

ANALYZING THE SPATIAL DISTRIBUTION OF CRIME: A CASE STUDY OF BADABER VILLAGE PESHAWAR, PAKISTAN

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ABSTRACT

This study provides a comprehensive spatial analysis of crime patterns in Badhaber, a village in KP, Pakistan, utilizing both primary and secondary data sources. The primary data comprises 1,064 First Information Reports (FIRs) collected from the Badhaber Police Station, detailing incidents of murder, narcotics offenses, and kidnapping over a specified period. Secondary data was gathered from police records, reports, journals, and online resources, further enriching the dataset. The methodology involved a systematic analysis of the collected data using various software tools, including MS Word, MS Excel, PowerPoint, and ArcGIS. This multi-step approach allowed for the detailed examination of crime patterns and the identification of crime hotspots within the village. The analysis revealed that specific zones, particularly the villages of Musa Zai, Bazid Khel, and Teh Bahader, exhibited higher concentrations of criminal activity, particularly in murder and narcotics-related crimes. The findings of this study have significant policy implications, emphasizing the need for targeted law enforcement, community-centric crime prevention strategies, and improved urban planning in high-risk areas. The study also highlights the importance of data-driven policy formulation and recommends the establishment of a dedicated crime analysis unit to continuously monitor and respond to crime trends. Future research directions include longitudinal studies, broader geographic analyses, and deeper investigations into the socioeconomic factors contributing to crime in the region.

Keywords: Spatial Crime Analysis; Crime Patterns; GIS Mapping; Badhaber Village; Law Enforcement Strategy

INTRODUCTION

Crime, often understood as an unlawful act punishable by the state, is typically defined as a violation of the law, though what constitutes a crime can vary significantly across different countries due to cultural and traditional differences (Sheppard, Lawshe, & McDevitt, 2021). At its core, criminal behavior involves actions that are against the laws of a country or region, with those who commit such acts being labeled as criminals (Richman, 2022; Bassiouni, 2023). These actions are usually considered harmful or problematic to others, such as murder, assault, or theft—offenses that are widely recognized across most societies (Felson, 2016). However, what may be seen as

ethical or acceptable in one society might be classified as a crime in another, highlighting the diverse interpretations of legality across the globe (Siegel & Worrall, 2019). This variability underscores the complexity of crime as a social phenomenon, requiring a nuanced understanding of its socio-cultural context (Bhowmik, 2023).

The causes of crime are multifaceted, encompassing a range of factors such as overpopulation, poverty, political instability, racism, violence, and family conditions (Sampson & Wilson, 2020). Social and mental disorders, substance abuse, and the experience of unfair rulings or a flawed correctional system further

contribute to criminal behavior (Godsoe, 2021). These factors are often interconnected, forming a complex web of influences that drive individuals toward engaging in criminal activities.

An analysis of crime statistics across Pakistan from 2011 to 2016 reveals a varied landscape of criminal activity, with some provinces witnessing a decline in certain types of crimes, while others experienced an increase. Notably, crime rates involving murder, attempted murder, kidnapping, and dacoity decreased in most provinces except Khyber Pakhtunkhwa (KP), where these crimes saw a rise (National Police Bureau, 2016). Sindh, in particular, experienced the most significant decrease in crime, while Punjab reported the highest number of murders in 2016, followed by KP, Sindh, and Balochistan (Bureau of Statistics, 2017). The socio-economic and psychological impacts of crime, such as the murder of a family head, underscore the profound consequences on dependents, emphasizing the need for focused crime prevention efforts.

In Pakistan, crimes are categorized by the Pakistan Penal Code into several broad categories, including crimes against the state, public tranquility, justice, public servants, government stamps, weights and measurements, public health, safety, convenience, morals, the human body, property, and religion (Pakistan Penal Code, 2020). Each category encompasses a range of offenses, reflecting the diverse nature of criminal activity in the country.

In Khyber Pakhtunkhwa (KP), the rise in crime can be attributed to several factors, including weak law enforcement, a flawed judicial process, low conviction rates, economic disparity, and poor family structures (Zafar, 2019). The capacity of law enforcement agencies is often hampered by political interference, further exacerbating the crime situation in the region. Additionally, the presence of Afghan refugees and other socio-economic factors contribute to the complex crime dynamics in KP. Crimes in KP are not limited to common offenses but also include serious forms of militancy such as terrorism, target killings, suicide attacks, narcotics trafficking, kidnapping, extortion, and smuggling (Abbas, 2018). These crimes have a profound impact on the region's stability and security, making it imperative for law enforcement agencies to adopt comprehensive strategies to combat these threats effectively.

Peshawar, the capital of KP, faces unique challenges that contribute to its crime rates. The influx of Afghan refugees, high poverty levels, law and order issues, psychological disorders, and socio-economic factors, coupled with a lack of education, are major contributors to the city's crime problem (Tariq & Ahmad, 2020). Addressing these underlying issues is crucial for reducing crime and improving the overall safety and well-being of the residents.

Geographic Information Systems (GIS) play a crucial role in analyzing the spatial distribution of crimes and identifying potential causal relationships and patterns, ultimately aiming to reduce the frequency of crime and alleviate public suffering (Bowers & Johnson, 2023). GIS enhances crime analysis in several ways, with one of the primary uses being the visualization of crime occurrences (Wheeler & Steenbeek, 2023). This capability allows law enforcement agencies to better understand and analyze crime patterns and the underlying factors that drive criminal behavior. A GIS translates real-world physical elements, such as crimes, into forms that can be displayed, manipulated, and analyzed alongside related police data, such as information about crimes, arrests, or other pertinent details (Chainey & Ratcliffe, 2017). The geographical nature of crime is significant because every crime occurs at a specific location, and the perpetrator also originates from a particular place. This place may coincide with the crime scene or is often in close proximity to where the crime was committed.

Crime mapping and spatial analysis encompass a wide array of techniques used to investigate various aspects of criminal activity (Willmott, Hunt & Mojtahedi, 2021). At its core, crime mapping involves the use of Geographic Information Systems (GIS) to visually organize spatial data, facilitating more structured statistical analysis. This spatial analysis can be applied in both exploratory and confirmatory ways, primarily to identify how specific community or ecological factors—such as population demographics or the built environment—influence the distribution of crime (Johnson, 2022). Two key areas of focus include examining the spread of crime and assessing the effectiveness of geographically targeted crime reduction strategies (Wheeler & Steenbeek, 2023). Additionally, crime mapping is valuable for visualizing and analyzing the

movement patterns or target selection of criminals. By creating electronic pin maps and spatially organizing data, GIS enhances the analytical utility of these maps (Sampson et al., 2022).

Crime mapping, a critical tool used by law enforcement agencies, plays a significant role in visualizing, analyzing, and understanding crime patterns. By utilizing Geographic Information Systems (GIS), crime analysts can identify the spatial distribution of crimes, including hotspots, trends, and patterns, thereby contributing to effective crime analysis and state policing strategies (Chainey & Ratcliffe, 2017). The application of GIS in crime mapping allows for a detailed examination of crime incidents and their spatial correlations, providing insights that are essential for crime prevention and law enforcement. Crime mapping enables researchers and law enforcement to explore patterns of criminal behavior, offender mobility, and serial offenses across both time and space (Bowers & Johnson, 2023). In the realm of local policing, crime mapping is crucial for visualizing crime clusters by type, which helps to confirm the on-the-ground knowledge of patrol officers. This tool is also instrumental in resource allocation, such as patrol distribution and specialized enforcement efforts, and in addressing the concerns of local communities (Townesley & Sidebottom, 2023). The interdisciplinary nature of crime studies and the development of spatial analysis methods underscore the growing importance of spatial analysis in understanding the geographical patterns of crime (Weisburd et al., 2023). The relationship between crime and the physical environment has been a focal point of research, with crime trends and patterns being systematically analyzed since the late 1980s. The U.S. National Institute of Justice (NIJ) pioneered efforts in crime mapping as part of community policing initiatives (Weisburd, 2015). Crime mapping not only helps identify crime hotspots but also plays a crucial role in crime reduction strategies. The use of GIS has become increasingly important in managing crime data, providing law enforcement with the tools needed for effective policing (Johnson, 2016). GIS aids in visualizing the spatial distribution of crimes, enabling stakeholders to analyze the relationships between crime types and land use, thereby forecasting potential future incidents (Bani-Taha & Shafiq, 2020).

Recent research has advanced the understanding of crime prediction, spatial analysis, and hotspot detection through various methodologies and techniques. Safat et al. (2021) applied machine learning and deep learning approaches, including logistic regression, support vector machines, and long-short term memory (LSTM), to forecast crime trends in Chicago and Los Angeles. Their findings indicated a decline in crime rates in Chicago, while Los Angeles exhibited mixed trends. The study highlighted the effectiveness of LSTM in analyzing time series data for crime forecasting.

In 2021, Khan and Talukder conducted a spatial analysis of crime across Bangladesh using GIS techniques, identifying significant regional variations in crime rates, with urban centers like Dhaka and Chattogram experiencing higher incidences. Their research underscored the importance of GIS-based crime mapping for developing targeted crime prevention strategies. Also in 2021, Tillyer et al. examined the influence of crime generators and neighborhood-level factors such as concentrated disadvantage and civic engagement on block-level crime. THEIR study revealed that crime rates were amplified in areas with higher opportunities for crime but were mitigated in neighborhoods with stronger civic engagement, emphasizing the need to consider neighborhood context in crime analysis. Wheeler and Steenbeek (2021) demonstrated the potential of Random Forests in predicting long-term crime risks at micro-locations in Dallas. Their research showed that machine learning models could surpass traditional methods like Risk Terrain Modeling (RTM) and Kernel Density Estimation (KDE) in predictive accuracy. They also introduced interpretability techniques to make these models more understandable, thus providing better insights into crime risk factors.

In 2020, Butt et al. conducted a systematic literature review of spatio-temporal crime hotspot detection and prediction techniques, synthesizing findings from 49 studies. Their review highlighted the role of data mining, machine learning, and deep learning in improving crime prediction accuracy, particularly through clustering techniques and time series analysis. However, they noted challenges related to data accuracy and the need for more robust prediction models. Hossain et al. (2020) explored crime prediction using spatio-temporal data from San Francisco, applying various machine

learning algorithms, including decision trees, K-nearest neighbor (KNN), random forest, and ADABOOST. Their study found that random forest, combined with random under-sampling, yielded the highest accuracy, achieving a final accuracy of 99.16%. This research emphasized the potential of machine learning models in accurately predicting criminal activities.

Agustí (2020) investigated the spatial distribution of tourist-generated images in high-crime cities such as Los Cabos and Acapulco in Mexico. The study found that tourists tended to concentrate their activities in safer areas, even within cities known for high crime rates. This research provided insights into the spatial dynamics of safety perceptions among tourists in high-risk urban environments. In 2020, Wainana et al. analyzed crime data in Kenya using data mining techniques like the k-means algorithm and the Apriori algorithm. Their study revealed a decrease in crime rates over time, with higher incidences in more populous counties. They suggested prioritizing resource allocation in these areas to control crime effectively and identified a gap in using time series methods for crime analysis, which could offer more insights into the temporal aspects of crime. In 2018, ToppiReddy et al. developed a crime prediction framework based on spatial analysis, using machine learning algorithms to predict crime distribution. Their research highlighted the importance of real-time crime predictions in reducing crime rates and improving public safety. The study also stressed the value of visualizing crime patterns to support law enforcement efforts. Algahtany et al. (2018) explored the relationship between crime and population density in Saudi Arabia, utilizing GIS to analyze crime data over a decade. Their study found that regions with higher population densities, such as Northern Borders and Jizan, experienced elevated crime rates, particularly for drug-related offenses and theft. This research demonstrated the utility of GIS in understanding the spatial dynamics of crime and informing law enforcement strategies. Heo et al. (2014) investigated the spatial patterns of urban crime in three Korean cities, focusing on how property and built environment variables influenced crime rates. Their study found significant correlations between urban crime rates and these variables, suggesting that regional differences in the built environment should be

factored into anti-crime policies. The findings contributed to developing region-specific crime prevention strategies.

Feng et al. (2016) conducted a spatio-temporal analysis of property crime in Beijing, uncovering the spatial patterns of urban crime and the factors that influence these patterns. The study utilized open crime data to gain insights into the dynamics of crime in rapidly urbanizing environments, contributing to the growing body of literature on crime in such settings. In 2015, Almanie et al. focused on identifying spatial and temporal crime hotspots using datasets from Denver and Los Angeles. They employed the Apriori algorithm and machine learning classifiers like Decision Trees and Naive Bayes to predict crime types and identify dangerous locations. The study provided valuable insights into the factors influencing crime distribution and the potential for predictive policing in high-risk areas. Hooghe et al. (2011) examined the spatial distribution of crime in Belgium, focusing on how unemployment, income inequality, and poverty impacted crime rates. Their findings indicated a strong positive correlation between unemployment and crime, with income inequality being particularly associated with property crimes. This study highlighted the significance of socio-economic factors in shaping crime patterns and informed policies aimed at reducing crime through economic interventions.

This detailed review of published literature on the spatial distribution of crimes reveals that although the use of GIS in studying crimes is a promising field of research, there are major gaps in research presently. Specifically, there have been very few detailed and systematic studies on spatial distribution of crimes and their causes in Khyber Pakhtunkhwa province of Pakistan. Therefore, this study aims to achieve several key objectives. The primary objective is to analyze the spatial and temporal distribution of crimes in the Badaber village for the years 2021 and 2022. By examining these distributions, the study seeks to uncover the crime rate across different zones or areas of influence within the village. Another critical aspect of this research is to identify areas with particularly high crime rates, which will help in understanding the geographical concentration of criminal activities. Furthermore, the study aims to investigate the underlying causes of crime, thereby offering insights into the factors contributing to

these criminal activities. The overarching goal is to understand the spatial distribution of crime in Badaber village comprehensively.

The study area

The study area includes the jurisdiction of Badaber Police Station located in the Subdivision Badaber in district Peshawar which is the capital of Khyber Pakhtunkhwa Province of Pakistan. The area

covered by a specific police station is commonly referred to as its jurisdiction or precinct. In some regions, it may also be called a beat or patrol area. These terms refer to the geographical boundaries within which the police station has authority to operate and enforce the law. The Badaber police station is located 33° 57' 28" N latitude and 71° 34' 25" E longitude. The Badaber Subdivision mostly consists of rural area.

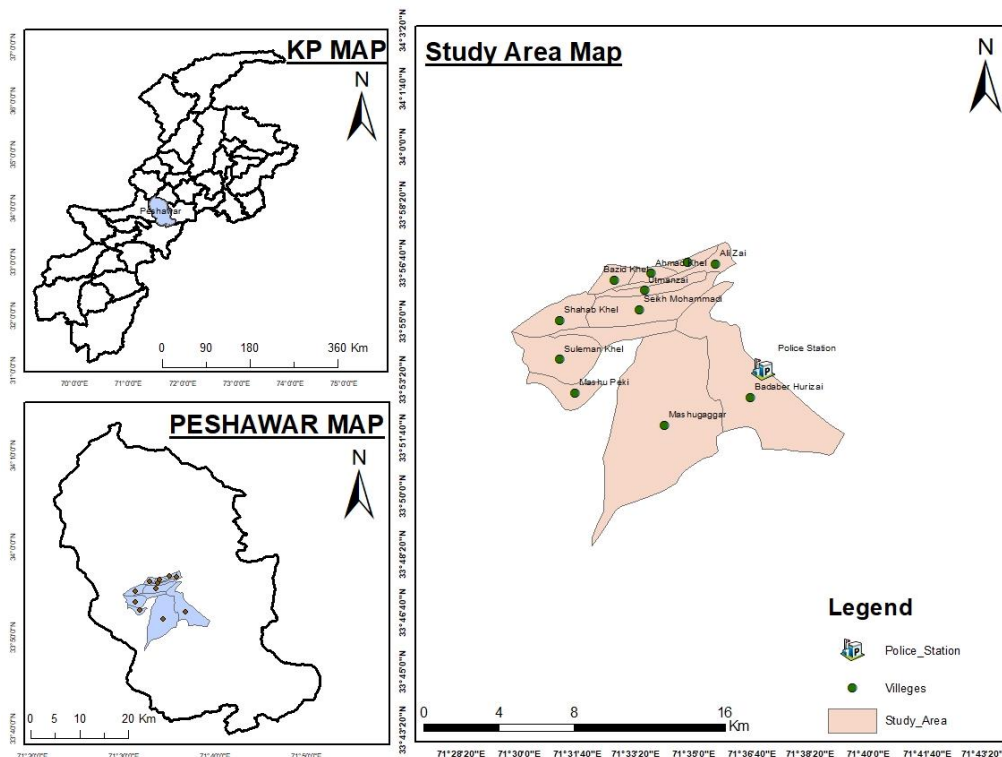


Figure 1: Location of study area.

Research Methodology:

Data Collection

Data collection for this study involved both primary and secondary sources. The primary data was obtained from the First Information Reports (FIRs) filed at the Badaber Police Station. A total of 1,064 crimes were reported during the specified period, providing a substantial dataset for analysis. Secondary data was sourced from various records maintained by the Badaber Police Station, which served as the main source of information regarding the selected crimes. In addition to police records, secondary data was also gathered from reports, journals, Google Earth, and other internet resources, enriching the dataset and providing additional context for the analysis.

Data Analysis

The analysis of data is a crucial step in this research, as it helps to reveal the patterns and nature of crime in Badaber village. The collected data was meticulously organized, manipulated, and then analyzed using various software tools, including MS Word, MS Excel, PowerPoint, and ArcGIS. The analysis was conducted step by step, ensuring a comprehensive examination of the selected crimes, such as murder, narcotics offenses, and kidnapping, within the study area. The results were then presented in the form of tables, graphs, and maps, providing a clear visual representation of the findings. This methodological approach allows for a detailed understanding of the spatial distribution of crime and the factors influencing

crime rates in different zones within Badaber village.

Results

Crime rate in Badaber

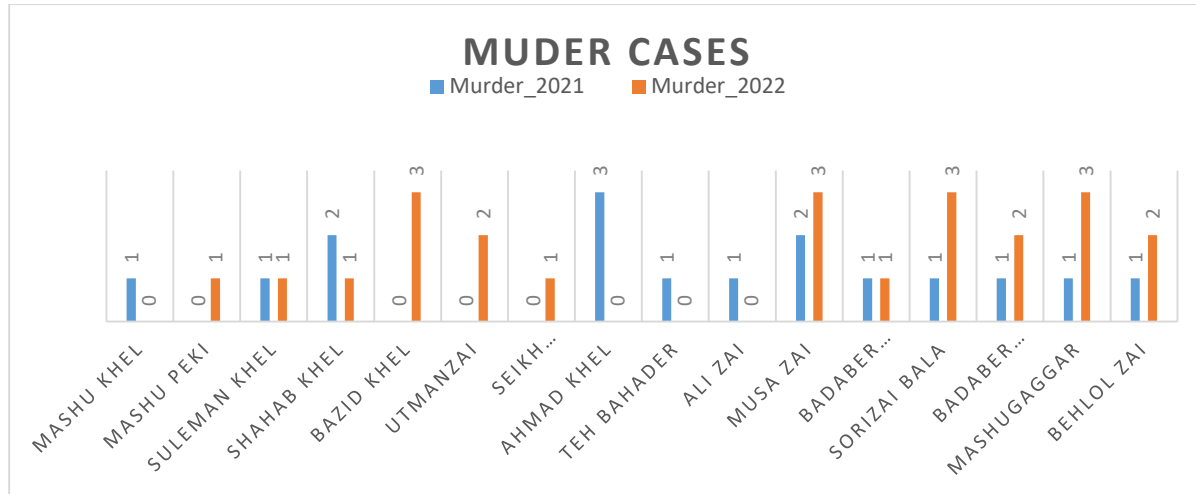


Fig 2 showing murder cases in different villages of BadaBer

Figure 2 provides an overview of murder incidents across various villages in Badaber during 2021 and 2022. Mashu Khel reported one murder in 2021 but none in 2022, while Mashu Peki had no murders in 2021, followed by one in 2022. Suleman Khel consistently recorded one murder in both years, whereas Shahab Khel saw a decrease from two murders in 2021 to one in 2022. Bazid Khel showed an increase, with three murders in 2022 compared to none in 2021. Utmanzai followed a similar trend, with no murders in 2021 but two in 2022. Seikh Mohammadi also had no murders in 2021, followed by one in 2022. Conversely, Ahmad Khel had three murders in 2021 but none in 2022. Teh Bahader and Ali Zai both reported one

murder in 2021 and none in 2022. Musa Zai experienced an increase, with two murders in 2021 and three in 2022. Badaber Maryam reported one murder each year, while Sorizai Bala saw an increase from one murder in 2021 to three in 2022. Badaber Hurizai witnessed a rise from one murder in 2021 to two in 2022, and Mashugaggar similarly had one murder in 2021 and three in 2022. Lastly, Behlol Zai reported one murder in 2021, which increased to two in 2022. Overall, while some villages like Mashu Khel and Ahmad Khel experienced a reduction in murders from 2021 to 2022, others such as Bazid Khel, Musa Zai, Sorizai Bala, and Mashugaggar faced an increase in murder incidents over the same period.

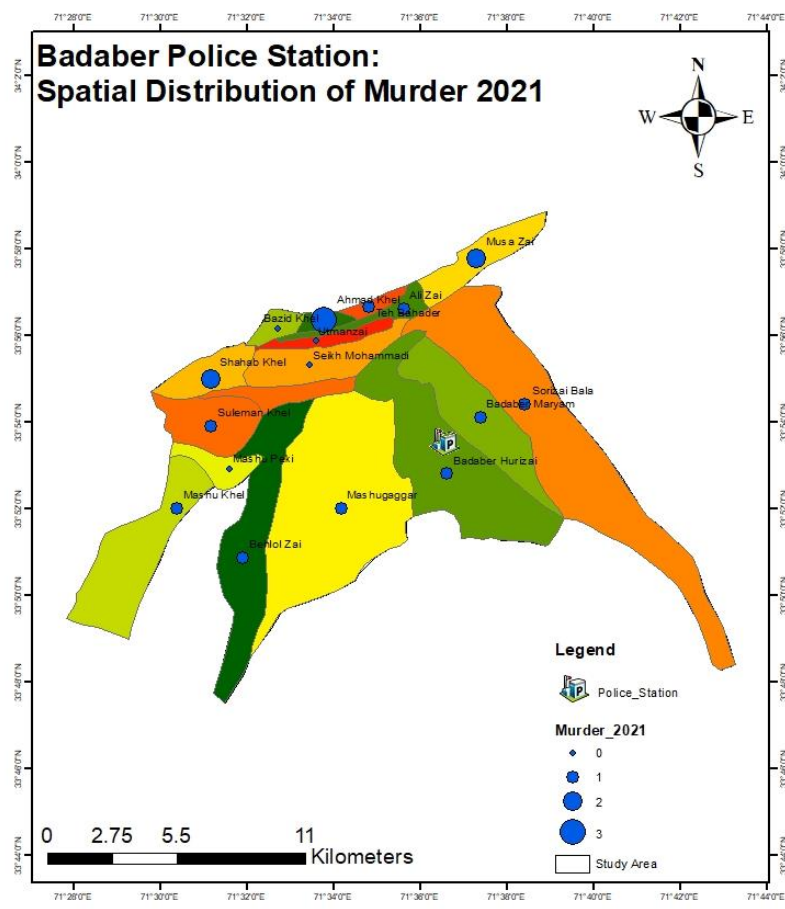


Fig 3 Map showing the murder rates in villages of Badaber in 2021

The Figure 3 illustrates the spatial distribution of murders across various villages within the jurisdiction of the Badaber Police Station in 2021. Each village is represented by a distinct color, indicating the number of murders reported that year. The legend clarifies that the blue circles denote the number of murders, with larger circles corresponding to a higher incidence. For example, Behlol Zai and Ahmad Khel are highlighted with larger circles, indicating they experienced more murders compared to other areas. Villages such as Mashu Khel, Mashugaggar, and Musa Zai show smaller circles, signifying a lower number of murders. The map also provides geographical

context, showing the spread of these incidents across the study area, with some clusters of higher murder rates in specific zones. Overall, the map visually represents the concentration and distribution of murders, helping to identify areas with higher crime rates in 2021. Figure 4 shows the spatial distribution of murders across different villages within the Badaber Police Station's jurisdiction in 2022. The villages are color-coded to represent various areas, with blue circles indicating the number of murders. Larger circles denote higher incidences of murder. Notably, Musa Zai, Bazid Khel, Sorizai Bala, Mashuggar, and Bazid Khel experienced a higher

number of murders, indicated by the larger blue circles, compared to other areas. Villages such as Mashu Khel and Ahmad Khel show no murders in 2022, indicated by the absence of blue circles. The map provides a clear visual representation of the

geographical spread of murders, with certain areas showing a higher concentration of criminal activity, reflecting changes in crime patterns compared to the previous year.

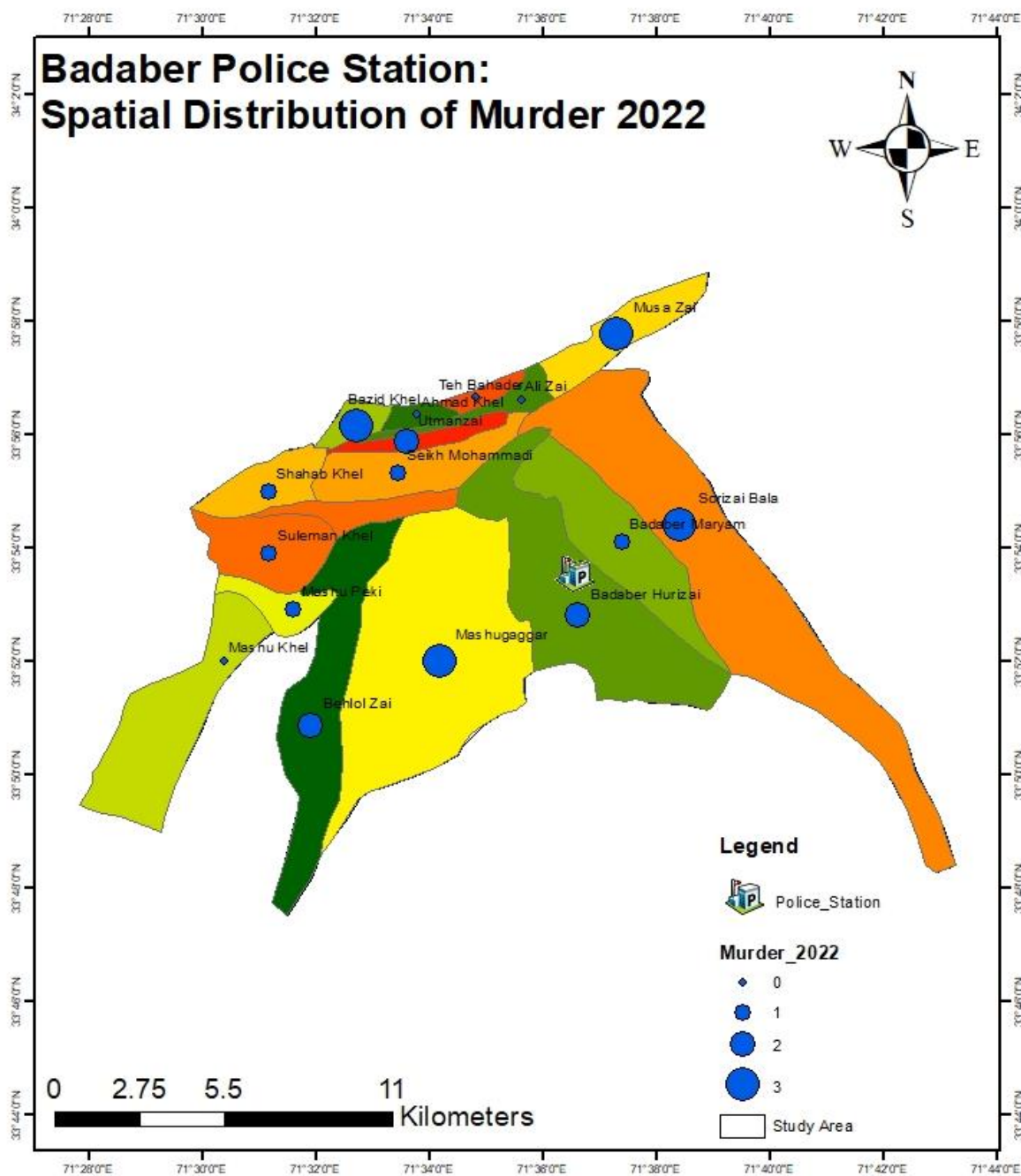


Fig 4. Shows the murder rates in villages of Badaber in 2022

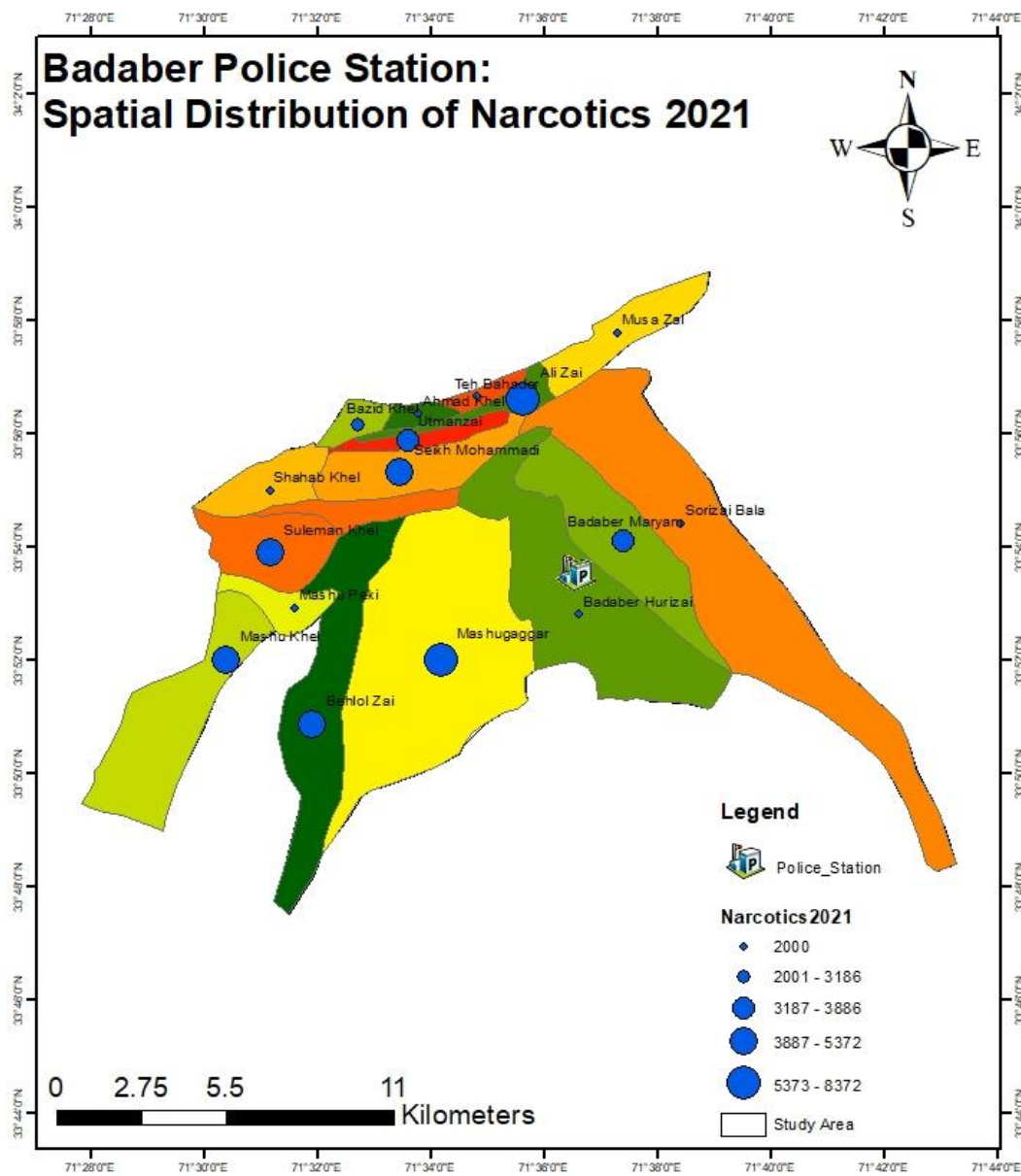


Fig 5 shows the Narcotics distribution in different villages of BadaBer in 2021

Figure 5 illustrates the spatial distribution of narcotics-related incidents across various villages under the jurisdiction of the Badaber Police Station in 2021. Different shades and colors represent various zones within the study area, while blue circles of varying sizes indicate the volume of narcotics cases reported in each village. The size of the circles correlates with the number of incidents,

with larger circles signifying a higher number of cases.

Significant narcotics activity is observed in villages like Teh Bahader, Bazid Khel, and Utmanzai, where the largest blue circles appear, indicating the highest number of narcotics cases, ranging between 5373 and 8372 incidents. Other villages, such as Musa Zai, Mashu Peki, and Suleman Khel, also show notable narcotics activity

but at a relatively lower frequency, as represented by smaller blue circles. In contrast, some areas, including Mashu Khel and Ahmad Khel, display smaller circles or none at all, indicating fewer or no reported narcotics-related incidents in 2021. Overall, the map provides a visual representation of the narcotics problem within the study area, highlighting villages with higher concentrations of narcotics cases, which could be areas of concern for law enforcement and policy intervention. Figure 6 illustrates the distribution and intensity of narcotic-related incidents across different areas within the jurisdiction of the Badaber Police Station. The map uses color coding to depict

various regions, with the size of blue circles representing the quantity of narcotics-related incidents reported in 2022. Larger circles indicate higher numbers of incidents, with the most significant concentration observed in areas such as Shaikhan Khel, Ahmad Khel, and Sulemankhel, where the number of cases ranges from 4,501 to 6,500. The map provides a clear spatial understanding of narcotics distribution, highlighting areas that require targeted law enforcement efforts. The legend and scale are provided for reference, with the study area clearly demarcated.

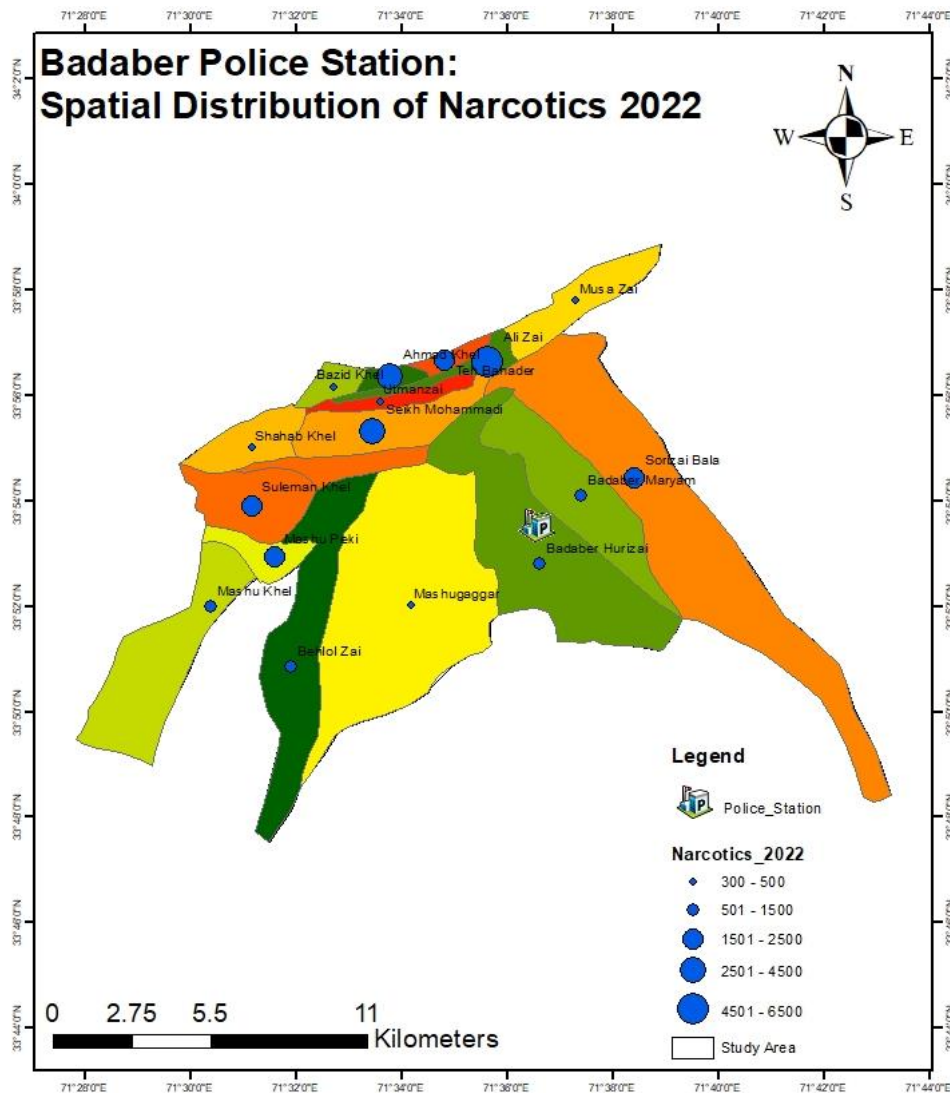


Fig 6 shows the Narcotics distribution in different villages of Badaber in 2022

Table 1: shows the Narcotics distribution in different villages of Badaber in 2021-2022

Villeges	Narcotics2021	Narcotics_2022
Mashu Khel	5372	1000
Mashu Peki	2000	2500
Suleman Khel	5000	2500
Shahab Khel	2000	321
Bazid Khel	3186	500
Utmanzai	3886	500
Seikh Mohammadi	5000	4500
Ahmad Khel	2000	3500
Teh Bahader	2000	2000
Ali Zai	8372	6500
Musa Zai	2000	500
Badaber Maryam	3886	1500
Sorizai Bala	2000	2000
Badaber Hurizai	2000	1200
Mashugaggar	6686	300
Behlol Zai	5000	1000

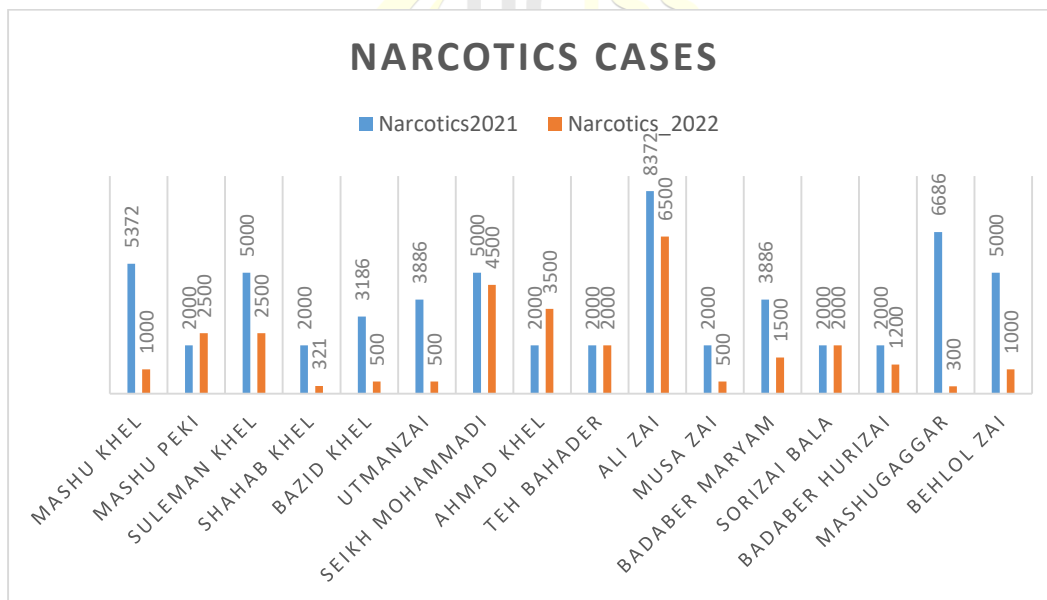


Fig 7 shows the Narcotics distribution in different villages of Badaber in 2021 and 2022

The Table 1 and Figure 7 presents a comparative analysis of narcotics-related incidents across various villages within the jurisdiction of the Badaber Police Station for the years 2021 and 2022. The data shows that several villages

experienced a significant decrease in narcotics incidents from 2021 to 2022. For instance, Mashu Khel saw a reduction from 5,372 cases in 2021 to 1,000 cases in 2022, and Ali Zai, which had the highest number of cases in 2021 at 8,372, reduced

to 6,500 in 2022. On the other hand, some villages like Mashu Peki and Ahmad Khel witnessed an increase in incidents, with Mashu Peki rising from 2,000 in 2021 to 2,500 in 2022, and Ahmad Khel from 2,000 to 3,500 over the same period. Villages like Seikh Mohammadi and Teh Bahader showed relatively stable figures, with only slight changes between the two years. This table underscores the varying trends in narcotics-related activities across different areas, highlighting where efforts have been effective and where additional interventions might be necessary.

Figure 8 illustrates the geographical distribution of kidnapping incidents within the jurisdiction of the Badaber Police Station. The area is divided into various zones, each represented by different colors, indicating varying levels of kidnapping frequency or risk. The map features prominent locations such

as Shaikh Mohammadi, Mas Huggogar, Musa Zai, and Ahmad Khel, among others. The size of blue circles indicates the number of kidnapping incidents in each location, with larger circles representing higher frequencies. The legend shows that these circles range from 0 to 1 incident per location, suggesting that the kidnapping incidents are relatively infrequent but spatially dispersed across the area. The map also includes key landmarks like police stations to provide spatial context. The scale bar at the bottom indicates distances, helping to understand the proximity of these incidents to each other within the study area. Overall, this map serves as a visual tool for identifying potential hotspots of kidnapping in the Badaber area during 2021, which could inform law enforcement and community safety measures.

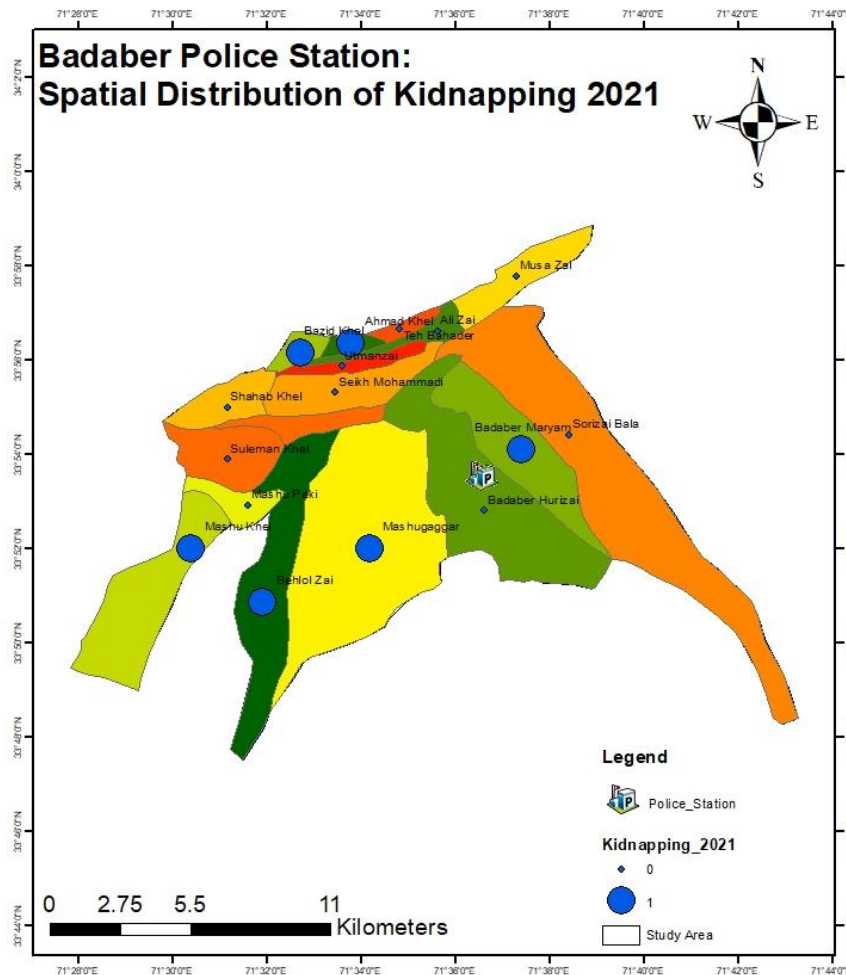


Fig 8 shows the Kidnapping rate in different villages of Badaber in 2021

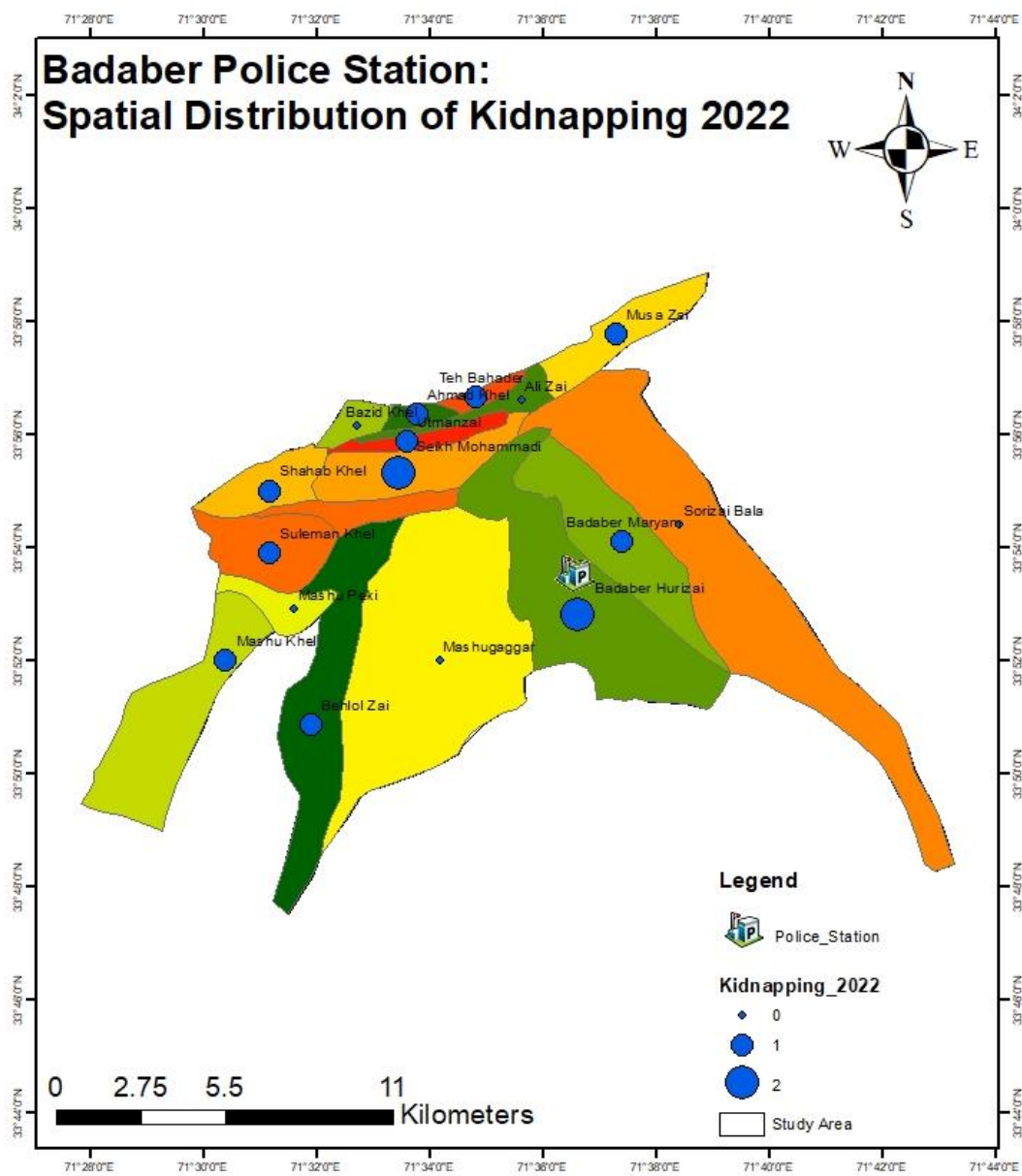


Figure 9: shows the Kidnapping rate in different villages of Badaber in 2022

Figure 9 depicts the spatial distribution of kidnapping incidents within the jurisdiction of the Badaber Police Station. The study area is divided into different zones, each colored differently to represent various areas or neighborhoods. Blue circles of varying sizes are used to indicate the number of kidnapping incidents reported in 2022, with the size of the circle corresponding to the frequency of incidents. The legend shows that the

smallest circles represent areas with no kidnappings, medium-sized circles indicate one incident, and the largest circles represent two incidents. The map also marks the location of the Badaber Police Station with a distinct symbol. The geographic coordinates and scale bar at the bottom provide spatial reference, indicating that the map covers an area of approximately 11 kilometers in length.

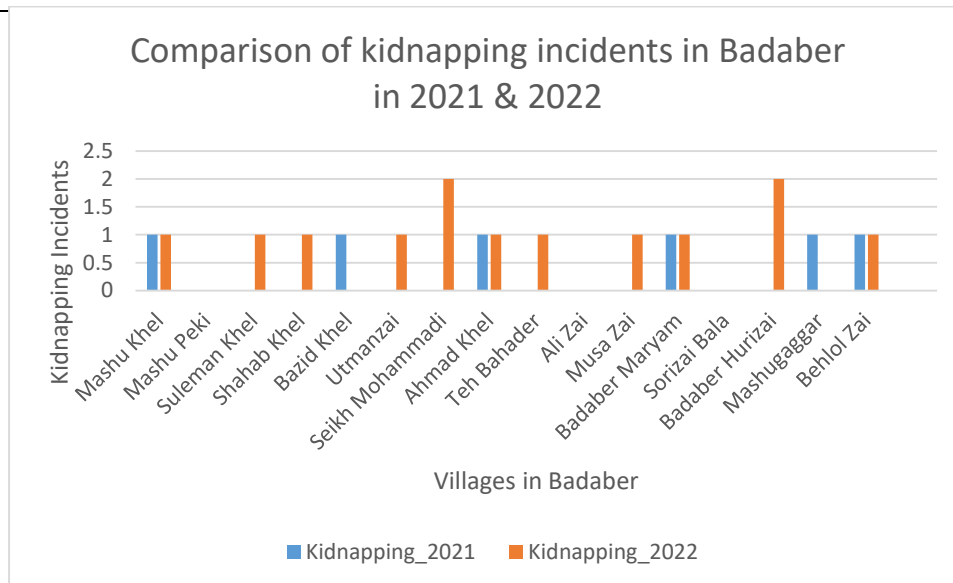


Figure 10: Comparison of kidnapping incidents in Badaber in 2021 & 2022

The data illustrates the number of kidnapping incidents in various villages within the jurisdiction of the Badaber Police Station for the years 2021 and 2022. Villages such as Mashu Khel, Ahmad Khel, Badaber Maryam, and Behlol Zai experienced a consistent number of kidnapping incidents, with each reporting 1 incident in both years. In contrast, Suleman Khel, Shahab Khel, Utmanzai, Teh Bahader, Musa Zai, Seikh Mohammadi, and Badaber Hurizai saw an increase in kidnapping incidents in 2022 compared to 2021. Notably, Seikh Mohammadi and Badaber Hurizai witnessed the most significant increases, from 0 incidents in 2021 to 2 in 2022. Meanwhile, villages like Bazid Khel and Mashugaggar reported a decrease in incidents, with Bazid Khel dropping from 1 in 2021 to 0 in 2022 and Mashugaggar also decreasing from 1 to 0. Other villages such as Mashu Peki, Ali Zai, and Sorizai Bala remained free of any kidnapping incidents during both years. Overall, the data indicates an upward trend in kidnapping incidents in several villages between 2021 and 2022.

Discussion

The results of this study on the spatial distribution of crimes in Badaber, particularly focusing on murder, narcotics, and kidnapping incidents across various villages, provide insights that both align with and diverge from previous research findings

in the field of crime analysis and spatial distribution. The analysis of murder incidents in Badaber reveals a mixed pattern, with some villages experiencing an increase in murder rates while others saw a decrease. For instance, Bazid Khel, Musa Zai, Sorizai Bala, and Mashugaggar reported higher murder rates in 2022 compared to 2021, whereas villages like Ahmad Khel and Teh Bahader showed a reduction. These findings resonate with the research by Khan and Talukder (2021), who also identified significant spatial variations in crime rates across regions, with some areas experiencing higher incidences than others. However, while their study focused on broader urban centers, our findings highlight that even within a smaller jurisdiction like Badaber, there are pronounced local variations. The spatial distribution of murders in Badaber, with certain villages emerging as hotspots, is consistent with the concept of crime generators discussed by Tillyer et al. (2021). Areas with more opportunities for crime, such as those with higher population densities or more significant economic activities, may see elevated crime rates. The study found significant fluctuations in narcotics-related incidents across different villages in Badaber between 2021 and 2022. For example, Mashu Khel and Ali Zai saw a sharp decrease in narcotics cases, whereas Mashu Peki and Ahmad Khel experienced an increase. These trends align

with the findings of Butt et al. (2020) and Hossain et al. (2020), who emphasized the effectiveness of machine learning algorithms in detecting changes in crime trends, including drug-related offenses. The observed decreases in some areas could suggest successful law enforcement interventions or shifts in criminal activity to less monitored areas, echoing Wainana et al. (2020)'s findings on the importance of resource allocation in crime prevention. However, the increases in certain villages indicate persistent challenges in combating narcotics distribution, suggesting that crime displacement might be occurring, where criminal activities move to areas with perceived lower risks of detection.

The spatial analysis of kidnapping incidents in Badaber presents a relatively low frequency but notable spatial dispersal. This finding is somewhat in contrast to the more concentrated crime hotspots typically observed in urban environments, as noted by Heo et al. (2014) and Feng et al. (2016). The low incidence of kidnapping could reflect either effective deterrence measures in place or underreporting due to social or cultural factors in the area. The distribution pattern, with few villages reporting one or two incidents, suggests that while kidnapping is not widespread, it is a sporadic issue that still needs addressing, particularly in the identified hotspots.

Compared to existing literature, this study contributes new insights specific to the Badaber region, which has not been extensively studied before. While much of the existing research, such as that by Safat et al. (2021) and Wheeler and Steenbeek (2021), has focused on larger urban areas or regions with significant crime data availability, our study highlights the importance of localized crime analysis in smaller, rural, or semi-urban settings. The findings underscore the need for tailored crime prevention strategies that consider the unique social, economic, and geographical contexts of areas like Badaber.

Moreover, this study reveals that even within a relatively small area, there are complex and dynamic crime patterns that require continuous monitoring and adaptive law enforcement strategies. The observed increase in certain types of crimes, despite overall reductions in others, points to the possibility of crime displacement, a phenomenon where criminal activities shift geographically rather than being entirely

eliminated. This aspect has been less emphasized in previous research, particularly in the context of rural or semi-urban settings like Badaber. The results of this study both confirm and challenge previous findings in the literature. While the spatial distribution of crimes in Badaber shows similarities with trends observed in other regions, particularly regarding the clustering of crimes in specific areas, it also highlights the unique challenges and dynamics of crime in a semi-urban Pakistani context. This study underscores the importance of localized crime analysis and the need for context-specific crime prevention strategies, contributing valuable insights to the broader field of crime geography and spatial analysis.

Recommendations

Based on the findings of the study conducted in Badaber, KP, Pakistan, several targeted recommendations can be made to address the specific crime-related issues identified in the area. These recommendations focus on law enforcement, community engagement, urban planning, and policy interventions to mitigate crime and enhance public safety.

1. The study identified certain villages, such as Musa Zai, Bazid Khel, Sorizai Bala, and Mashuggar, as hotspots for murder incidents. Increasing police patrols and establishing more police outposts in these areas could act as a deterrent to criminal activities.
2. Villages like Teh Bahader, Bazid Khel, and Utmanzai exhibited significant narcotics-related activities in 2021, while areas like Shaikhan Khel, Ahmad Khel, and Sulemankhel showed high narcotics cases in 2022. Law enforcement agencies should prioritize these areas for targeted anti-narcotics operations, including raids and surveillance.
3. Incorporating CPTED principles in urban planning, such as improving street lighting, increasing visibility through open spaces, and maintaining clean and well-kept public areas, can reduce opportunities for crime.
4. Establishing community policing programs can foster trust between law enforcement and local residents. Such programs would encourage citizens to participate actively in crime prevention by reporting suspicious activities and collaborating with police efforts.

5. Conduct awareness campaigns to educate the community about the dangers of narcotics, the importance of reporting crime, and the benefits of a safe and secure neighborhood. These campaigns can be conducted through local schools, community centers, and social media platforms.

6. Developing programs aimed at engaging the youth in positive activities, such as sports, arts, and vocational training, can help divert them from criminal activities, especially in areas identified as high-risk for narcotics-related crimes.

7. Investment in infrastructure, such as better roads, public transportation, and street lighting in high-crime villages, could improve the overall quality of life and reduce the likelihood of criminal activities.

8. Implementing strict zoning regulations to prevent the establishment of illegal businesses or unregulated housing in crime-prone areas can help reduce crime rates. Authorities should monitor the development of urban spaces to ensure compliance with safety standards.

9. Setting up a dedicated unit within the police department to continuously monitor and analyze crime data using GIS and other spatial analysis tools could help in real-time identification of emerging crime patterns and enable prompt response.

10. Encourage the regular collection and analysis of crime data, which will allow law enforcement to adapt to changing crime trends over time. This can also help in evaluating the effectiveness of implemented strategies and making necessary adjustments.

11. Advocate for stricter laws and harsher penalties for narcotics-related offenses and violent crimes, such as murders. The legal framework should be strengthened to ensure swift prosecution and deterrence.

12. The local government should develop a comprehensive crime prevention strategy that integrates law enforcement, community engagement, urban planning, and social services. This strategy should be regularly updated based on ongoing research and crime data analysis.

13. Collaborate with local non-governmental organizations (NGOs) and community-based organizations (CBOs) that work on social issues such as drug abuse prevention, youth development, and public safety. These partnerships can enhance

the reach and effectiveness of crime prevention initiatives.

14. Work closely with schools and colleges in the area to implement educational programs focused on crime prevention, civic responsibility, and the consequences of criminal behavior.

15. Continuously monitor and evaluate the effectiveness of crime reduction programs and interventions implemented in the area. This can be done through regular surveys, community feedback, and crime data analysis.

16. Based on the evaluation results, adapt and refine strategies to ensure they remain effective in addressing the evolving crime landscape in Badaber.

The recommendations provided aim to address the specific crime issues identified in the Badaber area through a multifaceted approach involving law enforcement, community engagement, urban planning, and policy reforms. By implementing these recommendations, local authorities and communities can work together to create a safer and more secure environment, reducing the incidence of crime and improving the overall quality of life for residents.

Conclusion

The findings of this study have significant policy implications for crime prevention and public safety in the Badaber area of KP, Pakistan. The spatial analysis revealed distinct crime patterns, including hotspots for murder and narcotics-related activities, underscoring the need for targeted and data-driven interventions.

The study highlights the importance of deploying law enforcement resources more strategically, with an emphasis on areas identified as crime hotspots. Policymakers should consider revising the allocation of police forces and resources to enhance surveillance and response in high-crime villages such as Musa Zai, Bazid Khel, and Teh Bahader. The study underscores the value of community engagement in crime prevention. Policies should promote community policing initiatives that encourage collaboration between law enforcement and local residents. Additionally, educational campaigns focused on crime awareness and prevention should be integrated into the broader crime reduction strategy.

The spatial distribution of crime in Badaber suggests that poor infrastructure and inadequate

urban planning may contribute to the prevalence of criminal activities. Policymakers should consider incorporating Crime Prevention Through Environmental Design (CPTED) principles into urban planning regulations, ensuring that new developments are designed with public safety in mind. The use of Geographic Information Systems (GIS) in this study has demonstrated the value of spatial analysis in understanding crime patterns. Policymakers should advocate for the establishment of a dedicated crime analysis unit within local law enforcement agencies, tasked with continuously monitoring crime data and informing policy decisions based on real-time insights.

While this study provides a detailed analysis of crime patterns in Badaber, it also opens avenues for future research and interventions. Future research could benefit from longitudinal studies that track crime trends over extended periods. Such studies would provide deeper insights into the effectiveness of implemented policies and the evolving nature of crime in the area. Expanding the geographic scope of similar studies to include other regions within KP and beyond would allow for comparative analyses. This could help identify regional variations in crime patterns and the factors driving these differences. While this study focused primarily on spatial analysis, future research could delve deeper into the socioeconomic factors contributing to crime in Badaber. Investigating correlations between crime rates and variables such as income levels, education, and employment could provide a more holistic understanding of the underlying causes of crime. Future studies should also focus on evaluating the effectiveness of crime prevention strategies implemented based on this study's recommendations. Assessing the impact of increased police presence, community policing, and urban planning interventions would provide valuable feedback for policymakers. There is potential for integrating advanced technologies such as predictive analytics and artificial intelligence in crime prevention efforts. Future research could explore how these technologies can be harnessed to predict and prevent crime more effectively, particularly in high-risk areas identified in this study.

The study's comprehensive spatial analysis of crime in Badaber has provided critical insights into the distribution and determinants of criminal activities in the area. By identifying specific crime

hotspots and trends, the study has laid the groundwork for targeted interventions that can significantly enhance public safety. The policy implications and recommendations outlined here, coupled with future research directions, offer a roadmap for local authorities and stakeholders to address crime in a more informed and effective manner. Ultimately, the successful implementation of these strategies could serve as a model for other regions grappling with similar crime-related challenges.

REFERENCES

- Abbas, H. (2018). *Militancy in Pakistan: The emerging threat in Khyber Pakhtunkhwa*. Carnegie Endowment for International Peace.
- Agustí, D. P. (2020). Tourist hot spots in cities with the highest murder rates. *Tourism Geographies*.
- Algahtany, M., Kumar, L., Barclay, E., & Khormi, H. M. (2018). The spatial distribution of crime and population density in Saudi Arabia. *Crime Prevention and Community Safety*, 20, 30-46.
- Almanie, T., Mirza, R., & Lor, E. (2015). Crime prediction based on crime types and using spatial and temporal criminal hotspots. arXiv preprint arXiv:1508.02050.
- Bani-Taha, O. I., & Shafiq, M. O. (2020). Combining the richness of GIS techniques with visualisation tools to better understand the spatial distribution of data-a case study of Chicago City crime analysis. *International Journal of Big Data Intelligence*, 7(1), 29-46.
- Bassiouni, M. C. (2023). *Crimes against humanity in international criminal law*. BRILL.
- Bhowmik, S. (2023). The Evolution of Crime: The Dynamic Definition of Crime as per Society. *Issue 3 Int'l JL Mgmt. & Human.*, 6, 3638.
- Bowers, K. J., & Johnson, S. D. (2023). Spatial patterns of crime: Understanding and predicting crime concentration. *Crime Science*, 12 (1), 15-28.
- Brantingham, P. J., & Brantingham, P. L. (1988). *Environmental criminology*. Sage Publications.
- Bureau of Statistics. (2017). *Crime statistics of Pakistan 2016*. Government of Pakistan. Downloaded from [chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.pbs.gov.pk/sites/default/files/tables/social_statistics/crime_report.pdf](https://www.pbs.gov.pk/sites/default/files/tables/social_statistics/crime_report.pdf)
- Butt, U. M., Letchmunan, S., Hassan, F. H., Ali, M., Baqir, A., & Sherazi, H. H. R. (2020). Spatio-temporal crime hotspot detection and

- prediction: A systematic literature review. *IEEE Access*, 8, 166553-166574.
- Chainey, S., & Ratcliffe, J. (2017). *GIS and crime mapping*. Wiley-Blackwell.
- Felson, M. (2016). *Crime and everyday life*. Sage Publications.
- Feng, J., Dong, Y., & Song, L. (2016). A spatio-temporal analysis of urban crime in Beijing: Based on data for property crime. *Urban Studies*, 53(15), 3223-3245.
- Frisbie, D. A., Lund, G. H., & Gottschalk, L. A. (1977). *Mapping and analysis of crime patterns in Los Angeles*. University of California, Los Angeles.
- Godsoe, C. (2021). The victim/offender overlap and criminal system reform. *Brook. L. Rev.*, 87, 1319.
- Heo, S. Y., Moon, T. H., & Han, J. H. (2014). Spatial distribution and influential factors of urban crime. *International Journal of Society Systems Science*, 6(1), 34-50.
- Hooghe, M., Vanhoutte, B., Hardyns, W., & Bircan, T. (2011). Unemployment, inequality, poverty and crime: Spatial distribution patterns of criminal acts in Belgium, 2001–06. *The British Journal of Criminology*, 51(1), 1-20.
- Hossain, S., Abtahee, A., Kashem, I., Hoque, M. M., & Sarker, I. H. (2020). Crime prediction using spatio-temporal data. In *Computing Science, Communication and Security: First International Conference, COMS2 2020, Gujarat, India, March 26–27, 2020, Revised Selected Papers 1* (pp. 277-289). Springer Singapore.
- Johnson, S. D. (2016). *Crime mapping and spatial data analysis*. Wiley.
- Johnson, S. D. (2022). The role of Geographic Information Systems in crime prevention and analysis. *Journal of Crime Mapping*, 14 (3), 45-59.
- Khan, B. U., & Talukder, M. I. A. (2021). Spatial Distribution of Crime in Bangladesh: An Analysis. *Journal of Penal Law and Criminology*, 9(2), 479-503.
- Khan, B. U., & Talukder, M. I. A. (2021). Spatial Distribution of Crime in Bangladesh: An Analysis. *Journal of Penal Law and Criminology*, 9(2), 479-503.
- National Police Bureau. (2016). *Crime data and trends in Pakistan*. Government of Pakistan. Downloaded from https://www.pbs.gov.pk/sites/default/files/table/social_statistics/crime_report.pdf
- Pakistan Penal Code. (2020). *The Pakistan Penal Code*. Government of Pakistan. Downloaded from <https://www.pakistani.org/pakistan/legislation/1860/actXLVof1860.html>
- Richman, D. (2022). Defining Crime, Delegating Authority-How Different Are Administrative Crimes?. *Yale J. on Reg.*, 39, 304.
- Rossmo, D. K. (2000). *Geographic profiling*. CRC Press.
- Safat, W., Asghar, S., & Gillani, S. A. (2021). Empirical analysis for crime prediction and forecasting using machine learning and deep learning techniques. *IEEE Access*, 9, 70080-70094.
- Safat, W., Asghar, S., & Gillani, S. A. (2021). Empirical analysis for crime prediction and forecasting using machine learning and deep learning techniques. *IEEE access*, 9, 70080-70094
- Sampson, R. J., & Wilson, W. J. (2020). Toward a theory of race, crime, and urban inequality. In *Crime and Social Organization* (pp. 37-54). Routledge.
- Sampson, R. J., Steenbeek, W., & Sluiter, R. (2022). Ecological factors and crime diffusion: Insights from spatial analysis. *Urban Crime Studies*, 18(2), 78-93.
- Sheppard, K. G., Lawshe, N. L., & McDevitt, J. (2021). Hate crimes in a cross-cultural context. In *Oxford research encyclopedia of criminology and criminal justice*.
- Siegel, L. J., & Worrall, J. L. (2019). *Introduction to criminal justice*. Cengage Learning.
- Tariq, M., & Ahmad, S. (2020). Crime and socio-economic factors in Peshawar. *Journal of Urban Affairs*, 42(3), 456-472.
- Tillyer, M. S., Wilcox, P., & Walter, R. J. (2021). Crime generators in context: examining ‘place in neighborhood’ propositions. *Journal of Quantitative Criminology*, 37, 517-546.
- ToppiReddy, H. K. R., Saini, B., & Mahajan, G. (2018). Crime prediction & monitoring framework based on spatial analysis. *Procedia computer science*, 132, 696-705.
- Townsley, M., & Sidebottom, A. (2023). Crime mapping in practice: Applications and challenges in law enforcement. *Policing and Society*, 33(5), 102-118.
- Weisburd, D. (2015). The law of crime concentration and the criminology of place. *Criminology*, 53(2), 133-157.
- Weisburd, D., Groff, E. R., & Yang, S. (2023). Innovations in spatial analysis for crime prevention. *Annual Review of Criminology*, 6(1), 335-358.
- Wheeler, A. P., & Steenbeek, W. (2023). Evaluating geographically targeted crime reduction strategies using GIS. *Journal of Quantitative Criminology*, 39(2), 289-312.

Wiles, P., & Costello, A. (2000). The "Road to Nowhere": The evidence for travelling criminals. Home Office Research, Development and Statistics Directorate.

Willmott, D., Hunt, D., & Mojtahedi, D. (2021). Criminal geography and geographical profiling within police investigations—a brief introduction. *Internet Journal of Criminology*.

Zafar, A. (2019). Criminal justice and its challenges in Khyber Pakhtunkhwa. Lahore University of Management Sciences.

