USE OF GEOGRAPHIC INFORMATION SYSTEMS IN MAPPING CRIME RELATED INSECURITY IN NORTHERN KENYA: CASE STUDY OF SAMBURU COUNTY

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Abstract
Containment of violent crime and sustainability of meaningful security in Northern Kenya has become a headache to Kenyan security agencies. Law enforcement agencies and in particular the police have not embraced the use of technology to curb crime. Instead use of crime pin maps to show crime frequency is normally utilized. Mapping crime without analysis is ineffective as far as achieving optimal security is concerned. This study explores the use of Geographic Information Systems (GIS) to map crime, etermine causes of dominant violent crime and predict areas where violence is likely to occur in Samburu County. This would assist in security policy making. Samburu County consists of three districts (Samburu North, East and Central). The methodology involved collection and mapping of crime data, mapping of all police posts in the county, overlay of population data to establish relationship between crime and population distribution, use of remote sensing data to establish areas offenders have advantage and hence predict likely areas where crime will occur. Other datasets used included proximity to police station, population density, poverty levels, transport network and terrain. Results of the study show that Samburu North District is the most insecure, with stock theft related insecurity. In this area violence is likely to occur in Barangoi town. Samburu East is the second insecure with robbery incidences, especially in Lerata location. Samburu Central is relatively secure except common crimes. Insecurity was directly related to population density, number of security personnel and poverty levels. Unlike use of crime pin maps to reveal frequency, GIS was able to graphically show high density crime areas, trends and patterns and relationship of crime with other factors analyzed. Use of high resolution image in such a study is recommended to reveal more potential areas for crime occurrence.

Key words: Insecurity, crime mapping, geographical information systems, remote sensing, Samburu

1.0 Introduction

Critical to the goal of achieving sustainable development is governments' ability to maintain and restore peace and order in all state regions. To achieve this, mapping of insecure locations and rife crime regions in easily understandable formats is key to attaining the objective. Crime and Insecurity correlate in many ways. Whereas crime can cause insecurity,insecurity of any form provides a ground upon which crime thrives.

Brantingham and Brantingham (1991) describe crime as a complex event and outline four things that have effects on the occurrence of an incident: a law, an offender, a target and a place. We cannot have a crime occurring in the absence of an offender and such an incident as Pauly *et al*., 1967 points out, occurs at a geographical location. The offender must have come from some place to get to the crime site, and he must have gone somewhere afterward.This then underscores the need for use of Geographic information systems (GIS) in crime mapping mapping and in effect map insecure neighbourhoods.

GIS is a type of computerized mapping, yet it is not limited solely to map form because information about a location can be represented through charts, graphs or tables in ways that are unavailable to traditional paper maps. Since the mid-1990s the acceptance and use of GIS for the analysis of crime related insecurity patterns, the allocation of resources, focused deployment, and strategic planning has grown geometrically.

According to Janet Sawin (2005) a senior researcher at the World watch Institute, Climate change is likely to trigger severe disruptions with ever-widening consequences for local, regional, and global security. In the worst case, further warming will reduce the capacities of Earth's natural systems and elevate already-rising sea levels, which could threaten the very survival of low-lying island nations, destabilize the global economy and geopolitical balance, and incite violent conflict.

Violent conflicts involving pastoralists have become widespread and increasingly severe not only in Northern regions of Kenya but also in other arid and semi arid bordered countries. Physical boundaries cutting across traditional migratory routes and wars in neighbouring countries continually bring increased problems in accessing traditional grazing resources.

Weapons entering Kenya from neighbouring war-torn countries are making raids increasingly dangerous and sophisticated. In addition to the traditional raiding, conflicts in the region have now taken an economic and political perspective.

Pastoralists are some of the most marginalized people in Kenya, often having virtually no say over the changes that are impacting on their lives. They derive their livelihoods mainly from natural resources – pasture, water, natural vegetation and livestock. However, reduced access to these resources, in particular, land and water, has increasingly put pastoralists under intense pressure. As a result, they are increasingly finding themselves fighting for their survival.

There are rife allegations that the economically powerful people are funding livestock thefts and politicians are encouraging conflicts to flush out would be supporters of political opponents from their political turfs. The above factors have compounded and complicated the security situation in those regions, especially when remoteness and the nomadic nature of the pastoralists are taken into account.

With this kind of scenario, the positive impacts made by development agencies in these areas are being affected negatively. As has been reported that declining security has seen NGOs present close their operations.Unless a more effective way of mapping and analysing insecurity to contain the situation is adopted, development and pastoral livelihoods will continue to deteriorate.

Samburu County, home to Samburu and Turkana communities has been on spotlight citing deteriorating insecurity. Massacre taking place in 1996 where sixty people died marked the onset of deadly raids. On 2011, an helicopter carrying state officers was shot down over this region. On 2012, during a police operation to recover stolen cattle, 42 police men were shot and killed. The trend of lawlessness and disregard for sanctity of human life in this region is worrying.

This study aims to identify and examines the factors contributing to such conflicts or insecurity by mapping those areas using a GIS technology hence be able to view and analyze patterns, draw conclusions and possible associations, identify and characterize at-risk populations, and test possible interventions.

By mapping layers of information including information on the location of the scope, crime, location of the pastoralist, extend of law enforcement posts,density of livestock,population and public utilities ,will provide an easier way of viewing and analysing patterns hence drawing conclusions.

2.0 Materials and Methods

2.1 Data Capture

Data used for this study is as highlighted below.

(i) Crime data
(ii) Population data
(iii) Police centers geographic data
(iv) Remote sensing data
(v) Transport network data
(vi) Poverty data
(vii) Urban centers data

The Samburu County base map was obtained from ILRI inform of shape files which were later used to make different types of maps. The shape files obtained included data for Locations, Villages, Roads, Towns and Land use. These were in Arc 1960 datum. Population data was sourced from Kenya Bureau of Statistics (KBS). This was given

in shape file format. A published 1999 population shape file was acquired since the one for the latest census i.e., 2009 was still under development. Poverty index data for 2005/2006 was sourced from Regional Center for Mapping and Development (RCMD). Remote sensing data was obtained from Jomo Kenyatta University of Technology which was mosaicked and layer stack using Erdas Imagine 9.1 and later subset and classified using Arcgis 10. This was a LandsatTM Image taken in 2000.

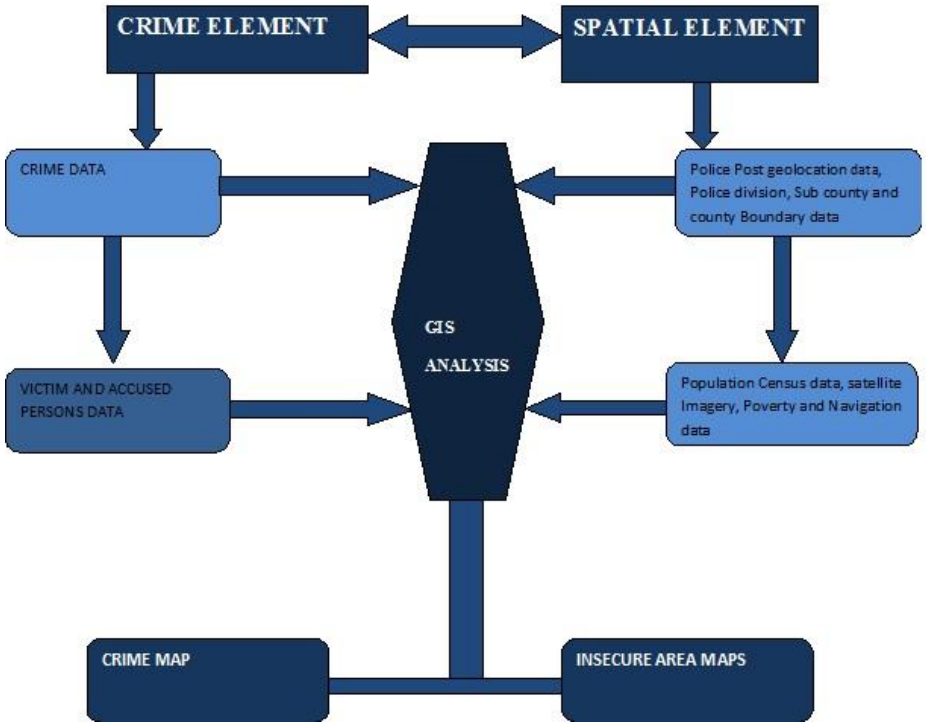

Figure 1: Shows the methodology flow chart

Crime data comprised of crime name, place of occurrence, map reference of individual crimes and date of occurrence. Place of occurrence was either the specific place, known landmark in vicinity or the village where it occurred. Time included the date, month and year when the incidence occurred. The data after being collected was mapped using Arcgis 10. All crime happening in respective division was centralized at the main station in that division where this data was collected. Crime data for Samburu North Division was collected at Barangoi Police Station. Crime data for Samburu East Division was collected at Wamba Police Station while crime for Samburu Central division was collected at Maralal Police Station. Since crime is not recorded with the exact geographical location where the incidence occurred, mapping was done using the most precise method that the Station provided. Crime in Samburu North division was mapped based on the village where it occurred. Crime in Samburu East division was mapped based on the distance from the station and the nearest landmark whereas crime in Samburu Central Division was mapped based on distance from station and sub location.

Crime analysis was done based on a number of variables. These were; Police centers (Stations and posts) geographic location, Population distribution, poverty levels, transport network, Terrain, land cover and number of security personnel.

Police centers data was obtained through ground truthing and Google maps. This data was then exported to Arcgis and integrated with crime data together with other datasets. Analysis was to be done on the effect these centers were having to the general distribution of crime and consequent insecurity in the county. All the police stations were mapped. Twelve out of the 15 AP posts in central division were mapped while AP posts in the other districts were all mapped.

Population census data was to be integrated with crime data to reveal whether crime and insecurity was in anyway being influenced by how the general population was distributed. Poverty levels data was to be used to determine whether violence in the county was affected by wealth or was spontaneous. Land use and land cover data was to be analysed in relation to crime levels to reveal whether crime, violence and general insecurity was in anyway grounded on how these variables were spatially placed. Number of security agents was to be integrated to determine if there numbers in any vicinity had any influence whatsoever on the general insecurity in the county.

3.0 Results and Discussions

3.1 Collection and Mapping of Crime Data

Figure 1 show how crime data is spatially distributed in the county.

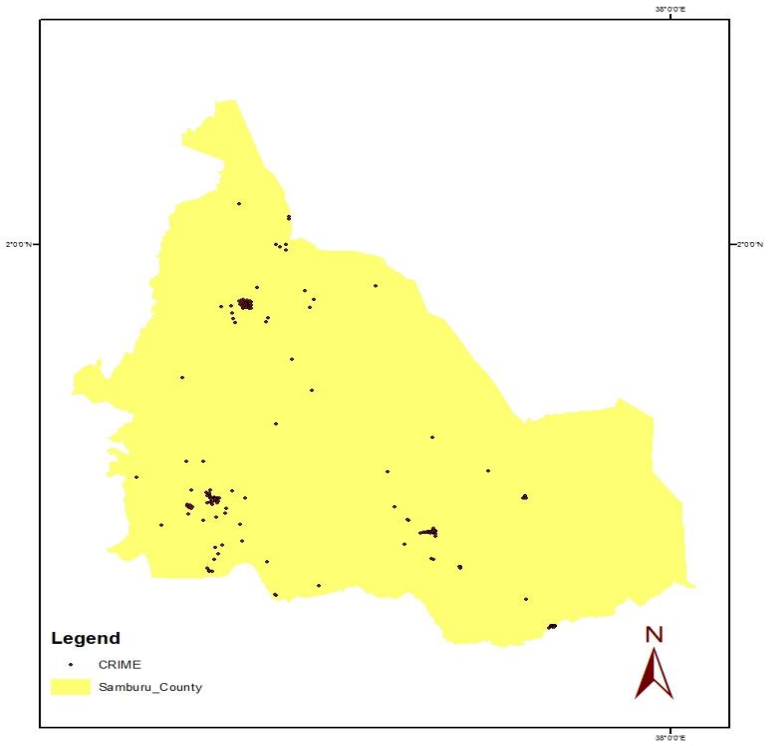

Figure 1: Crime spatial distribution

After mapping crime in the county, it emerged that Samburu North Division registered the highest number of stock theft and murder cases with 12 Stock theft incidences and 8 counts of Murder. Samburu East Division was second in Stock theft cases with 11 counts in the same exact period. Samburu East Division and Samburu North Division registered the highest number of Robberies with Violence with 5 incidences in East division and 3 in Samburu North. Analysis revealed that Samburu Central registered highest cases of rape and defilement with 9 counts. This number doubled cases of the same nature in other divisions which registered 8 cases combined. The Central Division also topped in assault cases.

Table 1: Summary of crimes

Offence	No. of Times Samburu East	Samburu North	Samburu Central
Stock theft	11	12	8
Normal stealing	13	8	23
Murder	2	8	0
Robbery with violence	5	3	1
Rape/defilement	4	4	9
Assault	8	8	11
Creating disturbance	19	6	11
others	37	18	32

Analytically, probability of someone meeting death in the county were high in Samburu north division than in the rest of the Divisions with a ratio of 4:1 Chances of one getting assaulted or being raped were high in Samburu Central division than in the rest of the Divisions and Chances of one getting robbed were high in Samburu East division than the rest of the divisions with probabilities of 5:3:1 for Samburu East, North and Central respectively.

3.2 Analysis of Crime and Insecurity

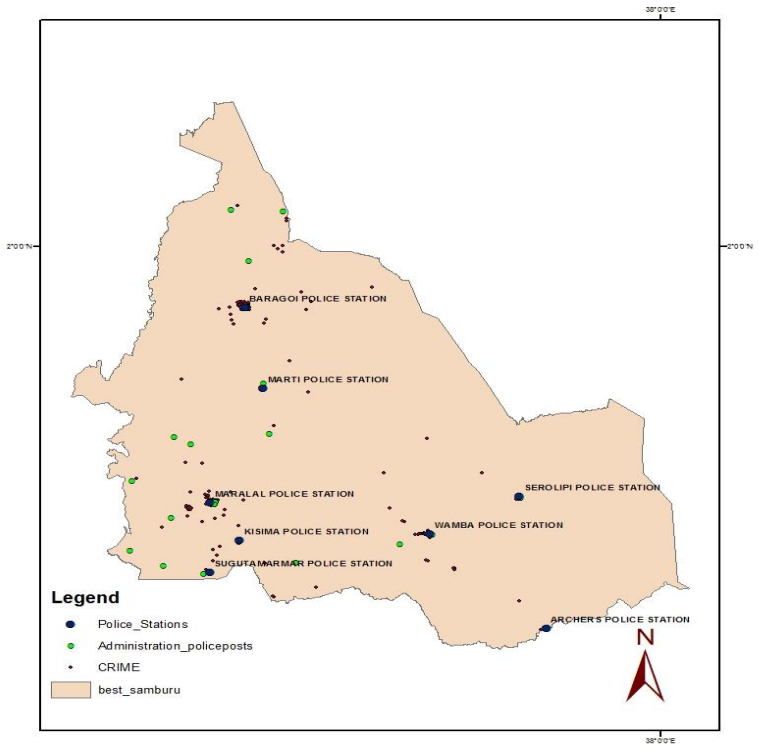

Figure 2: Police centers and crime map

Location of any police station, AP post or police post had minimal effect on the occurrence of crime in the vicinity. Buffer analysis revealed that considerable crime incidences happened within 1 kilometer range from the centers. A 500meter buffer in Barangoi, Wamba and Maralal police stations showed that

Barangoi was most affected since over 60 percent of all offences happened within this buffer range. Samburu east was second and lastly central.

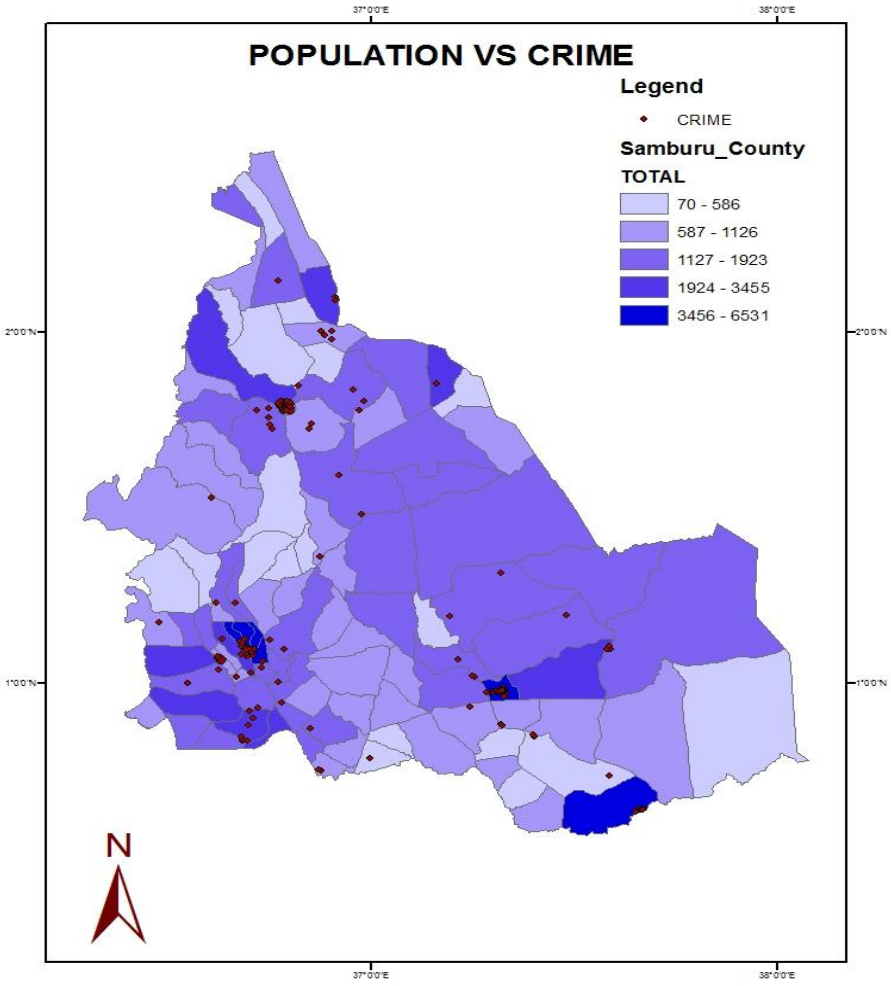

Figure 3: Crime versus population distribution

Figure 3 shows the relationship between crime and population in the county. As evidenced, locations with high population totals registered high crime rates. These locations are, Uaso East, Wamba, Maralal, Barangoi and Kawap. Locations where population was very low recorded zero crime rates except for Uaso Rongai Location in Northern Samburu.

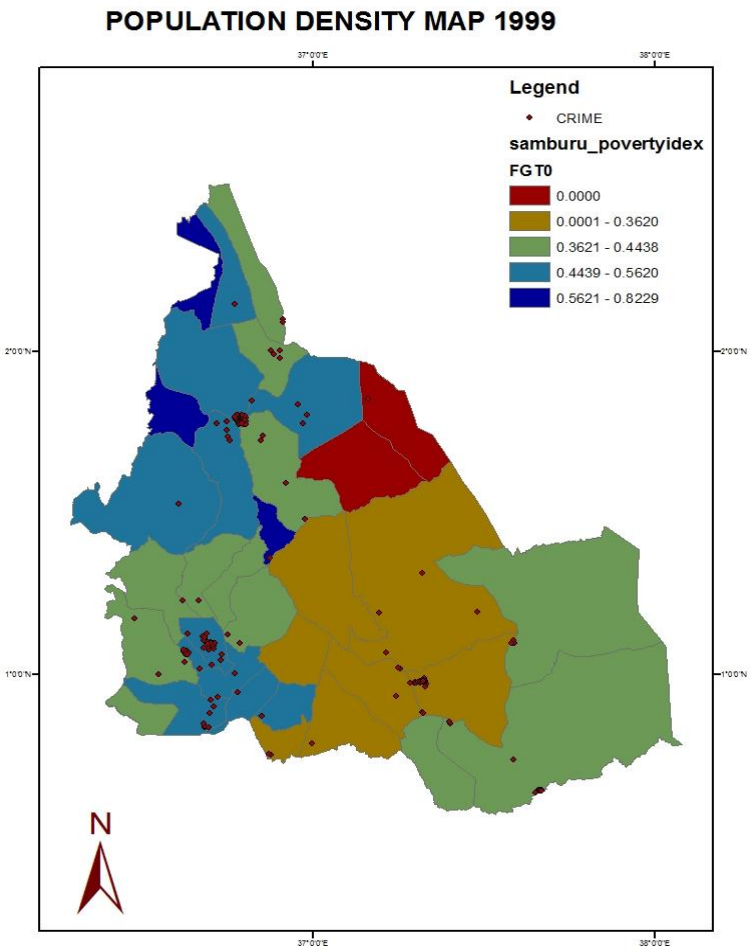

Figure 4: Crimes versus poverty index map

Figure 4 shows how crime is spatially distributed in relation to crime. It also emerged that crime and insecurity was at the minimum in the very poor locations. These locations included Nachola and Parkati. Land use map showed that these locations lie in barren land. This was interpreted to mean that pastoralism and animal keeping by which wealth in the communities living in this county is measured, was scarce and nearly never practiced in the two locations. Notably, crime and general insecurity was felt in places where inhabitants were well up. These locations constituted those having shopping centers.

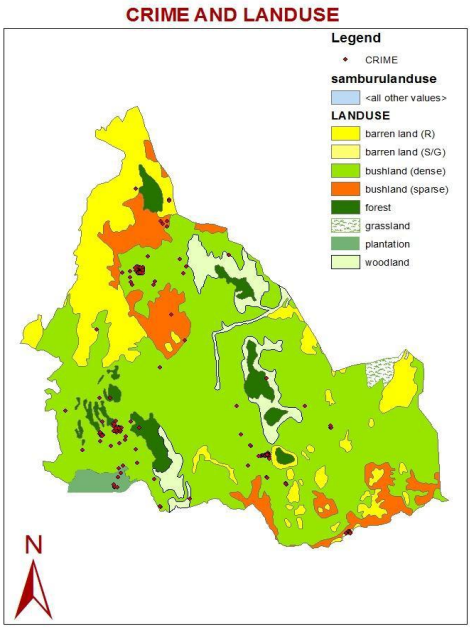

Figure 5: Crime versus Land cover map

It was noted from Figure 5, which shows a land cover map that, most of the county is covered by dense bush land. Most of the crimes occurred in the dense bush land as compared to barren land and forests which carried less than 1 percent of the total crimes committed.

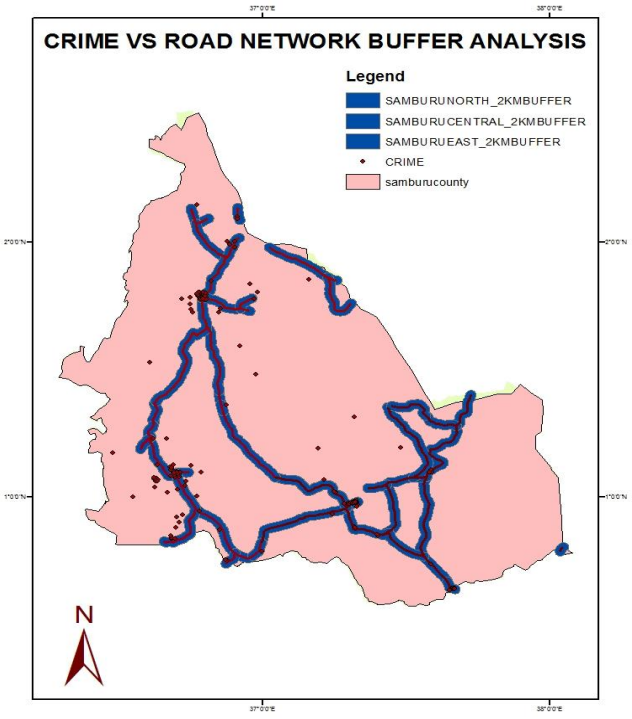

Figure 6: Crime versus road network map

Figure 6 shows a buffer analysis for crime in relation to road network. Results indicate that crime took a lineal pattern as travelled towards Wamba town in Samburu East District. Field observation revealed that Wamba town is developing outwards and along the road. The business premises and increasing population in and along the road formed a desirable target for bandits and offenders. Figure 7 shows a 3D satellite image for Samburu East Division.

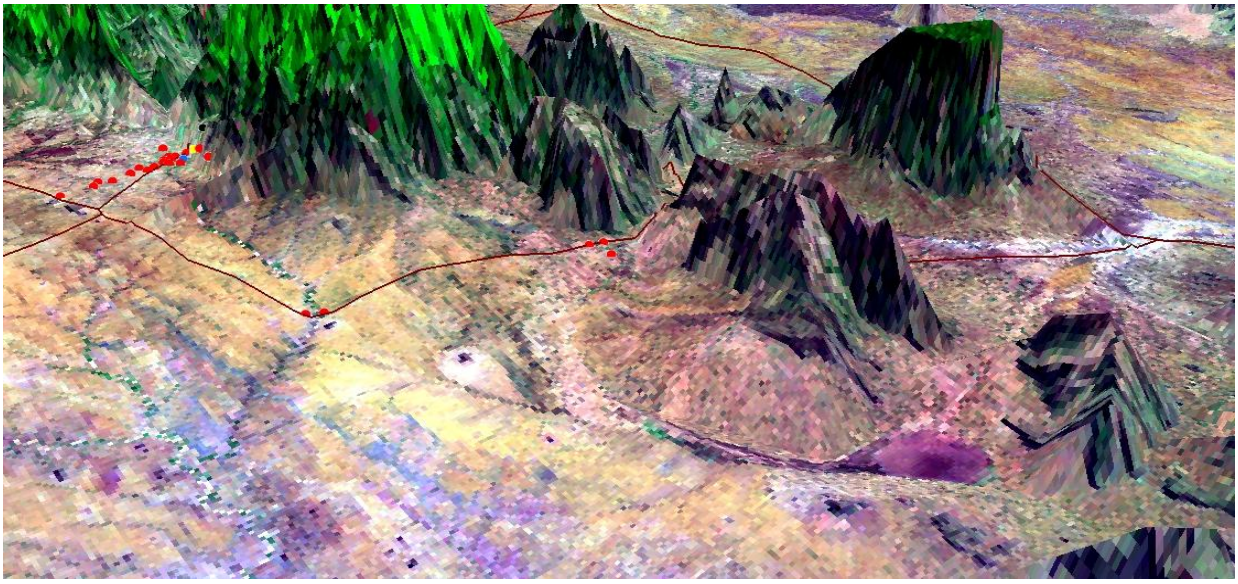

Figure 7: Samburu East 3D map

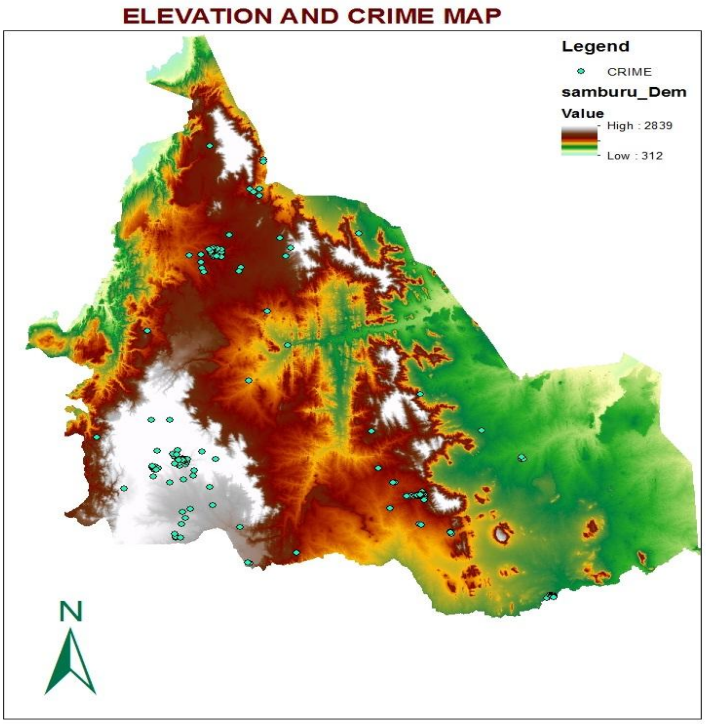

Figure 8: Digital elevation model

Figure 8, which is a digital elevation model for the study area was created and crime data over laid. Analysis revealed that crime was not much influenced by the geographical setting as is always the case. Though few cases of crime were noted to be influenced by the terrain. These mainly were highway banditry in Samburu east division and murder in Samburu north. Lack of a high resolution image greatly hampered this analysis since then the other would have been able to precisely highlight in accurate details the geographical setting of different types of crime.

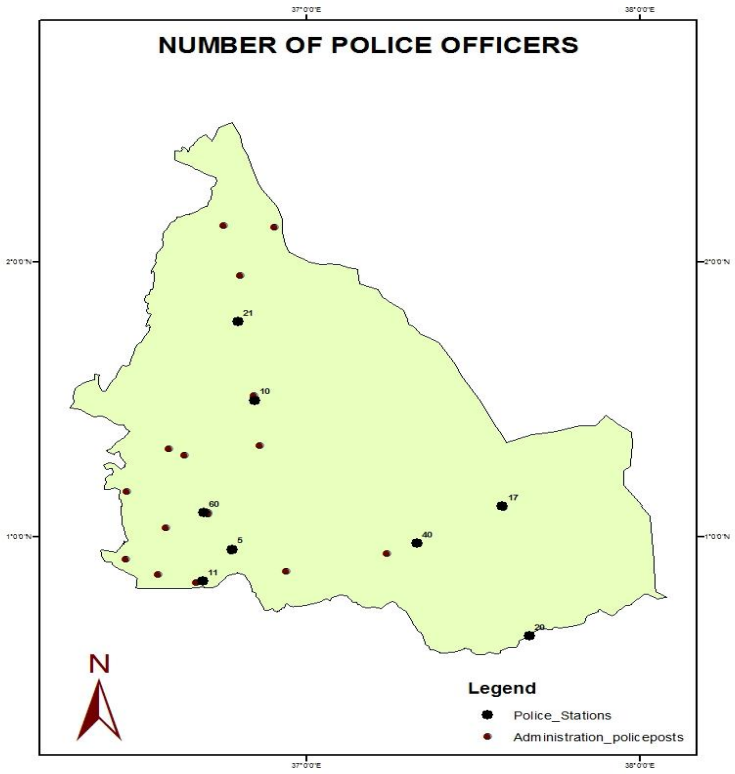

Figure 9: Security personnel statistic map

	Samburu Central Division	Samburu East Division	Samburu North Division
	83		
Police Officers		77	31
	170		
Administration Police		130	77
	866		
Kenya Police Reserves		200	415
	1119		
Total		407	523

Table 2: Comprehensive security personnel data

Figure 9 shows how and the number of police officers as distributed throughout the county. From Table 2 it was revealed that Samburu North Division had the least number of trained personnel. Crimes against person which lead to lose of death were more common in this Division, it was expected that this Division be assigned more police personnel to instill law and order. Personal interviews indicated that the communities in this district are

hostile and most of them in possession of illegal guns. Therefore, the distribution of police officers could therefore be blamed for increasing insecurity.

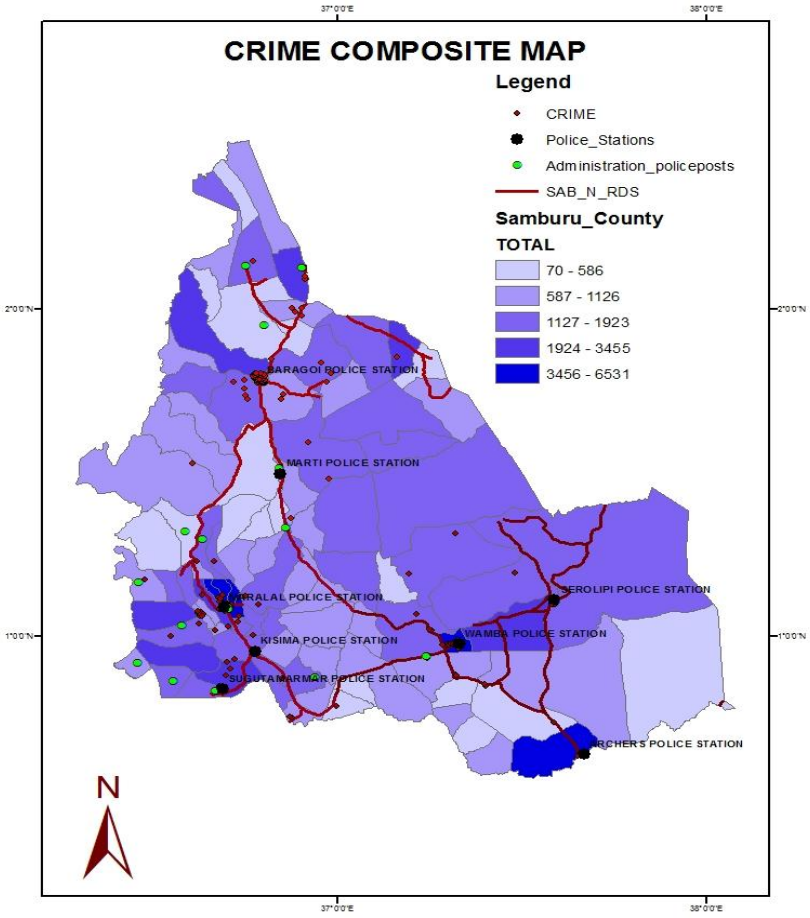

Figure 10: Composite map

Figure 10 shows how various variables relate with one another in defining crime distribution in the county. Imperatively, population and poverty levels had the greatest influence as to where crime occurred. Location of police stations, AP posts, police posts and topography variables had the least effect as to where crime was to be committed.

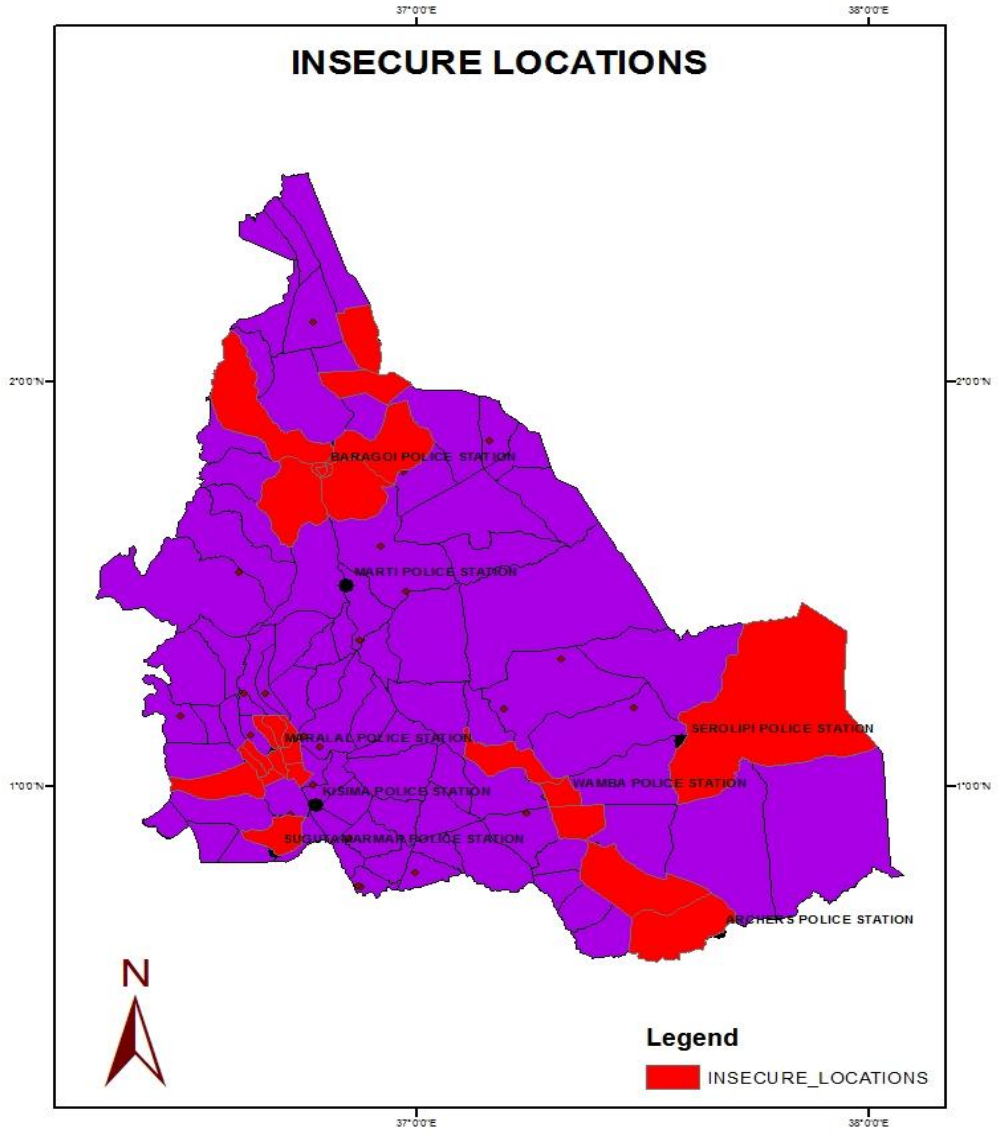

Figure 11. Insecure location map

Figure 11 shows the most insecure locations in Samburu County.

4.0 Conclusion

The methodology employed in this case study helped achieve all the objectives as outlined during the onset of the study. Crimes were mapped using the most precise method that the Stations provided. Crime in Samburu North division was mapped based on the village where it occurred. Crime in Samburu East division was mapped based on the distance from the station and the nearest landmark whereas crime in Samburu Central Division was mapped based on distance from station and sub location Crime map for the whole county was generated which showed concentrations of crime in and around urban centers.

In determining the most prevalent crimes and factors causing them, a number of variables were chosen to determine the existing relationship between them and crimes. Crime was not influenced by the location of police

stations and Topography had little influence in where crime occurred. Samburu North was identified to be the most insecure with insecurity catalyzed by ineffective control measures. Areas around Baragoi town and specifically Nalingangor locations were identified as potential threat areas where violence could erupt spontaneously.

Samburu Central insecurity was discovered to majorly emanate from robbery related cases. Highway robbery has caused lot of insecurity and GIS was able to identify Lerata location as a potential risk area. The terrain, dense bush land and long strait stretches of land form some of the observed factors. However, with GIS the escape direction of offenders was easily determinable.

The Insecure Location map generated graphically shows most insecure areas in the county. This was achieved by isolating insecure areas from every variable that was used for analysis. All the insecure regions were then merged to form the complete insecure zone map. The map is paramount to the law enforcement agencies to know where they need to concentrate their limited resources instead of distributing them evenly even to some areas that have little need for such resources like Waso East, Amaiya, and Latakweny.

Acknowledgements
First, I would like to thank Dr. Patroba Odera for the guidance provided and patience depicted in the process of accomplishing and adding quality to this work. GEGIS Department lecturers for their support, Department support staff for continued support and encouragement during the research. Different organizations; Survey of Kenya (SOK), RCMRD, ILRI among others for material support and facilitation in this research. Sincere appreciations go to my parents for their financial and emotional support which saw the smooth conclusion of this research.

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