort, Srirangam and AWPS Srirangam police stations come under the very high category; Edamalaipattipudur and Woraiyur police stations come under high category; Sessions Court, K.K. Nagar, Golden Rock, Airport, AWPS Golden Rock, Thillainagar police stations belong to

medium category; and the remaining Cantonment, AWPS Cantonment, Ariyamangalam, Palakkarai, Gandhi Market and Government Hospital police stations belong to low category (Figure 4).

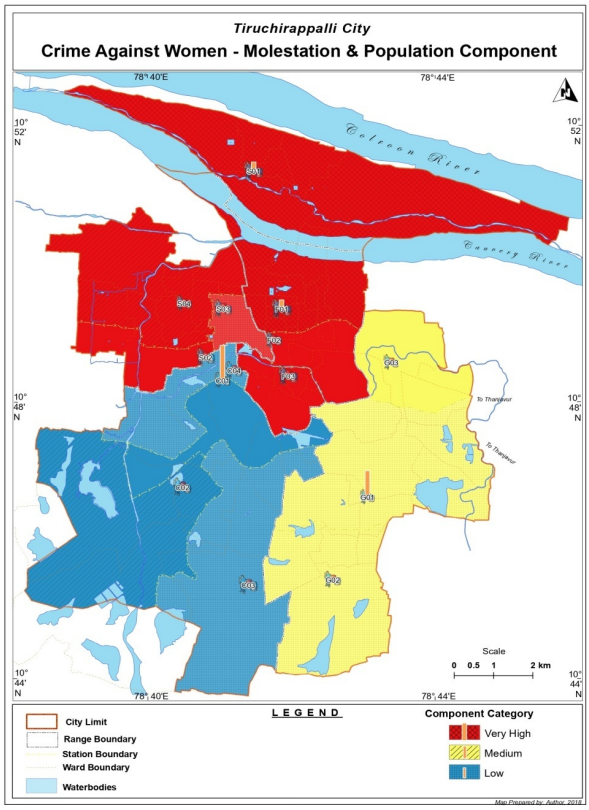

Fig. 4

Fig. 4. Crime against women- Molestation & population component

Work participation and sex ratio component – IV

The demographic parameter of work participation rate and sex ratio have the loading of 0.299 and 0.943 on factor 4 indicating that it is a combination of these two variables and are called 'Work Participation and Sex Ratio Component'.

Palakkarai and Woraiyur police stations belong to very high category; K.K. Nagar, Fort, Gandhi Market and Srirangam police stations belong to high category; Cantonment, Edamalaipattipudur, AWPS Cantonment, Ariyamangalam, AWPS Fort, Government Hospital and AWPS Srirangam police stations belong to medium category; and Sessions Court, Golden Rock, Airport, AWPS Golden Rock and Thillainagar police stations belong to low category (Figure 5).

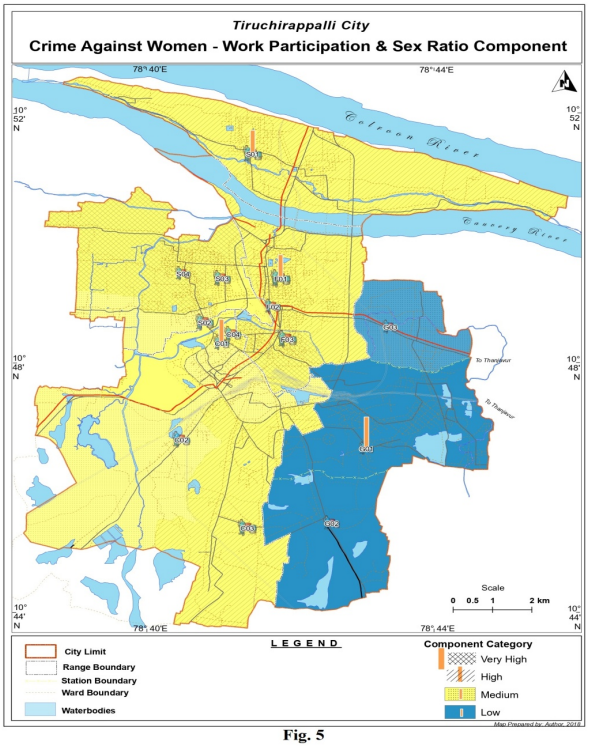

Fig. 5

Fig. 5. Crime against women- Work participation & sex ratio component

Conclusion

Factor analysis was carried out on crime occurrences with demographic parameters in Tiruchirappalli city to determine the factors that represent the data the best. It confirms 4 components for the crime against women, viz., Gender - component, Personal Crimes and Literacy- component, Molestation and Total Population- component and Work Participation and Sex Ratio- component. The components of gender, literacy ratio and molestation of Srirangam and Fort ranges in Woraiyur and Palakkarai police stations determine the high rate of crime against women in the city. The occurrences of cruelty by husband were of great concern especially in Srirangam range. Thus, it is recommended to organize periodic awareness programmes face to face or by social media for the women in the city to be alert of various crimes against them especially cruelty by husbands and their relatives.

The relationship between demographic parameters and crime occurrences against women in Tiruchirappalli city also reveals that a high female population, sex ratio, literacy ratio and work participation rate areas provided more opportunities for more occurrence of crimes against women. Srirangam range ranks the highest in the occurrence of crime against women. Occurrences of crime against women are

more in Sannathiveedhi near T.V.Kovil, Kondaiyampatti near bypass road, Sabariyar Kovil Street, Tharanallur, Thirumangalam Bharathi Street, Ramakrishnan Nagar Karumandapam, Ammakulam near Elanjiyam, Vasantham Nagar Airport, Kasisetti Street and Gandhipuram-Woraiyur of the city. Therefore, it is suggested to display the helpline numbers, email and website address, toll-free emergency call number, WhatsApp numbers of AWPSs prominently in hospitals, schools, colleges, workplaces of women and in all other appropriate places towards zero tolerance of sexual abuse and other crimes against women.

The study reveals that in Tiruchirappalli city, the police force and the number of AWPS in the city (4) have not grown in proportion to the growing population, inhabited areas and the number of occurrence of various crimes. Therefore, it is proposed that the number of police stations and their forces are to be increased in proportion to the population along with high-end security system in the northern part of the city of Srirangam range especially in Woraiyur, the central part of Gandhi Market and Palakkarai police stations of Fort range and southwest of Cantonment in Cantonment range.

References

1) Beirne P. Adolphe Quetelet and the Origins of Positivist Criminology. *American Journal of Sociology*. 1987;92(5):1140–1169. Available from: https://dx.doi.org/10.1086/228630.
2) Hackett M. Domestic Violence Against Women: Statistical Analysis of Crimes Across India". *Journal of Comparative Family Studies*. 2011;42(2):267–288.
3) Bott S, Guedes A, Goodwin MM, Mendoza JA. Violence Against Women in Latin America and the Caribbean: A Comparative Analysis of Population-based Data from 12 Countries. Washington. Pan American Health Organization. 2012.
4) Harries KD. Mapping Crime: Principles and Practice. 1999.
5) Farrell G. Crime Concentration Theory. *Crime Prevent Commune Safe*. 2015;17(4):233–248.
6) Grove L, Farrell G, Farrington D, Johnson S. Preventing Repeat Victimization: A Systematic Review, The Swedish National Council for Crime Prevention, Stockholm. 2012.
7) Bursik R, Grasmick GH. Neighborhoods and Crime: The Dimensions of Effective Community Control. New York. Lexington Books. 1993.
8) Annan K. Women's Role in Decision-Making - Central to Progress of Humankind. 2006. Press Release (OBV/542-WOM/1547), United Nations, New York.
9) Anselin L. Spatial Econometrics: Methods and Models. Dordrecht. Kluwer Academic. 1988.
10) Andresen MA. Crime Measures and the Spatial Analysis of Criminal Activity. *The British Journal of Criminology*. 2006;46(2):258–285. Available from: https://dx.doi.org/10.1093/bjc/azi054.
11) Chang Y, Choi SB, Lee J, Jin WC. Number of Crimes: Is the Relationship Superlinear? *International Journal of Information Systems and Social Change*. 2018;9(1):26–39.
12) Johnson S. A Brief History of the Analysis of Crime Concentration". *European Journal of Applied Mathematics*. 2010;21(1):349–370.