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Distribution Pattern of Urban Crimes in Sri Lanka; with Special Reference to Mirihana Police Division

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Abstract

Crime records of arrests and crime events in police stations (police records) are kept manually. No sufficient systems have been still developed for crime mapping, and other types of recording. Therefore, this study focuses on finding out the identification of crime locations, time and the factors that directly and indirectly affect crimes.

Geographic Information System (GIS) uses geography and computer-generated maps as an interface for integrating and accessing massive amounts of location-based information. Hence it plays a very important role in crime mapping and analysis. In addition, GIS allows police personnel to make plans effectively for emergency response, priorities, analyze crime events, and predict future crime control.

The objective of the study is to identify the relationship between crime and geographic environment. In addition, finding out hot spots in a location where different crimes keep occurring over an extended period of time and finding out the location which signals the police personnel to be more attentive.

The Mirihana police station was selected to study the problem using different techniques and secondary and primary data. The analysis was mainly carried out using GPS and GIS techniques.

The relationship between environment and crime is very clear. Specially, road network and commercial clusters and low income settlement areas have a positive relationship and other factors like open space, government institution, parks, grounds etc. have no direct relationship with crimes in the Mirihana Police Division in Sri Lanka.

Keywords: GIS, Crime, Spatial Pattern, Police, Crime Analysis

1. Introduction

The study of crime has traditionally been the preserve of other disciplines such as sociology and psychology and it was not until the late 1970s that the spatial dimension to crime began to be more fully explored. The police have long recognized the inherent geographical component of crimes by sticking pins into maps displayed on walls, where each pin represented a crime event, but it was the studies such as the 'Chicago School' of the 1930s that first demonstrated the importance of geography in understanding crime.

The new trend in techniques identifying patterns and concentrations of crime are related to the topics such as the exploration of the relationships between crime and environmental or socio-economic characteristics and the techniques to assess the effectiveness. Geographic Information System (GIS) uses geography and computer-generated maps as an interface for integrating and accessing massive amounts of location-based information. GIS allows police personnel to plan effectively for emergency response, determine mitigation, priorities, analyze historical events, and predict future events. GIS can also be used to get critical information to emergency responders upon dispatch or while route to an incident to assist in tactical planning and response. GIS plays an important role in crime mapping and analysis. Response capabilities often rely on a variety of data from multiple agencies and sources. The ability to access and process information quickly while displaying it in a spatial and visual medium allows agencies to allocate resources quickly and more effectively. In the establishment of legal information about crimes, the location of a crime, incident, suspect, or victim are often crucial to determine the manner and size of the response. GIS software helps co-ordinate vast amounts of location-based data from multiple sources. It enables the user to layer the data and view the data most critical to particular issues. It is used by police departments all over the world, to provide mapping solutions for crime analysis. In addition, it could help to control criminal tracking, traffic safety, community policing, internet mapping, and numerous other tasks.

The rate of crime events is increasing in all developing countries due to the transform of capability and majestic lifestyle and also due to poor socio-political, and environmental conditions. Naturally, a crime does not disappear by itself. Police departments are on the duty of

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Defending the citizen’s safety and taking precautions to minimize the risk of crimes. It’s long been a common practice for the police to identify locations and times that are more liable to criminal activity .To reduce or eliminate the crime, some actions, such as crime prevention methods, ought to be taken. Crime prevention can be signified as a set of ideas for hostility incident and includes the activities taken by individuals and groups, both public and private.

The current stage of spatial perspective on crime is according to that of the complementary fields of the geography of crime and environmental criminology. The geography of crime represented the first attempts by geographers to enter the crime research in the area. This mainly involved engaging in a “modern form research in aerial and ecological traditions” which forms the initial links with the geography of crime (Herbert, 1982). The majority of this work emerged in the USA, although British research is also well documented. There are no GIS related crime studies found out in Sri Lanka except some of the unpublished Monographs and dissertations. Therefore, it is identified that the spatial distribution patterns of crimes and related factors behind the living environment in police divisions in Sri Lanka.

The study problem is to identify the crime location, time and the factors which can have a direct or indirect association with crimes while assessing the need of computer hardware, GIS software, GIS operation for crime data and crime analysis in Sri Lanka.

The objective of the study is to identify the relationship between crimes and geographic environment concerns on the following aspects. They are, to find out hot spots of locations

where different crimes keep occurring over a period of time, to identify the locations that should be given more attention by the police, to find out whether there is a relationship between crimes and the geographical environment and to identify the distribution pattern of crimes.

The Colombo district was selected for the study. It consists of three types of settlements; rural, urban and sub-urban consequently. Usually the crimes in the urban area are higher compared to the rural areas. Within the urban areas, the main urban centres are more important places for recording crimes. Especially in the Colombo metropolitan region (CMR), there are many large urban centers including Colombo primate city. At present, adjoining area of the capital city of Colombo is more urbanized and those surrounding areas are suburb and can be seen some of the scattered rural service centres. However, the places of crime records are mostly located in the main centres. Therefore, Sri Jayewardenepura Kotte is an administrative capital in Sri Lanka and before promoted it into that status, it remained as an old suburb area. The police division which is selected for the study should represent the Sri Jayewardenepura Kotte administrative city. It has 3 police stations, namely, Rajagiriya, Thalangama and Mirihana. Mirihana is one of the selected police stations that covers different dynamic environments. This area represents urban and suburban settlements, different types of income levels, many commercial centres, institutions and industrial activities (Figure 3.1). In addition, a large number of crimes have been recorded to the said police station within a year. The Mirihana police division records show more than 550 crime incidents in 2013.

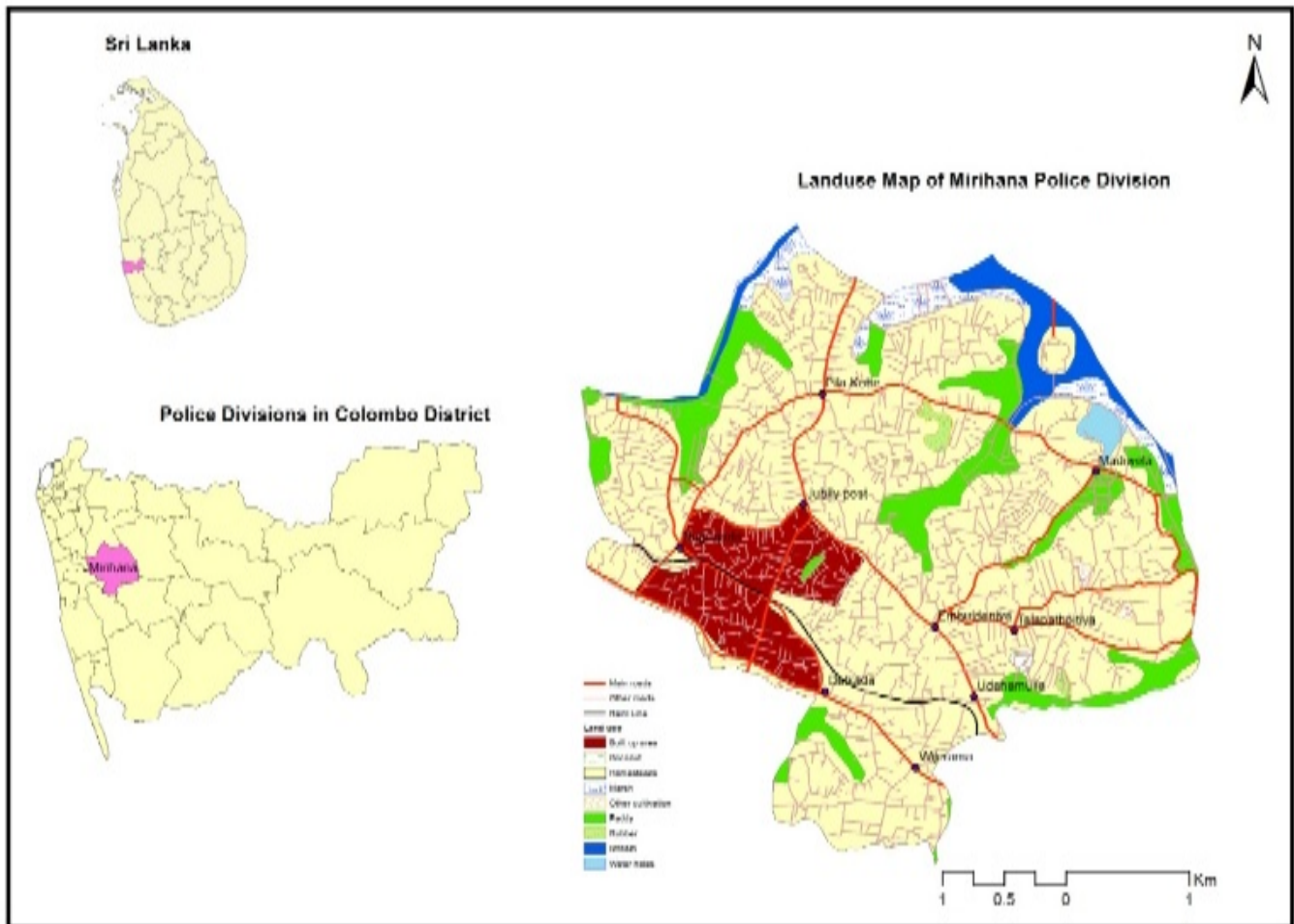
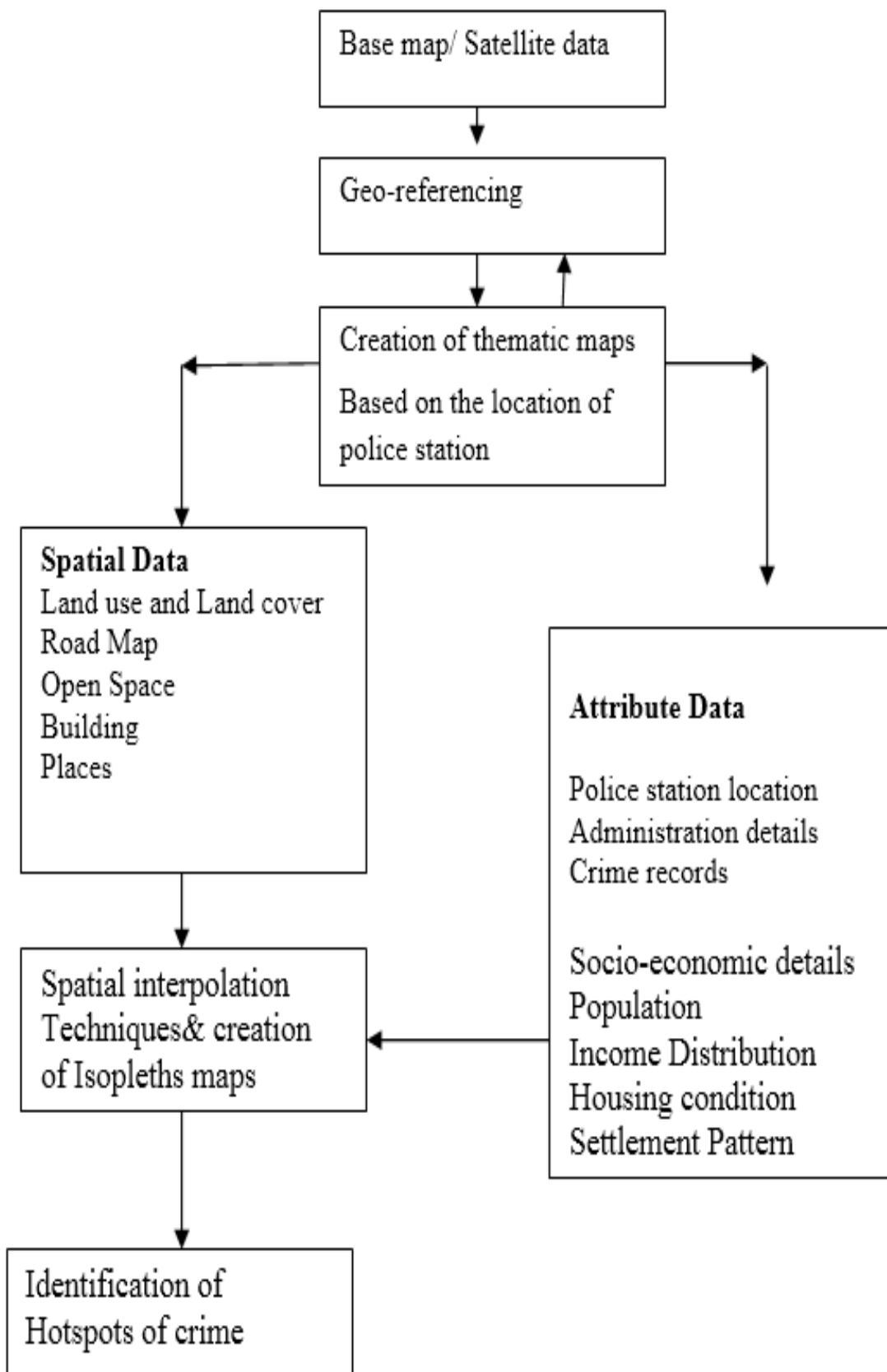


Fig 1: Mirihana Police Division
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Both primary and secondary data are used for collecting and analysing the data according to following steps.



The data analysis has been done using the softwares such as XL, ArcGIS and OZiexplorer. The GPS points of the recorded crimes were taken based on the data from the Mirihana Police division. All the crimes which were recorded are to be considered in the analysis.

Distribution patterns of crimes and related environment

In the year 2013, total of 563 crimes were recorded within 19 Grama Niladhari divisions in the Mirihana Police Area. According to the summary of cases in fourteen postal areas, many crimes can be identified in thirteen categories as shown

in Table 1. Those categories are used for the categorization of the penal codes.

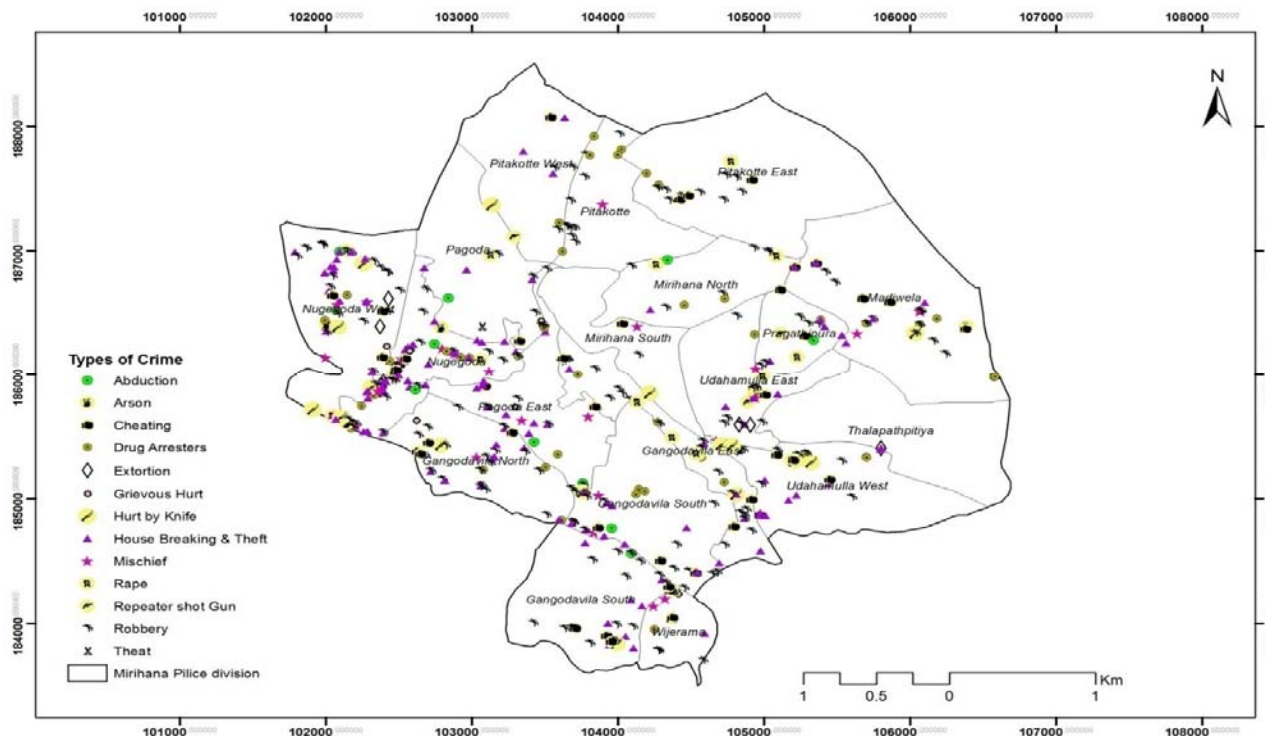
Table 1: Crimes Records in Mirihana Police Division – 2013

GN Name	Robbery	House breaking Theft	Cheating	Grievous Hurt	Drug Arresters	Rape	Repeater shot Guns	Mischief	Hurt by Knife	Arson	Treat	Abduction	Extortions	Total
Ambuldeniya	9	2	4	2	1	0	0	0	0	0	0	0	0	18
Beddagana	0	1	1	0	1	1	1	1	1	0	0	0	0	7
Delkada	5	3			3	1		1		1	1	1		16
Gamsaba Junction	0	0	0	1	2	0	0	0	0	0	0	0	0	3
Gangodawila	9	16	4	0	0	2	0	2	0	0	0	1	0	34
Jambugasmulla	1	3	0	0	0	0	0	0	0	0	0	0	1	5
Madiwela	17	3	3	2	8	3	1	2	5	0	0	1	0	45
Mirihana	24	10	1	0	1	2	0	0	1	1	0	0	0	40
Nugegoda	77	70	27	3	14	3	1	14	7	1	0	6	4	227
Pita Kotte	16	17	4	2	4	1	1	1	1	0	0	1	0	48
Rabar watta	0	0	1	0	0		0	0	0	0	0	0	0	1
Thalapatpitiya	12	6	2	4	4	1	2	1	1	1	0	0	0	34
Udahamulla	41	8	4	0	9	0	0	1	1	0	0	1	0	65
Wijerama	10	2	0	0	4	1	0	2	0	0	0	0	1	20
Total	221	141	51	14	51	15	6	25	17	4	1	11	6	563

Source: Police Record, Marihana -2013

According to table 1, nearly 40 percent of the crimes are recorded in the Nugegoda area. Nugegoda is a main junction that meets the main road from Colombo-Ratnapura highway and Dehiwala to Battaramulla Administration Centre. In addition, it is one of the famous and wellfunctioning urban clusters consisting in Kotte and Dehiwala Municipal Councils. Therefore, all crimes, robberies and house break theft are the highest, while cheating, drug arresters and mischief are the other important crimes recorded in Nugegoda. The other important areas are Udahamulla, Pitakotte, Madilewa and

Gangodawila. The robberies and house burglary thefts are the main crimes recorded in Mirihana. Out of total crimes in Mirihana more than 64 percent of crimes consist of both robbery, house burglary and theft. The distribution of crimes shows an asymmetry when considering the geographical pattern in Mirihana. Some of the clusters show a higher concentration of crimes. The other map shows the crime density by the Grama Niladhari Division in the area (Figure 2). When comparing the two maps, the crime report can easily be recognizable.

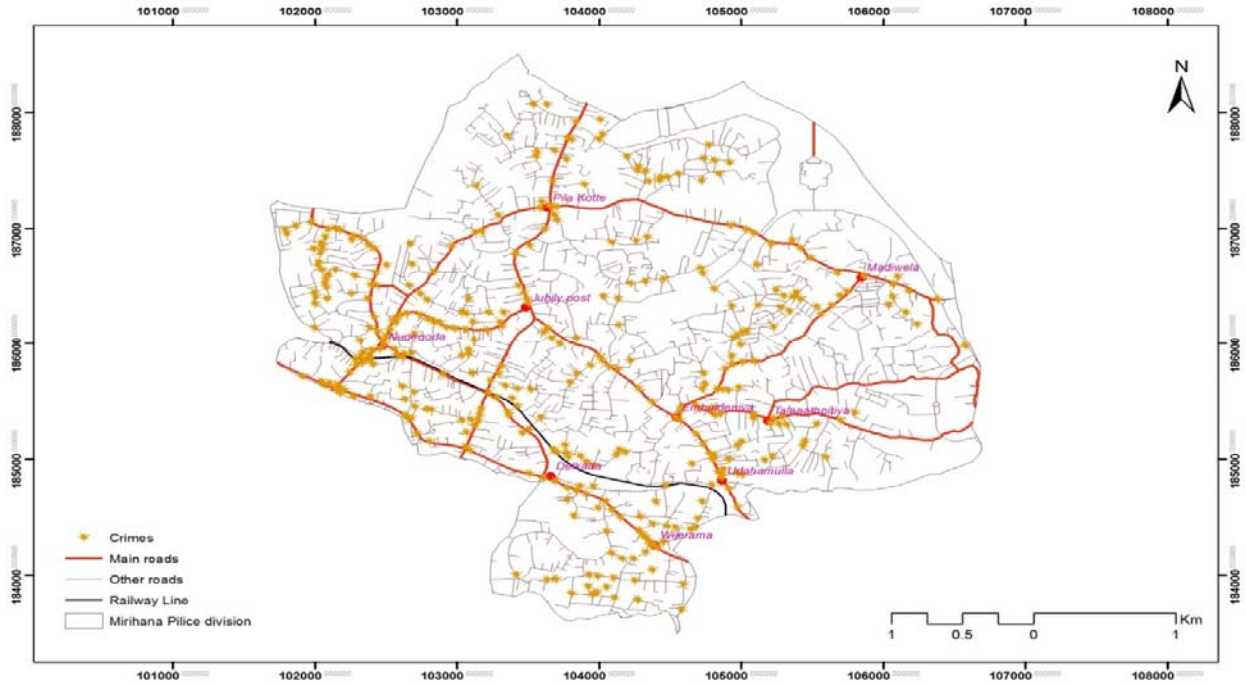


Source: Created Based on Field Data, 2013

Fig 2: Distribution Pattern of the Crimes in Mirihana Police Division – 2013

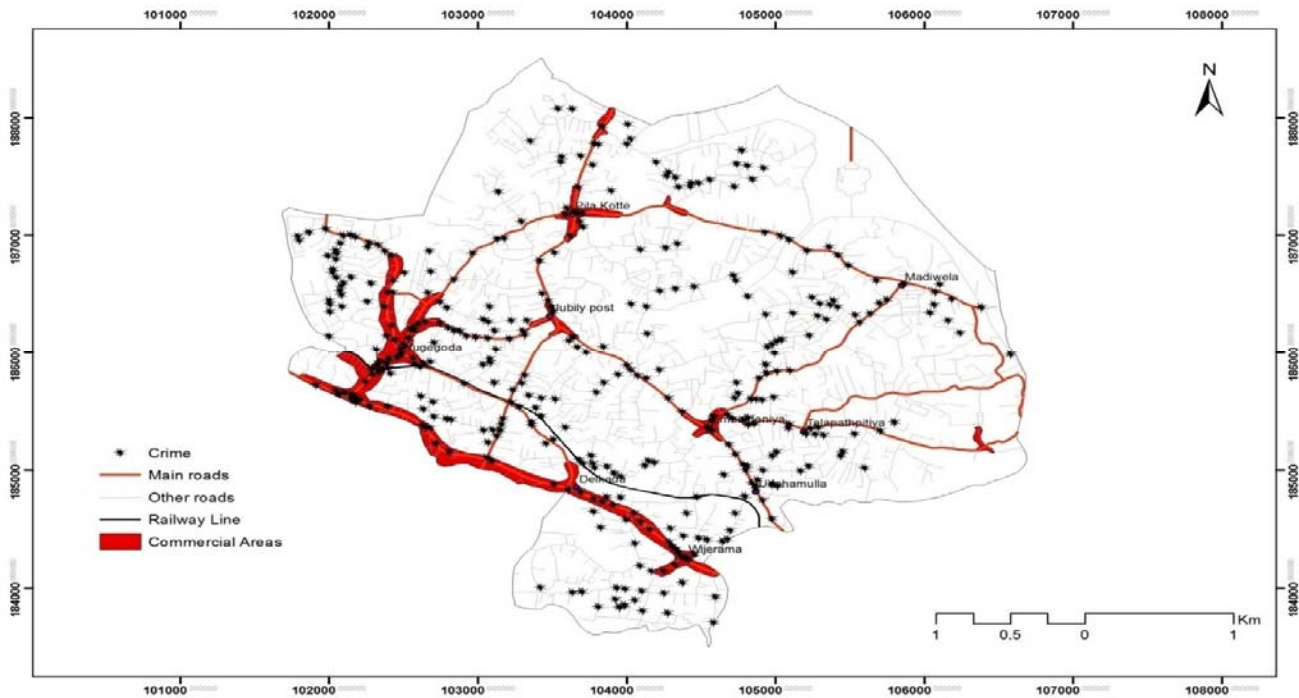
According to the pattern of crime distribution map, the highest crimes are recorded in Nugegoda, Nugegoda West respectively and Gangodawila North, Gangodawila South, Gangodawila, East, Udahamulla West and the Madiwela GNDs. The main reason is the area covers the main road network with high level of commercial activities beside the road. The less crime recorded GND's are the Pita Kotte west, Mirihana South and the Thalathpitiya respectively. Because those areas are not privileged with more commercial activities compared to other areas

The relationship of other environmental factors and crime pattern are shown in figure 3, 4 and 5. Figure 3 shows the positive relationship between distribution pattern of the road network and the crime the detailed analysis differences can be identified among the crime types. The relationship of low income households is not directly linked to all types of crimes. The other important relationship is shown in Figure 4 with commercial clusters and crime distribution patterns.



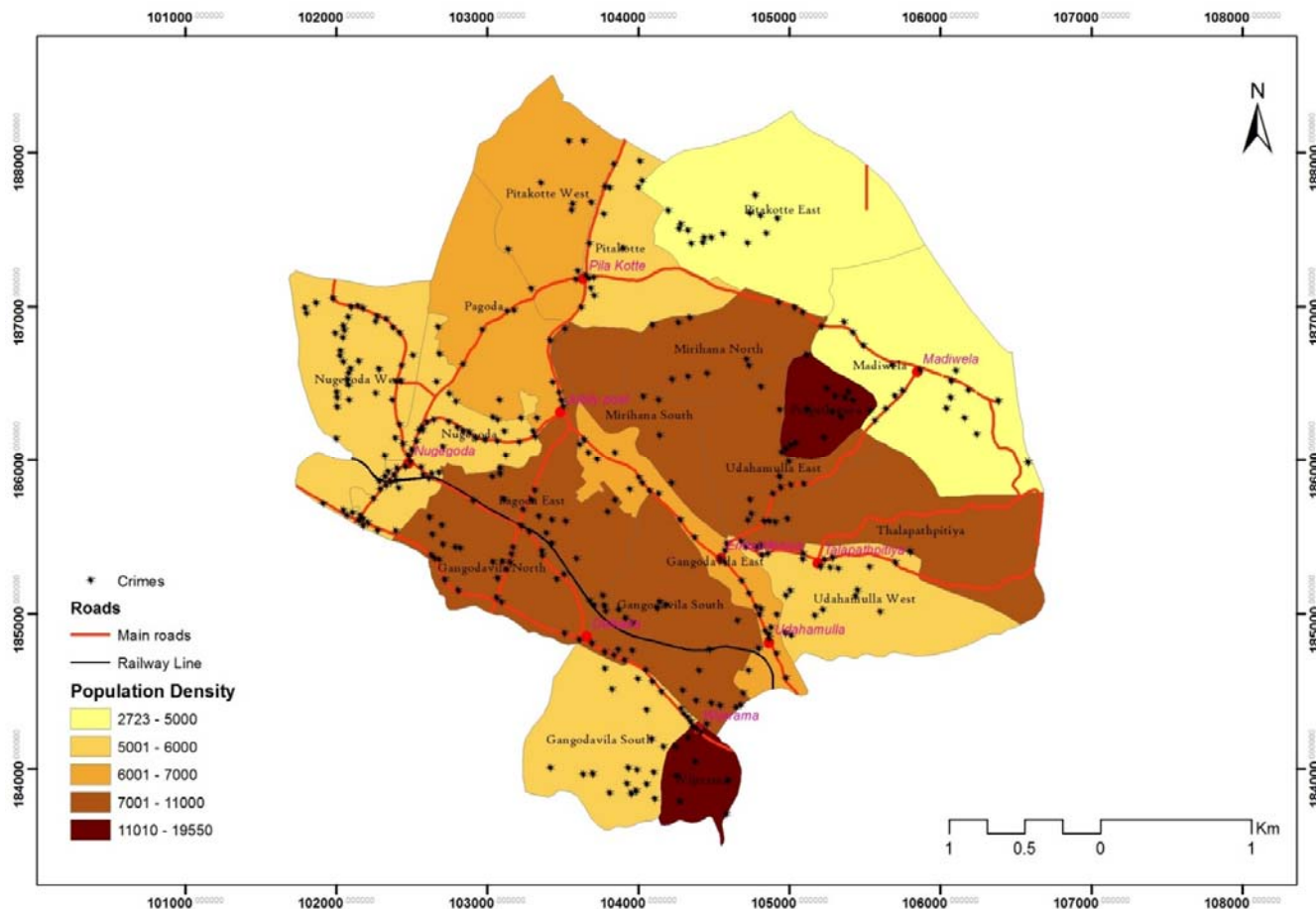
Source: Created Based on Field Data, 2013

Fig 3: Road network and crime



Source: Created Based on Field Data, 2013

Fig 4: Commercial Clusters and Crime



Source: Created Based on Field Data, 2013

Fig 5: Population Density and Crime

Relationship between crime and geographic environment

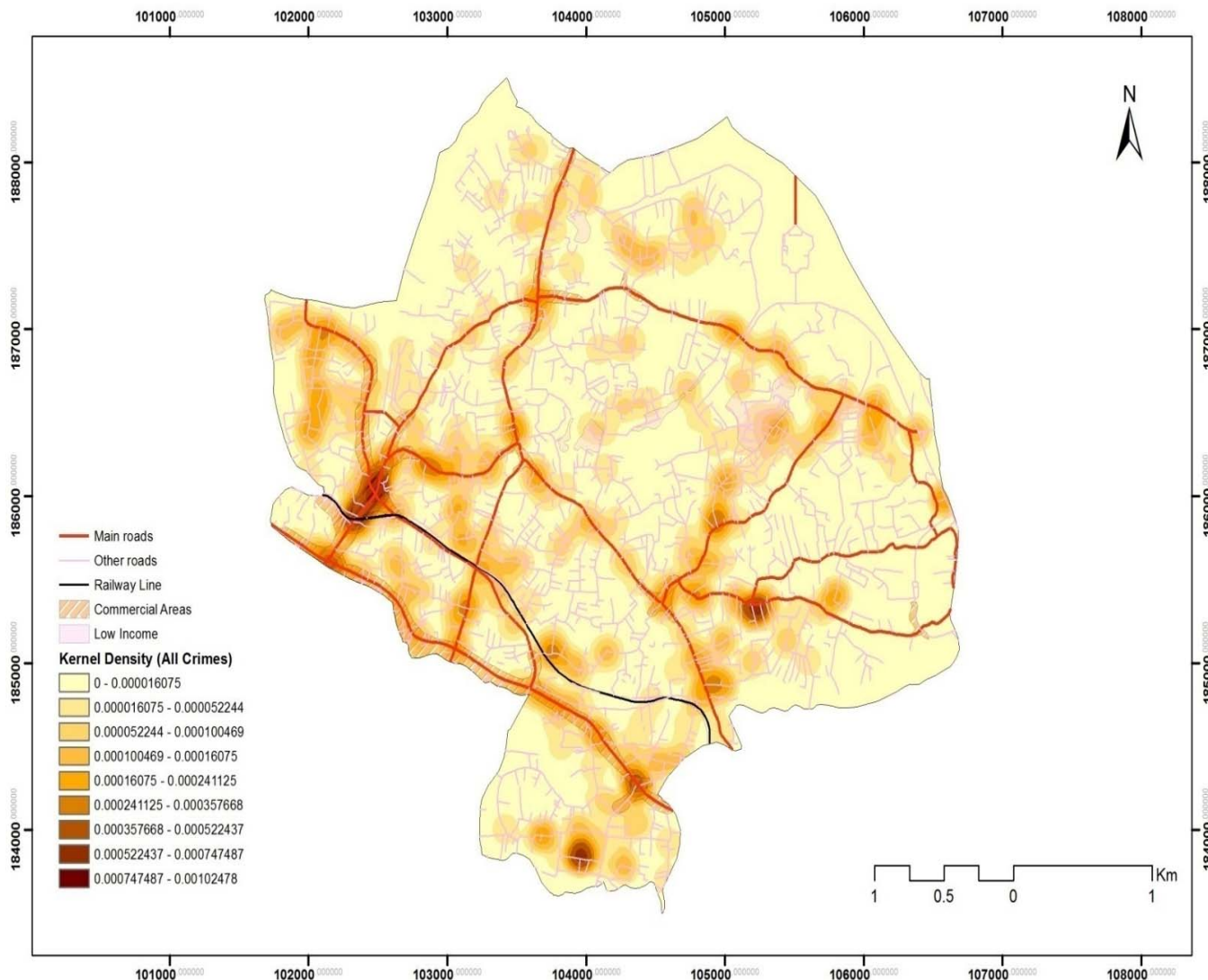
The relationship between crime and geographic environment can be calculated using the density under the spatial analysis. It calculates a magnitude per unit area from point features using a kernel function to fit a smoothly tapered surface to each point. Kernel Density calculates the density of point features around each output raster cell. Conceptually, a smoothly curved surface is fitted over each point. The surface value is at the highest at the location of the point and diminishes with increasing distance from the point, reaching zero at the Search radius distance from the point. Only a circular neighborhood is possible. The volume under the surface equals the crime field value of the point, or 1 if NONE is specified. The density at each output raster cell is calculated by adding the values of all the kernel surfaces where they overlay the raster cell center.

Increasing the radius will not greatly change the calculated density values. Although more points will fall inside the larger neighborhood, this number will be divided by a larger area when calculating the density. The main effect of a larger radius is that the density is calculated considering a larger number of points, which can be farther from the raster cell. This results in a more generalized output raster.

The result of the kernel density calculation is based on the number of crime records (more Than 10 Cases). According to the result, the relationship between crime and commercial clusters are positive. The figure 6 shows the result of kernel density in robbery, housebreaking and theft, cheating, drug arresters, rape, mischief, hurt by a knife, abduction in

Mirihana with road network, Commercial Clusters and low income households. Because all the crimes have a good relationship between crime and commercial clusters, road network and the low-income housing areas. Commercial centres and main junction settlements are the important places for recording robberies according to the result shown.

The pattern of the kernel density of the house breaking and theft is also shown (Figure 6) in relation to the road and the commercial clusters. In addition there are some clusters spread surrounding the areas of commercial clusters. The reason for it may be the dwelling of high economic class people in the area. It is also a very important factor for controlling the crimes. Every cheating crime in road network and the main junction shows a direct relationship with the different levels of commercial activities. The highlighted clusters of the kernel density of the drug arresters are visible in mainly roads, but most of the low density clusters and some high density clusters are spread away from the main roads. Therefore, it shows that the less access road connection areas are the places which support the drug arresters. The aspects of the kernel density of rape cases are mainly concentrated around the Udahamulla, Thalapathpitiya and Nugegoda area. Therefore, the concentrated of the all crimes distribution patterns of the kernel density shows (Figure 6) a very strong relationship between road network and main junction if they are either main business areas or comparatively high populated areas. However, finally, the south-western part of the Mirihana Police Division is the most crucial area when considering the aspect of crime.



Source: Created Based on Field Data, 2013

Fig 6: Kernel Density of All Crimes in Mirihana – 2013.

Different crimes and the times occurring crimes

There are important patterns through which the aspect of crime reported can be identified in day and night. According to the crimes in Mirihana Police Division, many crimes are recorded at night (Table 2). Out of all crimes 66 percent of crimes are recorded at night. Exact times are not available for about 10 percent of the sample. Specially, cheating happens in nearby banks, or close areas and in commercial centres. Many of them are done by the travel agents. The rest is recorded at the day time.

The distribution pattern of the crimes in Mirihana shows in figure 09 using the time scale as AM and PM. Most of the

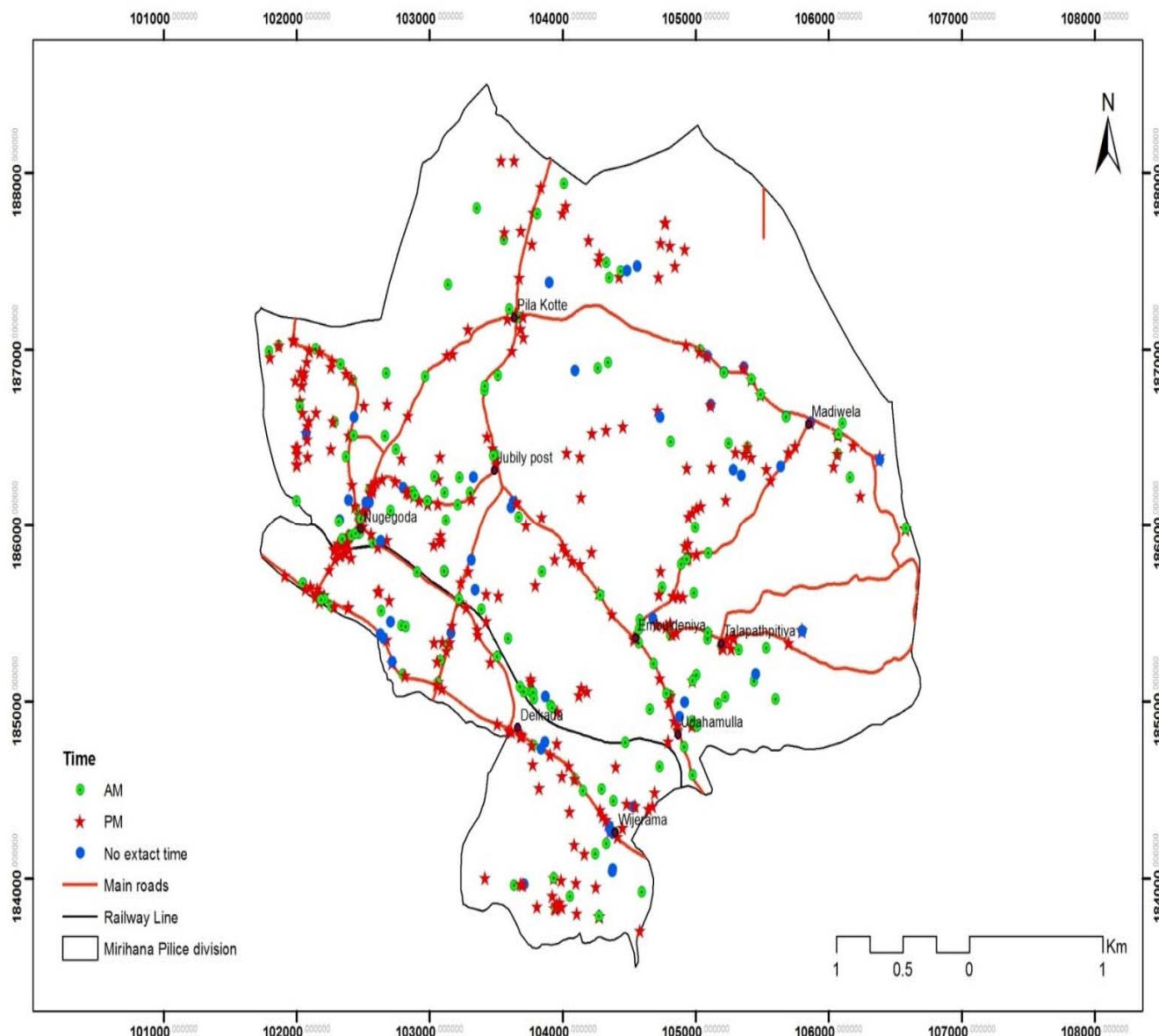
scattered crime is dispersed in far away from the commercial clusters (Figure 7).

In detail, day and night crimes are very important for the police personnels for their day to day planning to control crimes (Table 3). According to data from the table 5.3, 67 percent of the crimes are recorded in day time. Out of these crimes 36 percent of crimes are the robberies and another 33 percent of crimes are recorded as housebreaking and theft. The mischief is not recorded at night and the creating is also mainly recorded at day time. The figure 8 shows the distribution pattern of crimes within 04 hours of time slots within a day according to AM and PM.

Table 2: Crimes Recorded in different Times in Mirihana Police Division

Time Period	No. of Crime
No Exact Time	51
00.00 - 04.00	33
04.00 - 08.00	40
08.00 - 12.00	82
12.00 - 16.00	121
16.00 - 20.00	144
20.00 - 24.00	92
Total	563

Source: Generated Based on Field Data, 2013



Source: Created Based on Field Data, 2013

Fig 7: Distribution pattern of crimes in AM and PM in 2013

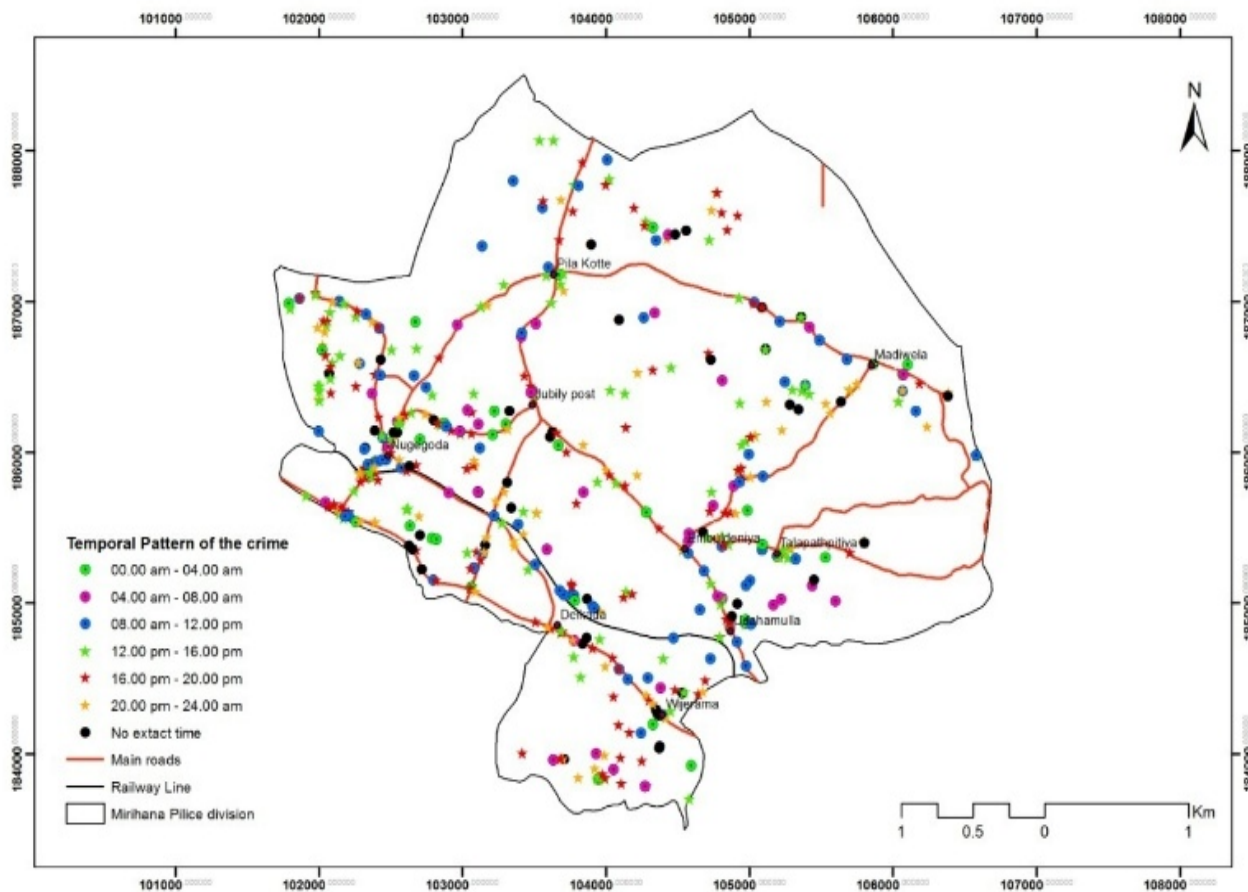
Table 3: Day and Night crime records in Mirihana – 2013

Time	Robbery	House breaking Theft	Cheating	Grievous Hurt	Drug Arresters	Rape	Repeater shot Guns	Mischief	Hurt by Knife	Arson	Treat	Abduction	Extortions	Total
Day	137	78	47	10	44	8	5	25	10	3	1	7	3	378
Night	84	63	4	4	7	7	1	0	7	1	0	4	3	185
Total	221	141	51	14	51	15	6	25	17	4	1	11	6	563

Source: Generated based on Field Data, 2013

Table 3 and Figure 8 show the importance of time slots for crimes. The highest crime is recorded between 12.00 noon and 20.00 PM. Between the four hours time slots, from 16.00 to According to total robbery in Mirihana, 221 out of these 137 cases are recorded during day time while the rest is recorded at night. The house burglary and theft show a similar tendency. Out of 141, nearly 78 are recorded during daytime

20.00 pm is the most vulnerable with regard to the aspect of records. This is the highest crime record (141 cases out of 265) per day and the rest is at night. Most of the drug arrests are recorded in day out of total 51, 47 are recorded at the day and rest few is recorded at night.



Source: Created Based on Field Data, 2013

Fig 8: Temporal Pattern of Crimes in Mirihana – 2013

The crime pattern and distance

The important characteristics of the crime distribution are based on the road network. According to proximity analysis, it can be found that the patterns of crimes depend on the road network. The distance from police station to periphery based on distance to 100, 200, 300, 400, 500 and more than 500 meters buffers shows the interesting patterns of crimes and road network. Those types of relationships are very important to identify the pattern when planning to control crimes.

However, considering figure of this analysis shows that nearly 63 percent of the crimes are recorded in the surrounding areas of the road. The other aspect of this data shows that many crimes in Mirihana are not directly related to the Natural environment. It is basically dependant on the man-made environment factors like, commercial, law, income etc. The rest of the crimes are gradually decreasing far away from the road (Table 4).

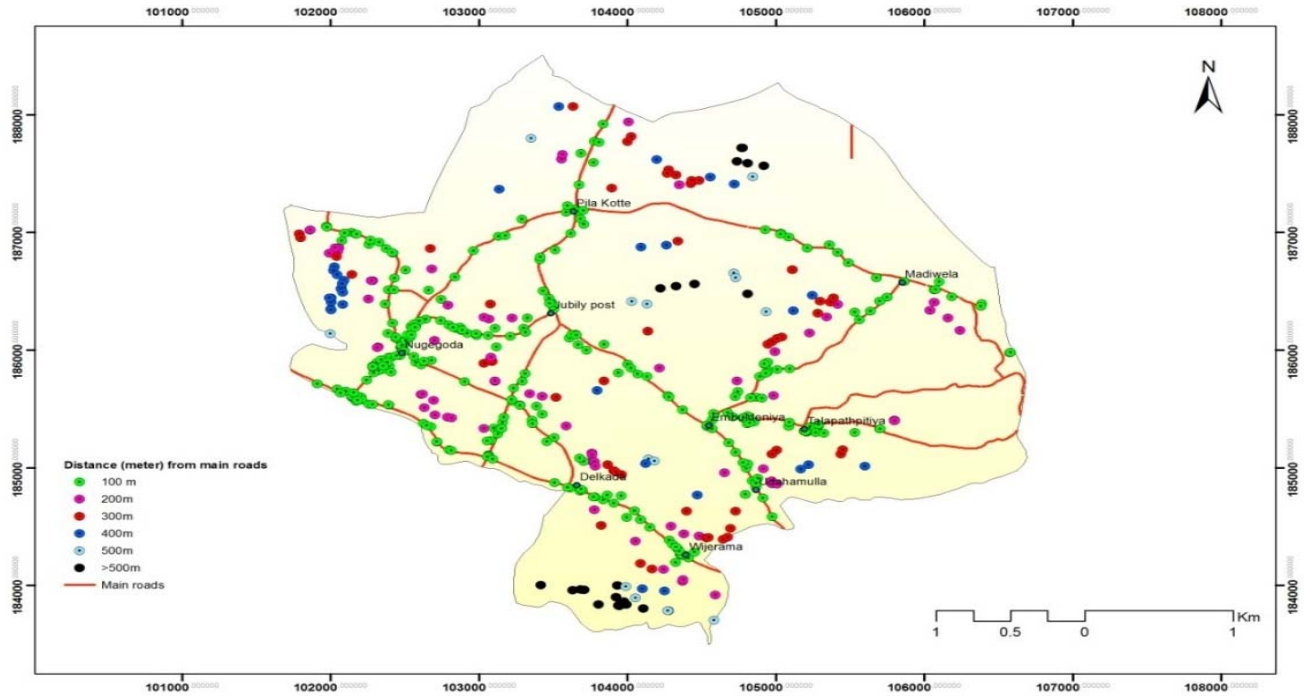
Table 4: Crime reported distance from main Roads in Mirihana -2013

Distance from Main Road	Robbery	House breaking Theft	Cheating	Grievous Hurt	Drug Arresters	Rape	Repeater shot Guns	Mischief	Hurt by Knife	Arson	Treat	Abduction	Extortions	Total
100	144	80	28	13	35	11	4	14	10	2	0	7	5	353
200	25	27	6	1	2	2	1	4	4	1	0	2	1	76
300	20	17	8	0	4	0	0	3	0	0	1	1	0	54
400	9	8	2	0	4	1	1	2	2	1	0	1	0	31
500	7	2	1	0	4	0	0	2	0	0	0	0	0	16
>500	16	7	6	0	2	1	0	0	1	0	0	0	0	33
Total	221	141	51	14	51	15	6	25	17	4	1	11	6	563

Source: Generate based on Police records, 2013

According to the data shown in Figure 9, 144 cases out of total 225 robberies, are reported within 100 meters radius from the main roads. More than 64 percent of robberies, thefts fall under the categories of stealing money supply from houses, stolen money from the workplace, jewelries, or mobiles etc. All those types of stealing valuable and

movables items continuously have a relation with the road network. Therefore a careful observation of the data can identify a gradual decrease of the robbery in nearby roads to outsiders. The other important characteristic is the presence of the same pattern.

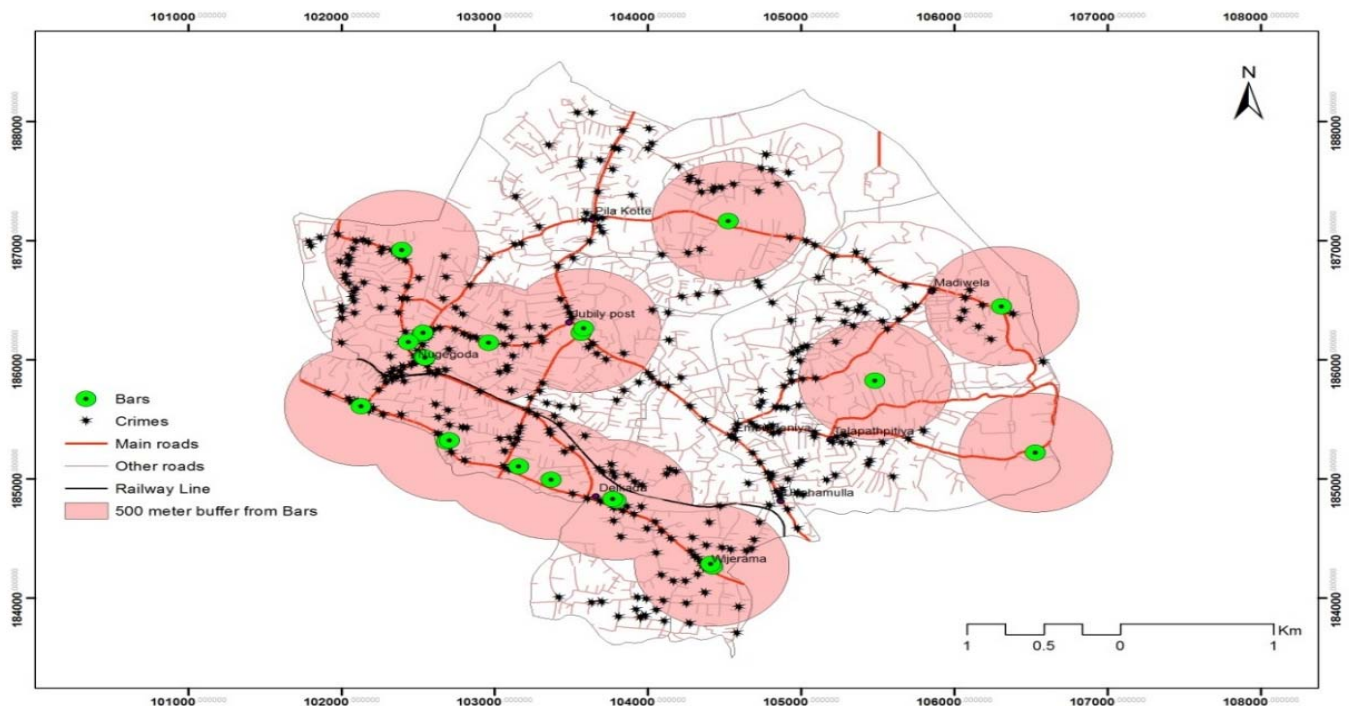


Source: Created Based on Field Data, 2013

Fig 9: Distribution Pattern in Crime within 100 Meters Distances

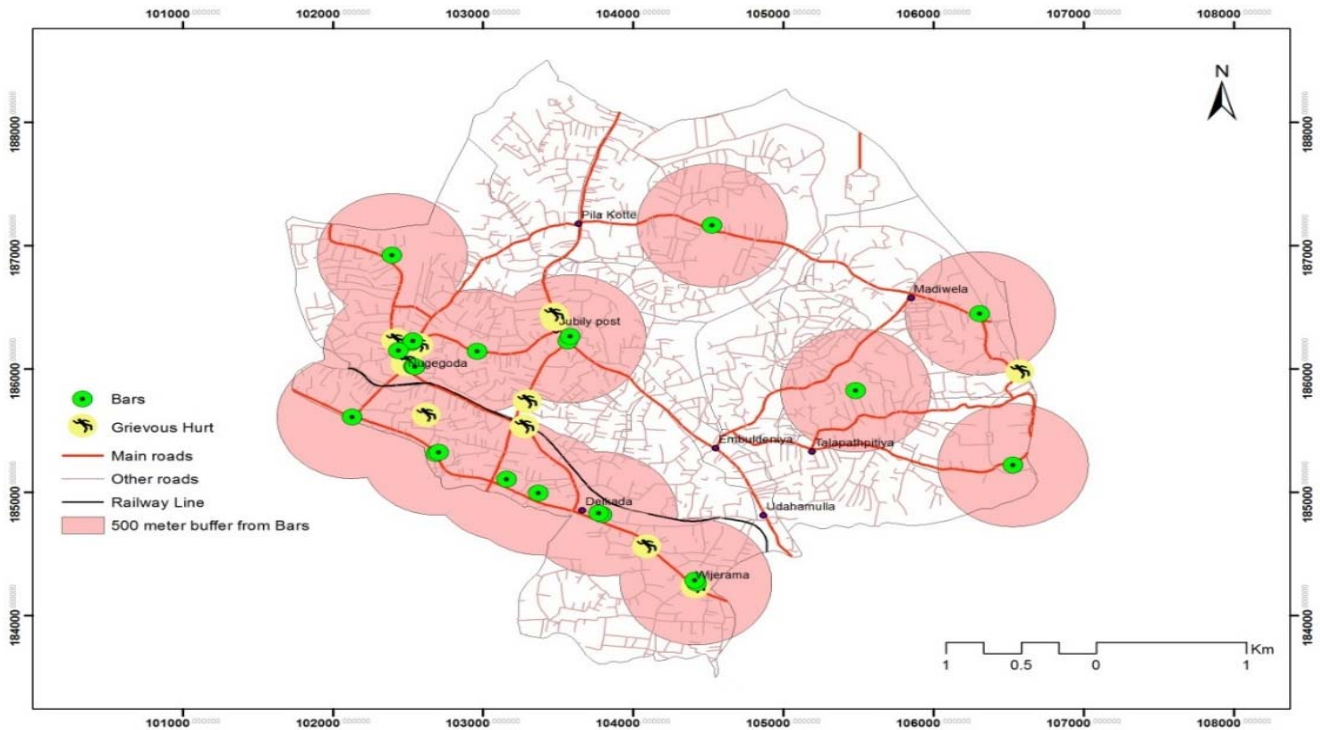
The other relationship between liquor bars and some of the major crimes can be identified. Not only liquor bars, the sell outlet related to reception halls is also very important factors for recording many crimes. Unfortunately, this analysis only uses liquor bars. According to the distribution of the liquor bars and its 500 meter buffers show some relationship to the alcohol related crimes. The figure 10 shows the liquor bars distribution pattern with crimes. All the liquor bars are established in main roads and commercial clusters. If the people travel to liquor bars within 500 meters, the crime and

liquor bars have a positive relationship in relation to the crime occurrence. With the experience of society, many drinkers engage in criminal activities like grievous hurt and rape case. Therefore this analysis tries to identify whether there is any relationship between those two crimes using 500 meter buffers. According to figures 11 and 12, the tables shows the above relationship. The shows the grievous crimes like hitting people and stealing their property have 100 percent relationship with the liquor bars.



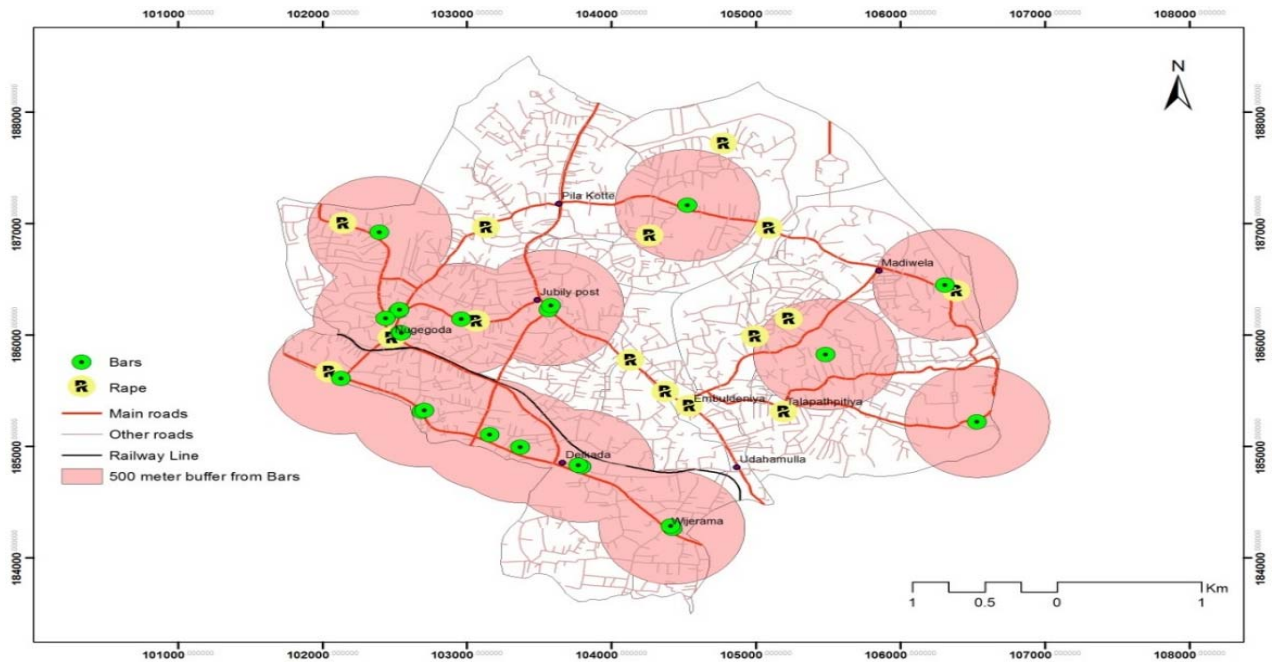
Source: Created Based on Field Data, 2013

Fig 10: Distribution Patterns of Liquor Bars and Crimes in Mirihana within 500 Meters Buffer



Source: Created Based on Field Data, 2013

Fig 11: The Relationship between Liquor Bars and Grievous Hurt



Source: Created Based on Field Data, 2013

Fig 12: The Relationship between Liquor Bars and Rape Cases

The figure 13 shows the rape cases recorded in the Mirihana police area have no direct relation with liquor bars. But it's considers the illegal liquor or other sell outlet can recognized some relationship.

On the other hand, the pattern of crimes shows the differences depending on the distance from the police station. Based on the distance from police station, five buffers can be generated using distances of 200, 500, 1000, 3000, and over 4000 meters as shown in Table 5. The result of this analysis is very

interesting. The nearest area of the police station (within 200 meters) reported only 5 crimes. But within 500 meters radius it increases to 23 crime cases. These figures show a gradual increase in crimes with the increase of distance from police station. This situation clearly indicates that the distance between 1000 to 3000 meters radius has recorded a very high number of crime cases. Considering the data from different radius it can be seen that the increase of crimes depends on the distance from the police station.

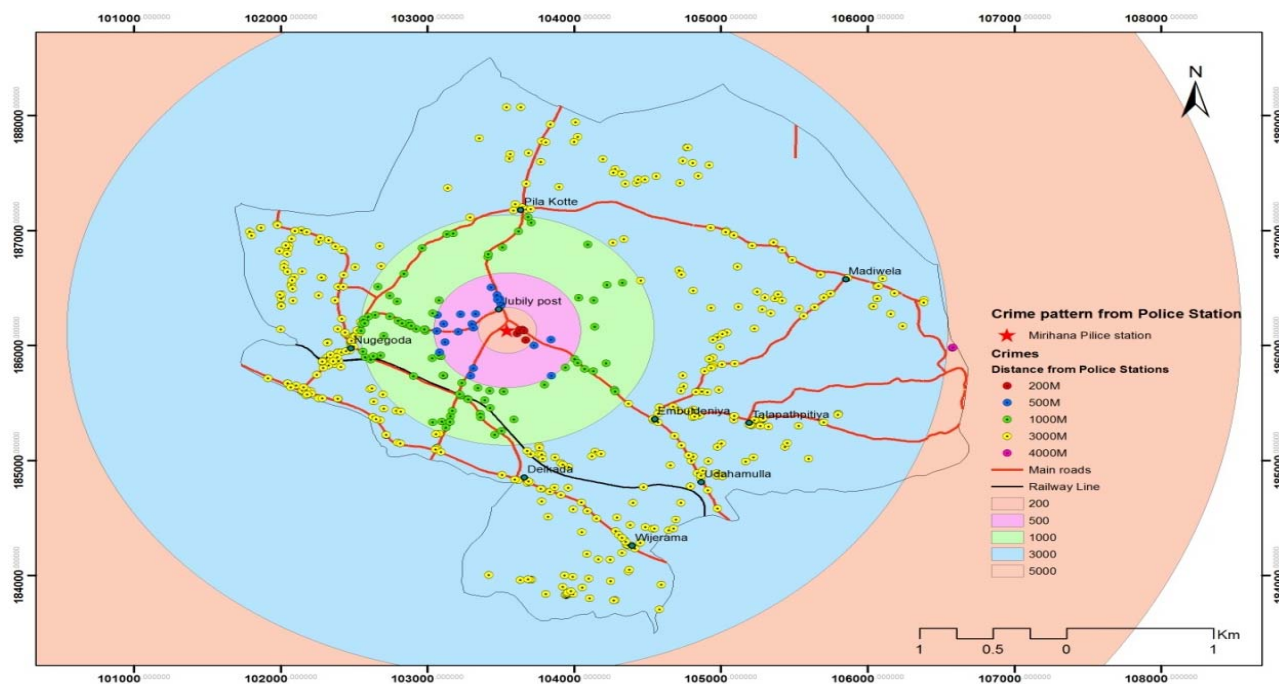
Table 5: Crimes by Distance from Police Station in Mirihana – 2013

Distance (Meters)	Number of Crime
200	5
500	23
1000	87
3000	443
4000	5
Total	563

Source: Generated based on Police records, 2013

The distribution patterns of the distance from main roads are shown in Figure 13. It is very clearly shown that the crimes increase from the police station to outside. It is very important

when choosing the best place to establish police stations if the crimes are to be controlled.



Source: Created Based on Field Data, 2013

Fig 13: Distribution pattern of difference radius of the crimes from the police station – 2013

The details of the crimes in different radius are shown in Table 5.8. According to table 6, out of total robberies, more than 81 percent of them are recorded within 1000 to 3000 meters radius from the police station. These figures indicate

the crime rate varies if the distance is gradually increased from the police station. That indirectly states that the attention of police personals is focused on the distance and people who engage in the crimes are well aware of it.

Table 6: The pattern of differences of the crimes from the police station – 2013

Distance from Police Station	Robbery	House breaking Theft	Cheating	Grievous Hurt	Drug Arresters	Rape	Repeater shot Guns	Mischief	Hurt by Knife	Arson	Treat	Abduction	Extortions	Total
200	3	1	1	0	0	0	0	0	0	0	0	0	0	5
500	8	5	2	3	3	1	0	1	0	0	0	0	0	23
1000	29	31	4	2	7	2	0	5	1	1	1	4	0	87
3000	180	105	44	8	37	11	7	19	16	3	0	7	6	443
4000	1	0	0	1	3	0	0	0	0	0	0	0	0	5
Total	221	142	51	14	50	14	7	25	17	4	1	11	6	563

Source: Generated based on Police records, 2013.

Conclusions

Mirihana Police Division comprises 1.03 percent of the total crimes in Sri Lanka and it has no recorded murder cases in the year 2013. Aspect of the other grave crimes in Mirihana was the robberies which nearly has increased for 40 percent. In addition to robberies and house break, theft cases are all together more than 50 percent. Therefore, the Mirihana Police Division is not a worst aspect of the grave crimes.

The crime records in house breaking and theft, theft of property, cheating and robbery are the major crimes in Sri Lanka. But in Mirihana number one holds robbery and house breaking, theft whereas cheating and mischief are respectively important.

Many crime cases in Nugegoda area are recorded in Mirihana because it is a major commercial centre. Many of the robberies, cheating and breaking of shops and theft cases are recorded in commercial centres. Compared to commercial clusters of the area, the rest is recorded as less crimes and also it is difficult to identify crime clusters.

Predominantly high density crime areas are situated in South-western part of the police division. Because larger commercial clusters, Educational Institutions, and many work places etc. are situated nearby the high-level road. In addition, low income dwellers are also settled down closely to reservation of the railway line parallelly running with highway road. Those factors are the reasons for many crimes recorded in the division.

A better relationship can be identified with crime and man-made environment of the area. The natural environmental factors are silence aspect of the crime in Urban centres in Sri Lanka. Specially, characteristics of the built-up environment, such as road network, low-income households, commercial clusters and high density population are dominant.

The crime analysis is mainly done using kernel density. According to the results, commercial clusters and crimes have a positive relationship. Similarly the demarcated low-income household and crimes also have a good inter-relationship. But main roads have no direct relationship with crime occurrence when compared to other two factors.

Within a day, many crimes are recorded during 4.00 PM to 8.00 PM. The other important time slot is 12.00 noon to 4.00 PM. All together more than 50 percent of the crimes are recorded within these eight hours in the Mirihana Police division.

There is no any of the separate crime areas can be seen in the Mirihana Police Area. All are temporary incidents recorded all over the places. But, some of the incidents are mainly responded to the alcohol and drug abusers.

The distribution patterns of crimes are dependent on the distance from the Police Stations and facilities which are used by police personnel to control the crimes.

In addition to the strength of the police, the distance from the police station is another reason to increase crimes.

Some maps show the distribution pattern of crimes based on selected features. But, if the other features are also the pattern can be identified with little changes. For example, it can be identified in relation to the roads, income levels of the people, condition of the own security and the activities in cultural institution and people organizations.

Recommendations

Police personnel are required to use technology for identification and control of crimes in the area with the help of the relevance government institution. Because the manpower is not the only one solution to establish law and order. Hence,

they need to reach a whole place at once in the office and should be able to take good decisions to control crimes with the strategic use of their familiarity of the area. For this requirement, the IT facilities and police personnel are required to get continues training of GIS and related facilities.

The time slots provide considerable hints for the police personnels to get an idea about the high amount of crime periods. If they use that information to control crimes and use present facilities, already, they need to get the service of a police mobile service when establishing temporary police post.

Small scale drug sellers and users are mainly active in the low-income residential areas. Therefore, police can use technology to find out the access and use Global Positioning System to find accuses and control their involvement again and again. For this purpose the police doesn't need to spend more money.

The updating maps are the main resource to control crimes. Therefore; it is recommended for police personnel to continuously use technology for the establishment of law. For this purpose they don't need to invest more money and need only a successful plan and its continuations.

5. Reference

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