

Utilizing Crime Mapping Techniques to Mitigate Violence against Women: Crafting a Comprehensive Framework

Shajitha.S, Dr. Annie John, Jahnavi S

Student, Department of Architecture College of Engineering Karicode, Kollam

Professor Dr. Annie John. Department of Architecture College of Engineering Karicode, Kollam

Professor. Jahnavi S Department of Architecture College of Engineering Karicode, Kollam

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ABSTRACT: The escalating concern over the surge in crime against women underscores the imperative for innovative approaches to bolster urban safety. Urban crime against women is on the rise, as evidenced by the increasing trends reported in the NCRB Data over the past decades. In response to this critical issue, this research employs crime mapping and strategic planning methodologies to craft comprehensive strategies aimed at fostering a safer city environment. This study delves into the spatial patterns of crime against women, utilizing methodologies such as kernel density estimation and multi-criteria decision-making methods to pinpoint hotspot areas. By drawing insights from best practices observed in cities like Copenhagen, Denmark, and Vienna, Austria, the research compares these approaches with Crime Prevention Through Environmental Design (CPTED) strategies. The aim is to derive a robust crime mapping framework tailored to the specific site, which can be effectively applied to urban areas. The research identifies and analyses various crime mapping methods, scrutinizing their efficacy in identifying hotspot areas. By juxtaposing international best practices with CPTED strategies, the study aims to formulate a refined and context-specific crime mapping framework that can be seamlessly integrated into urban areas, ultimately contributing to the creation of safer city environments.

KEYWORDS: Crime, Safe city, Crime Prevention Through Environmental Design, Mapping Framework, CPTED Strategies, NCRB Data

I. INTRODUCTION

Creating safe and enjoyable urban spaces has become an urgent priority for cities worldwide, as it is a fundamental requirement for building

inclusive and sustainable urban environments. Establishing measurable standards for public safety at the community and street levels can be challenging, and the consequences of inadequate protection can be life-threatening, especially for vulnerable groups such as women, children, and new comers to urban areas who may not be familiar with local hazards and risks. According to the World Health Organization, one in three women has experienced some form of physical or sexual assault. Addressing this critical issue requires urban planning that is sensitive to gender considerations. Despite more than three decades of efforts by the international women's movement to combat violence against women, progress has been disappointingly slow.[2] The safety of women in India is a subject that is heavily debated today because it has become a serious issue. Women no longer feel safe inside their houses or when going outside as a result of the rising crime rate. Even female visitors from other countries frequently encounter dangerous situations. These concerns, however, shouldn't prevent them from engaging in social activities. Even if there are laws in place, it is crucial to implement and strictly enforce strong security measures to protect women from abuse. operating and environmental conditions and demonstrate advantages of adaptive control over the non-adaptive type.[1]

Safe City is an idea in a community that uses technology to help governments, communities and businesses reduce the possibility of crime and provide an environment where people feel safe and comfortable. [1].

II. AIM AND OBJECTIVE

A) Aim
 To assess how crime mapping and strategic planning can enhance women's safety in urban environments

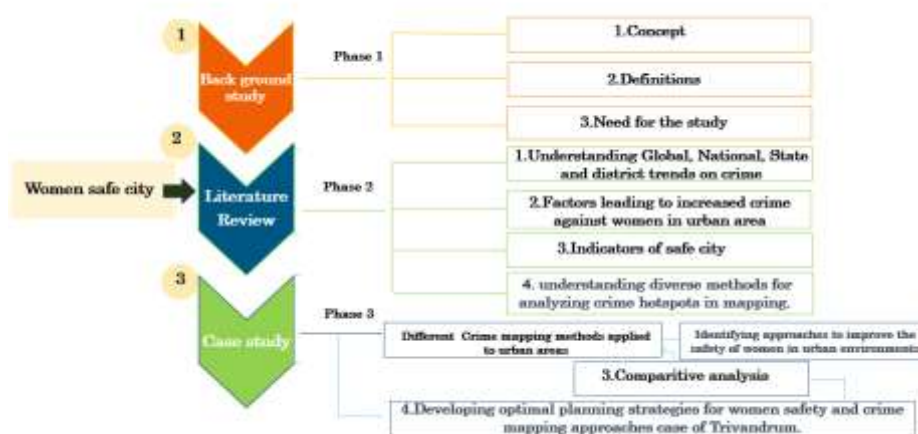
B) Objective
 1.To investigate trends in crimes against women at the global, national, state, and district levels
 2. To evaluate how well current crime mapping tools identify areas with a high risk of violence against women in cities

III. NEED FOR THE STUDY

1. Women and girls have been subjected to significant levels of violence and harassment in

public settings across different cities, ranging from stalking to escalating forms of abuse and assault[2]
 2.According to the **National Crime Records Bureau of India**, reported incidents of crime against women increased by 15.3% in 2021 compared to the year 2020[2].
 3.In India, the **Ministry of Home Affairs, in partnership with the Ministry of Women and Child Development and with the support of the Nirbhaya Fund**, recognized the imperative for establishing safe cities. These cities are designed with the objective of fostering a secure, empowering, and protective environment for women and girls in public areas.

IV. METHODOLOGY



V. LITERATUREREVIEW

1.Global trends of crime against women
 Approximately **736 million women worldwide**, which is nearly one-third of all women aged 15 and older, have experienced physical and/or sexual violence from either an intimate partner or a non-partner at least once in their lifetime.[3].

Gender-based violence by a non-partner is **higher in urban areas**. The prevalence of violence inflicted by non-partners on women is 19 percent in rural regions, contrasting with 34 percent in urban areas.[3].

In countries identified as "**least developed**" according to the **Sustainable Development Goals, 37 percent of women aged 15 to 49** have experienced physical and/or sexual intimate partner violence at some point in their lives [4]

Out of the 19 megacities assessed, **Cairo ranked as the most dangerous city** for women, while **Delhi secured the fourth position** as one of the least safe urban areas.[4]

Violence against women is unevenly distributed worldwide, with a pronounced impact on low- and lower-middle-income countries and regions.[4]



Top 10 dangerous cities across the world.

2. Alarming Rise in Crime Against Women in Indian Cities Sparks Urgent Calls for Action"

In 2019, according to data from the National Crime Records Bureau of India, there was a **15.3%** rise in reported cases of crimes against women when compared to the previous year, 2020.[5]

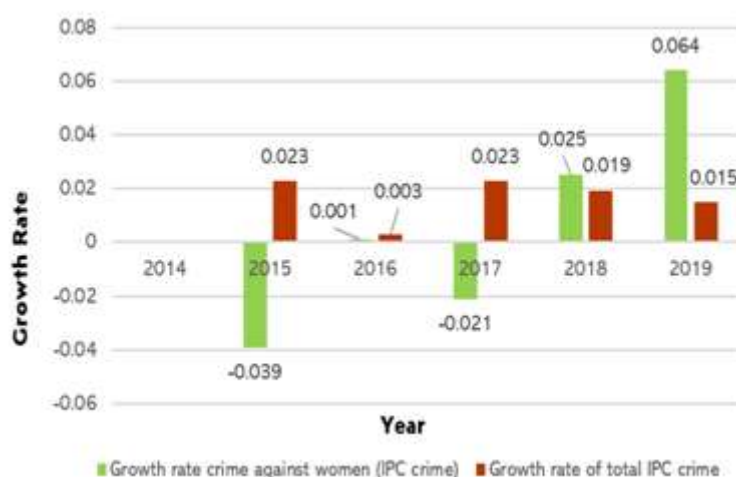
Violence Against Women (VAW) persists as an ongoing and pervasive issue in urban India. According to the latest statistics from the National Crime Records Bureau (NCRB), there has been a significant **83% rise** in reported crimes against women in India from 2012 to 2017. The rate of all crimes against women, encompassing VAW, in

metropolitan cities stands at **77.2 per lakh**, surpassing the national average of **55.24**[5]

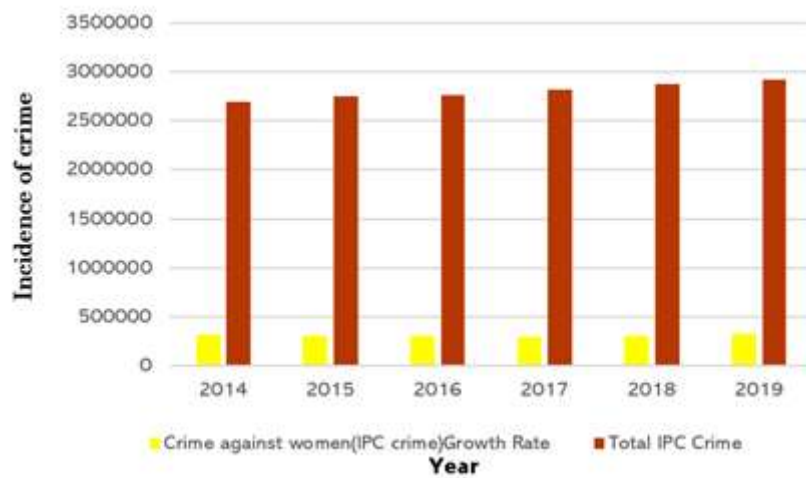
Kidnapping and Abduction of Women

Sections **359 to 369 of the Indian Penal Code** prescribe penalties for kidnappings and abductions. Uttar Pradesh and Bihar and west Bengal stand out with the highest rates of abductions and kidnappings.[5]

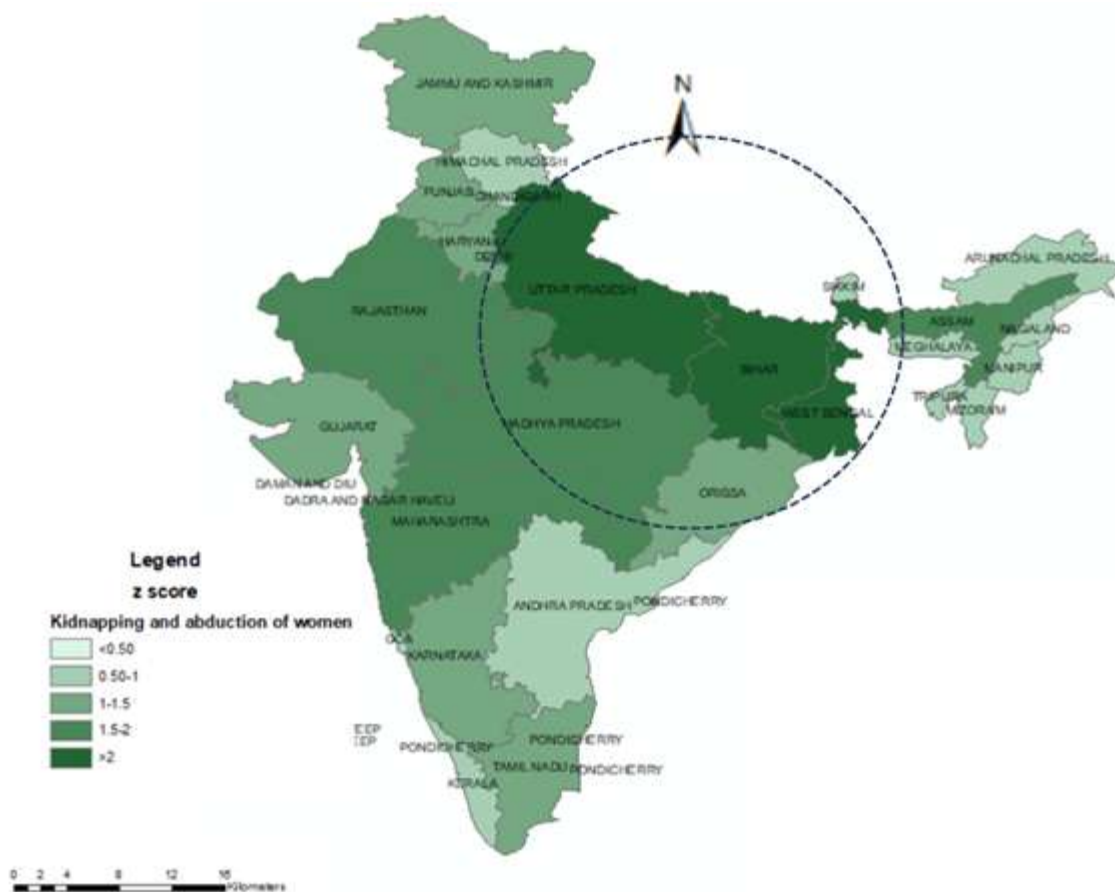
lowest incidences (<-0.50) are observed in **Arunachal Pradesh, Meghalaya, Mizoram, Manipur, Nagaland, Sikkim, Tripura, Kerala, Himachal Pradesh, Andhra Pradesh, and Goa**[5]



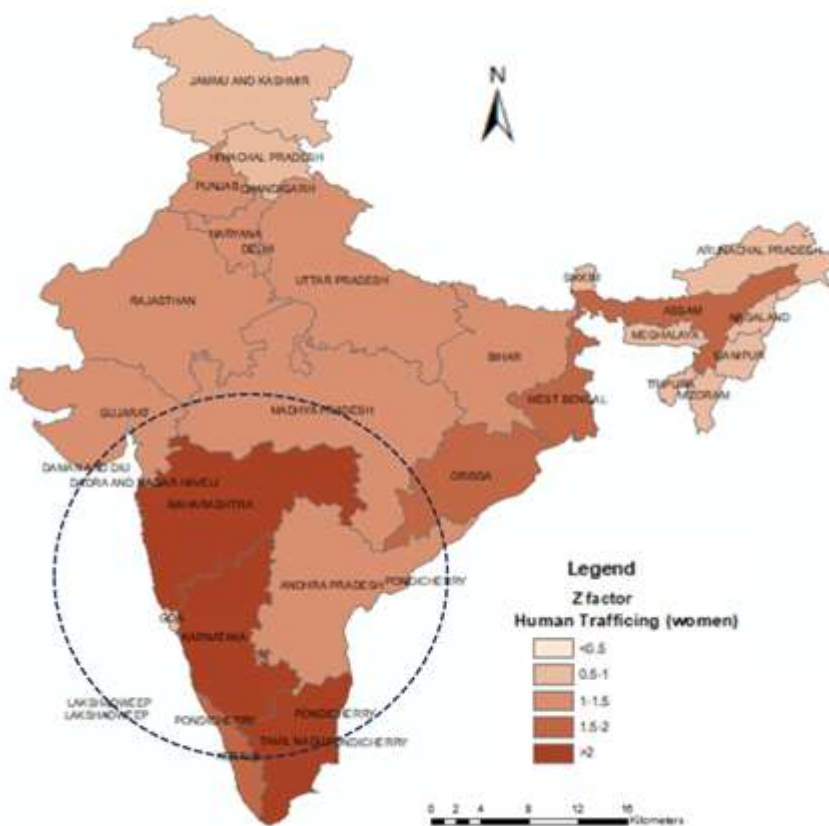
Growth rate of crime against women in total IPC Crime in India (2014-2019)



Incidence of crime against women in total IPC Crime in India (204-2019)



Map showing spatial variation of kidnapping and abduction of women in india



Map showing spatial variation human trafficking of women in India

Human trafficking is notably high in Maharashtra, Tamil Nadu, and Karnataka, [5] Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura exhibit the lowest incidence of human trafficking[5]

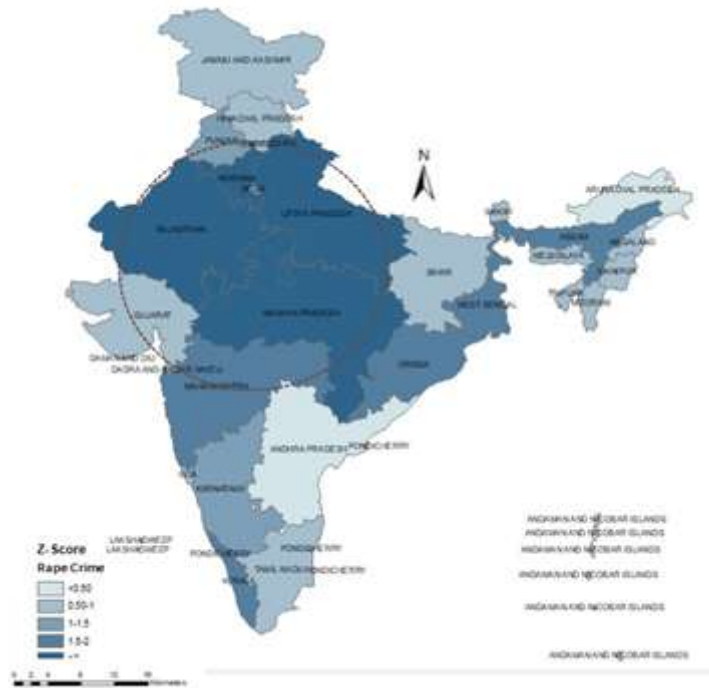
Rape crime in India

Madhya Pradesh, Rajasthan, Uttar Pradesh, and Maharashtra and Delhi Marked the highest number states like West Bengal, Chhattisgarh, Kerala, and Haryana exhibit crime rates in the middle range[5]

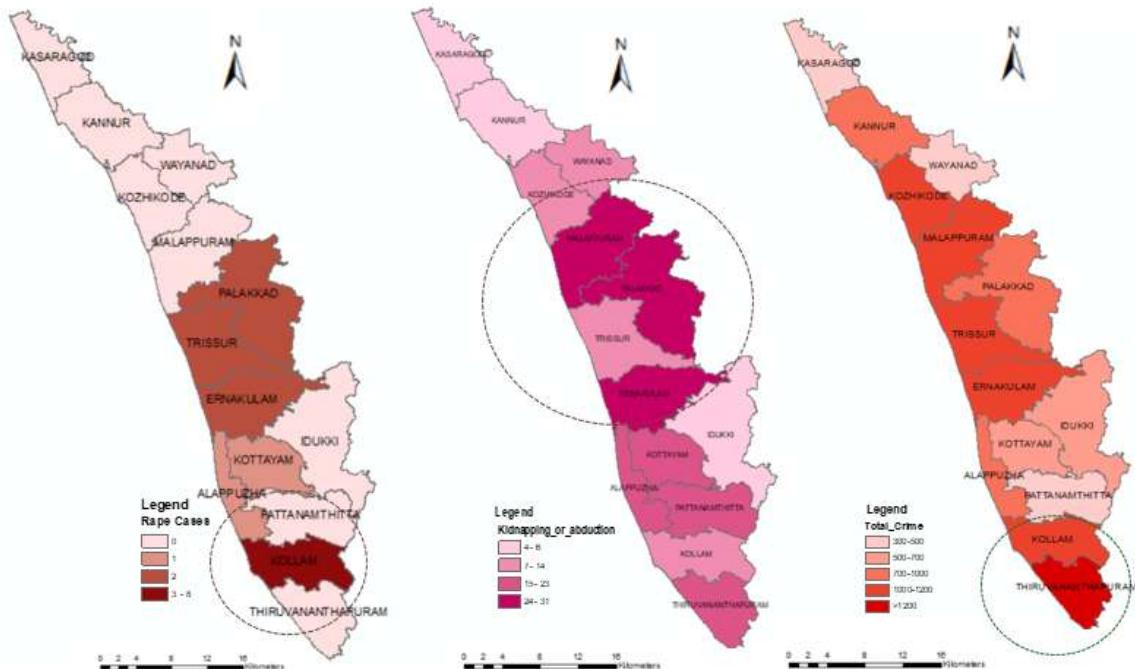
Goa, Himachal Pradesh, Jammu and Kashmir, Tamil Nadu, Uttarakhand, Arunachal Pradesh Andhra Pradesh mark the fewest[5]

Crime Trends against women in Kerala

Analyzing the NCRB data, Kollam emerges as the district with the highest rape rates among all districts. when it comes to kidnapping and abduction, Malappuram, Palakkad, and Ernakulam are the districts that report the highest numbers. However, when we take into account the overall crime rate against women, Thiruvananthapuram (TVM) registers the highest incidence[5]



Map showing spatial variation of rape crime in India



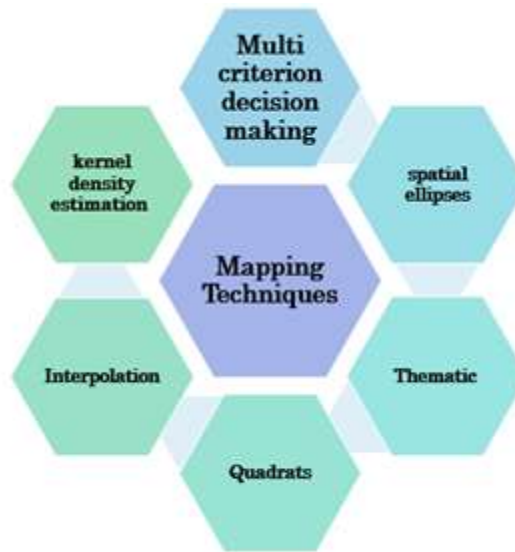
Spatial variation of rape cases in Kerala 2014-2019(NCRB)

Spatial variation of kidnapping and abduction in Kerala 2014-2019

Spatial variation of Total crime in Kerala 2014-2015

Crime trends against women in Kerala

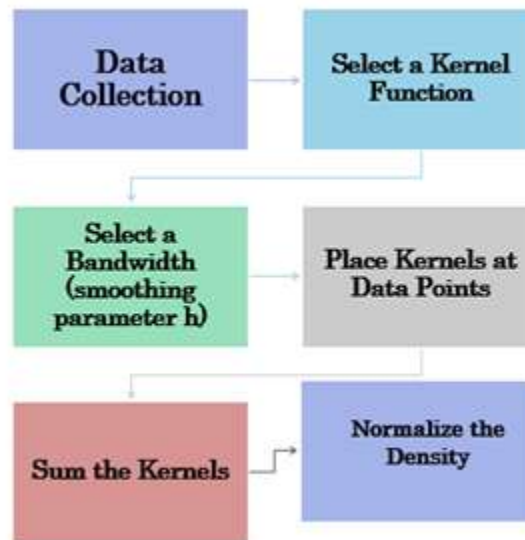
Different mapping techniques



kernel density estimation

A hotspot mapping technique that depicts hotspots as a smooth density surface is the kernel density estimation (KDE). It is a popular mapping method because of its visual impact.[6]

Kernal density estimationMethodology

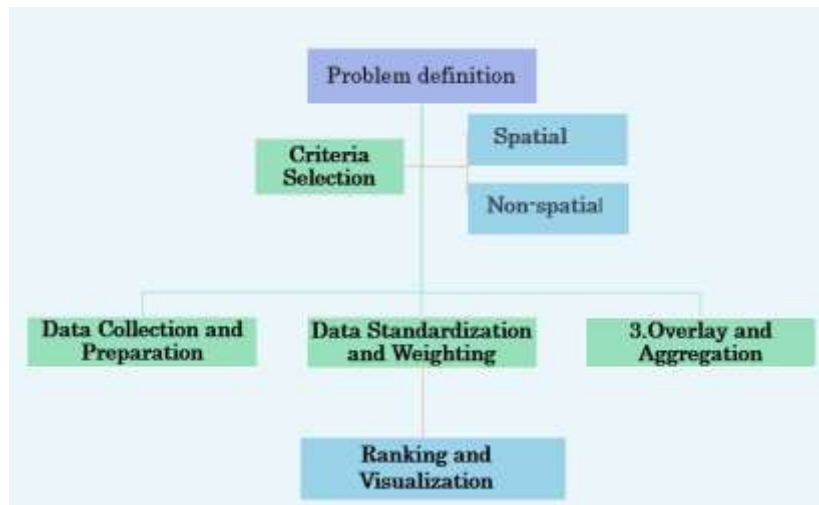


Kernal density estimation process

Multi criterion decision making

Multi-criteria analysis (MCA) is a decision-making approach that combines spatial ;

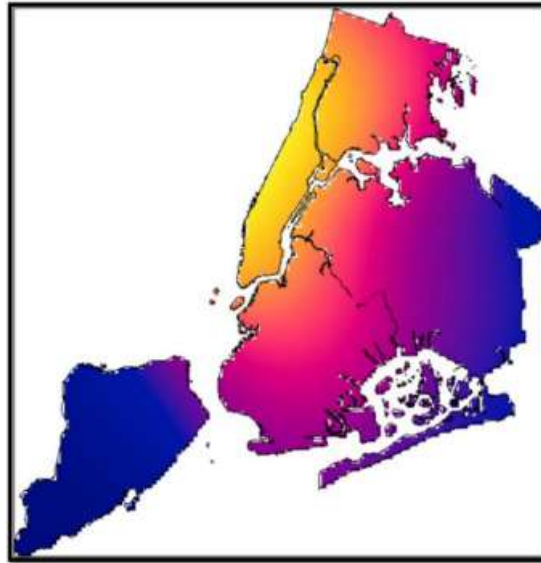
data and various criteria to evaluate and prioritize locations or alternatives based on their spatial and non-spatial attributes.[7]



Multi criterion decision making Process

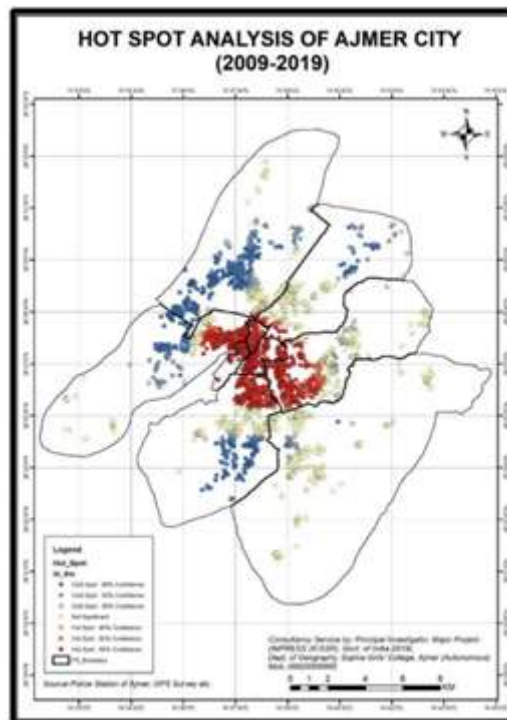
Aspect	Kernel Density Estimation (KDE)	Multi-Criteria Analysis (MCA)
Nature of Analysis	Univariate method for density estimation based on observed data points.	Multivariate method that considers multiple criteria and spatial data to evaluate locations.
Purpose	Provides a visualization of the spatial distribution of crime incidents.	Evaluates and prioritizes locations or areas based on various criteria for crime-related decision-making.
Data Requirement	Requires only the spatial coordinates (x, y) of crime incidents.	Requires spatial and non-spatial data, such as crime data, population data, and criteria for analysis.
Objective	Describes the concentration and hotspots of crime incidents.	Supports decision-making by identifying optimal locations for crime prevention or intervention.
Methodology	Utilizes a kernel function (e.g., Gaussian) and bandwidth to estimate a smooth density surface.	Involves defining objectives, criteria, and weights, conducting spatial analysis, and ranking alternatives.
Visualization	Provides a density surface or heatmap representing crime hotspots.	Provides a prescriptive framework for decision-making and resource allocation.
Decision Support	Primarily a descriptive tool for understanding crime patterns.	May generate suitability or preference maps indicating areas suitable for crime prevention.
Sensitivity to Parameters	Sensitive to the choice of kernel function and bandwidth.	Sensitive to criteria weights and their relative importance.
Scope	Suitable for exploratory data analysis and initial pattern recognition.	Applicable to various decision-making processes related to crime, including resource allocation, surveillance, and policing strategies.
Data-Driven vs. Expert Judgment	Primarily data-driven; minimal need for expert judgment.	Incorporates expert judgment in defining criteria, assigning weights, and interpreting results.
Trade-Offs and Compromises	Doesn't explicitly address trade-offs or compromises between criteria.	Allows for explicit consideration of trade-offs and compromises through criteria weighting.
Applicability to Different Domains	Primarily used for understanding spatial patterns in a variety of fields, not limited to crime.	Can be applied to crime mapping as well as land-use planning, site selection, environmental assessments, and more.
Outcome	Descriptive maps showing crime hotspots.	Decision support maps and recommendations for resource allocation and crime prevention strategies.

Comparative Analysis of two crime mapping methods



Overall Crime hot spots in NYC by using Kernel Density Method of mapping[8]

SOME OF THE ADVANAGES FROM



Crime hotspot analysis of Ajmer city using multicriteria decision making [9]

VI. CONCLUSION

Both Multicriteria Decision-Making (MCDM) and Kernel Density Estimation (KDE) methods are highly effective in identifying potential crime locations that may pose a risk of violence against women.

MCDM and KDE offer complementary approaches to crime mapping for women's safety. MCDM considers various criteria to make informed

decisions about potential risk areas, while KDE visually represents the spatial concentration of crimes against women. Together, these methods provide a robust framework for identifying and addressing locations where proactive measures are needed to prevent violence against women.

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