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# Use of GIS Technology in the Implementation of Alcoholic Drinks Control Act: A Case Study of Karima Location, Othaya, Kenya

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**Abstract:** ***The Alcoholic Drinks Control Act was signed by former President Kibaki and became a law in Kenya in 2010 which provided some limits on alcohol consumption. This was meant to curb excessive alcohol consumption by many youths who were consuming illicit brews which were resulting to death. The Act stipulated that no alcohol drinking place should be within 300m from any learning school and the operation time was set to be between 5pm to 11pm. In the initial implementation of this Act, enforcers' only considered the operations time. This resulted to this law been partially implemented since the restriction of spatial distance of 300m was not taken into consideration. In conjunction, the issue of revoking licenses for bars operating within a distance of 300m from schools also came into been and this affected many bars in Kenya. This necessitated the need for thorough inspection which called for consideration of the optimal routes that law enforcers' such as police officers, County Commissioners and other Administrative officers would use when carrying out the inspection and patrol. Moreover, some bars operators who were ordered to evacuate, claimed that their businesses were not within 300m from schools. This issue made the work of licensing of bars difficult and emphasized for the need to determine regions or areas suitable for bars operations. The solution to these conflicts and challenges associated with the implementation of this Act was only arrived at, through effective handling of spatial data related to bars and schools. GIS technology was advocated since it has capability of mapping and carrying out geographical analyses related to bars and schools. It provided tools for buffering which generated regions or areas around schools using a proximity distance of 300m. The buffered regions assisted in performing further analyses aimed at determining all bars and pubs within 300m from schools. Moreover, further spatial analyzes were performed and determined suitable regions where bars and pubs would be operated away from schools. This aided in the licensing of retailers dealing with wines and spirits shops as well as bars and pubs. In addition, point distance method of determining Euclidian distances was used to provide linear measurements (distance) from bars to nearby schools. Maps, graphs and reports containing information related to bars were generated that would assist in the Implementation of Alcoholic Drinks Control Act.***

**Keywords:** Spatial strategies, GPS, GIS, Universal Traverse Mercator, World Health organization, NACADA.

## 1. Introduction

Alcohol is basically a central nervous system depressant and dulls the brain making learning a difficult task [1]. Alcoholism is a disease and like many other diseases, alcoholism lasts a person's lifetime; it usually follows a predictable course; and it has symptoms [2]. The risk for developing alcoholism is influenced both by a person's genes and by his or her lifestyle [3]. This issue of alcohol consumption needs to be addressed to educate people concerning its negative impacts.

The excessive use of alcohol is becoming a problem on a global scale, resulting in a variety of societal problems upsetting all walks of life [4]. This has been influenced by high unemployment level which results to idleness among many people in the East Africa countries. This has also been contributed by peer influences among the friends [5]. In Kenya alcohol is the most commonly abused drug by about 61% of the population [6]. The same report indicated that 40.9% of the students were abusing alcohol in Nairobi Province and 26.3% in Central Province. This triggered baseline survey on alcohol use in Central Province which came in the background of public and Government concern over increasing alcohol use in the province. It also came in the background of a previous fact finding mission [6] that confirmed the existence of an acute alcohol problem. This has been contributed by availability of low quality alcohols brands that have high methanol and ethanol content which are also cheaper.

To address the problems of alcohol drinking in Kenya, a private member's motion known as the Alcoholic Drinks Control Bill (2009) was introduced in Parliament by the Member for Naivasha, Hon. John Mututho. The Bill seeks to mitigate the negative health, social and economic impact resulting from the abuse of alcoholic drinks. The Bill contains important proposals that when implemented would greatly reduce the harm caused by the abuse of alcoholic drinks. It aims at educating the public on the health, economic and social consequences of alcohol abuse and also stipulated that no alcohol dealing businesses should be operating within 300 m from any learning institution. This meant that no alcohol selling business should be licensed within that radius from any school as stipulated by Alcoholic Drinks Control bill.

Needless to say most of these bars have been licensed through corruption since they do not meet the set distances of 300 m from schools. This therefore call for NACADA to establish a way of carrying out geographical analyses such as buffering and spatial analyses based on the location of bars and schools so that they can know bars that are violating the law.

The geographical analyses require the use of GIS technology which is a powerful tool suitable for map compilation, buffering, point distance calculations and also for performing spatial analyses that will help in determining the most suitable locations for running alcohol selling business [7]. GIS will also help in generating of graphs and reports from bars and pubs attributes data.

## 2. Problem Statement

In Karima Location, there have emerged notable trends in the sale and consumption of alcoholic drinks that fuel alcohol abuse within its jurisdiction. This scenario has been witnessed whereby bars and pubs are packed to the full with people consuming one bottle after another. This was constituted by the following reasons as stipulated by Alcohol Drinks Control Act: increase in the number of alcoholic drinks selling outlets in the region, in or near learning institutions, easy accessibility to and excessive consumption of alcohol; Increase of cheap and low quality type of alcohol such as wines and spirits, aggressive marketing, promotion of alcoholic drinks especially with messages targeting young people. These problems of alcohol consumption have been witnessed throughout the whole country and not only in Karima location.

To address this problem, the government of Kenya ordered for full implementation of the Alcoholic Drinks Control Act within its jurisdiction and the responsibility was given to County Commissioners who delegated this task to their lower authorities including Members of County Assembly (MCA), Chiefs and Sub-Chiefs. To adhere to this order, Karima Location Chief in collaboration with Sub-chiefs, police officers and Village elders took the responsibility of enforcing the law. In the initial stage of implementation of this Act, they only considered the operations time to control the bars businesses operations. This meant that the law was only implemented partially since the restriction of spatial distance of 300m was not taken into consideration. Also the issue of revoking licenses for bars within 300m from schools came into place after an order was issued by County Commissioners of Central Province. In the enforcement of this order, most of bars in Karima location were affected since most of them were operated near schools. This created tension whereby, some bars operators ordered to evacuate claimed that their businesses were not within 300m from schools. They also claimed that they needed better method of determining distances to be employed, rather than using estimation method which was inaccurate and could not provide enough evidence concerning distances between bars and existing schools.

In conjunction, in Karima Location, new bars businesses were being started haphazardly without owners of these businesses taking into consideration the restriction contained in the Act. This increased tension between the bars operators and enforcers' of the Act in this region. Moreover, in Karima location, there was also an issue of corruption in the process of licensing whereby some bars within 300m from schools were given retail licenses while others were denied licenses or their licenses were revoked. This raised a problem between some bars operators and the people responsible for licensing of businesses and this affected negatively the process of the implementation of the Act. Some bar operators in Karima location requested for transparency in licensing processes whereby each and every bar needed to be subjected to Act requirements without some bars operators being favored.

## 3. Study Area

Karima is one of the Locations in Othaya Division, Nyeri South District, Central Province, Kenya. It shares boundary with Mahiga, Iriaini, Chinga locations. It covers an area of about 33.151km$^2$ and has a population of about 19093 as per 2009 census data. The number of males as per 2009 census data was 8932 while that of women was 10161. In this Location, there are 23 bars and 16 schools. The main economic activity in the region is coffee and tea farming as well as small subsistence farming. Many of the residents in Karima location are unemployed and most of them are poor with a small group which is in the middle class constituting of teachers, nurse and some other public servants.

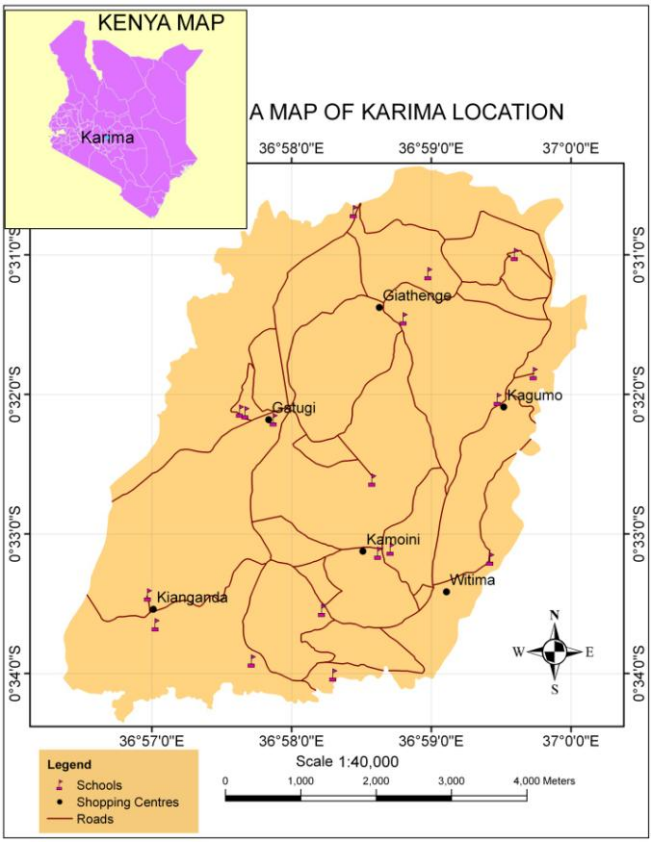


**Figure 1:** Study area

## 4. Methodology

The project explores the viability of GIS technology in the implementation of Alcoholic Drinks Control Act 2010 in Kenya especially in the Central region. Karima Location was selected as the pilot project area. Problem definition reviewed the general challenges experienced in the implementation of Alcoholic Drinks Control Act.

The research objectives were developed which guided on the relevant data to be collected. GPS data for schools, police posts, shopping centres, bars and pubs were collected using Hand held GPS. Moreover roads shapefile, topographical maps as well as 2009 census data were obtained. All these data were harmonized to the same coordinate system i.e. UTM zone 37S. This was achieved by first geo-referencing topographical map using the UTM coordinates of four known points. Then data digitization and editing was carried out to improve data integrity. Then all data from various sources were integrated whereby attributes data were added to the spatial data.

The proximity toolset was used to determine the proximity distance between bars and schools. With regard to this project, buffers were generated using a distance of 300m from learning institutions in the area. The buffered layer was used for further analyses to determine bars and pubs within 300m from schools using selection by location query capability.

Network analyses tool was used to determine the optimal routes to be used by police officers when carrying out patrol and inspection to bars. This involved first, creation of the network dataset from the road shapefile. Lengths of roads network were used as the impedance in determination of the optimal routes to various shopping centres from closest police posts. Since there were two police posts in Karima Location, closest facility approach assisted in assigning shopping centres closest to each police post for ease of coordination. This involved consideration of the spatial locations for police posts as the destination locations while shopping centres as the target location or location for incidences.

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In addition, Euclidian distances surfaces between shopping centres and between schools were generated that assisted in carrying out spatial analyses operations. Spatial analyst tool was used to determine the suitability of the area for bars operations. This tool provided a broad range of powerful spatial modelling and analysis features. This enabled the creation, querying, mapping, and analyzing cell-based raster data; performing integrated raster/vector analysis; deriving new information from existing data; querying information across multiple data layers and fully integrating cell-based raster data with vector data sources. To determine the suitable sites for operating bars businesses, the restriction provided by the Alcoholic Drinks Control Act as well as distances of bars from shopping centres were taken into consideration. The suitable sites for bars should not be near any learning institution, whereas need to be within shopping centres. Therefore, areas within 300m from any school were considered to be unsuitable sites for bars, whereas areas beyond 300m from schools were considered to be suitable for bars businesses. A proximity distance of 400m from shopping centres was considered as the most suitable location for bar businesses. As distance increases away from shopping centers, the suitability of the sites for bars operation kept on decreasing.

Using spatial modeller tool, the schools and shopping centres layers were used in spatial modeling. The Euclidian distance tool from the arc tool box was also added to the same window. The connector tool was used to connect the school and the Euclidian distance tool containing the process and the output. This operation was also done to connect the shopping source feature layer with the Euclidian distance process and output. The two operations were run simultaneously. To obtain the required class intervals, the reclassify tool was used. The generated Euclidian surface from schools layer was reclassified into two regions, i.e. suitable and unsuitable regions. The unsuitable region took the range between 0-300m and the suitable region took values greater than 300m. Also, Euclidian surface generated from shopping centres layer was reclassified into two classes. The suitable region was set to be within 0-400m and the unsuitable region included distance greater than 400m from shopping centres. The two surfaces generated were then overlaid to generate more superior results.

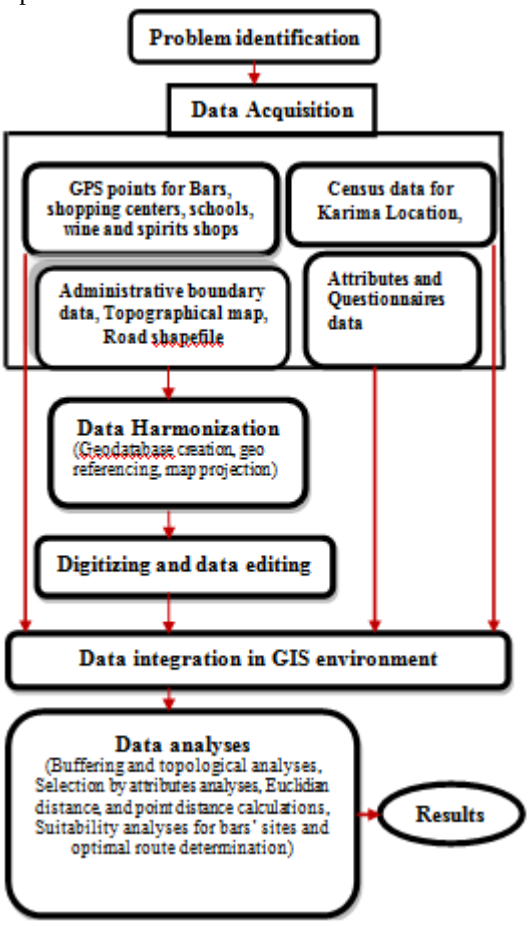


**Figure 2:** Overall Approach of the project

## 5. Results and Discussion

### 5.1 Spatial distributions of bars and schools

A map was generated showing the distribution of bars, schools and shopping centres in Karima Location as shown in figure 3. From the map, it was identified that bars were clustered in Gatugi, Kianganda, Kamoini, Kihugiru and Witima shopping centres. There were seven bars operating in Gatugi as well as in Giathenge shopping centres. In conjunction, Kamoini and Kianganda shopping centres each

had two bars operating whereas in kagumo shopping centre, there was only one bar. In Witima shopping centre, there were four bars operating. Moreover, kamoini shopping centre was neighboured by Witima secondary school as well as Witima primary school. Kagumo shopping centre was neighboured by Kagumo primary school. In conjunction, Giathenge shopping centre was neighboured by Karima primary school as well as Karima boys. Moreover, Gatugi shopping centre was neighboured by three schools namely: Gatugi primary, Gatugi girls and Gatugi mixed secondary school whereas, Kianganda shopping centre was neighboured by Othaya girls and Kihugiru primary schools.

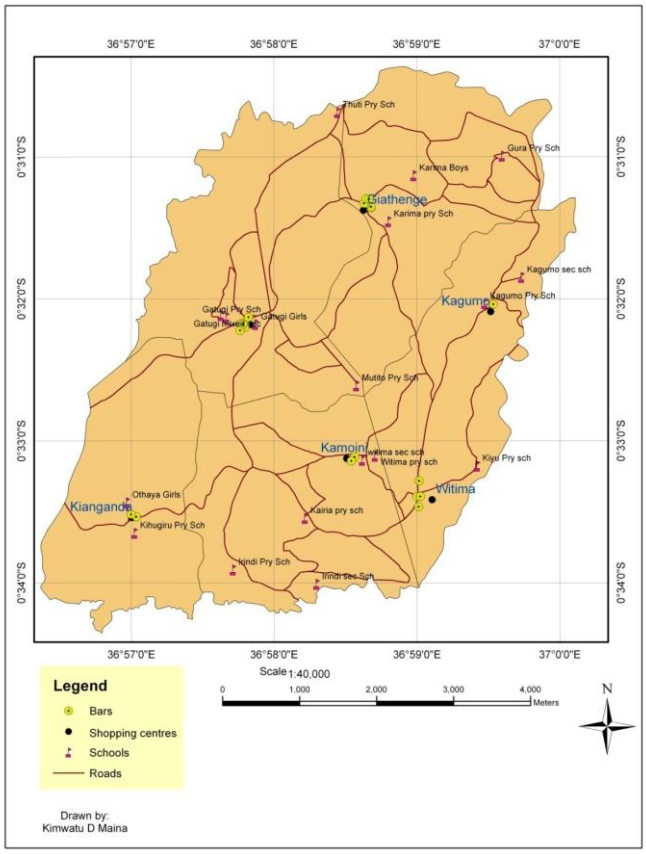


**Figure 3:** Distribution of bars and schools in Karima Location

### 5.2 Relationship between bars and population

The relationship between bars and 2009 population data in each Sub-location in Karima location was done and a map showing the results was generated as shown in figure 4. It was deduced that the number of bars in each sub-location were not directly related to the population. For example, in Kihugiru sub-location, it was realized that the population was the highest amongst the other sub-locations, but there were only two bars. Moreover, in Thuti sub-location, the population was less than that of Kihugiru but it had seven bars operating. Thus this put it very clearly that the numbers of bars operating in each sub-location were not directly related with total population in each sub-location. The reason behind this was that some people prefer taking alcohol in certain bars irrespective of whether they are operating within their sub-location and from the questionnaires administered, it was realized that many people prefer drinking alcohol in Giathenge, Witima and Gatugi shopping centres.

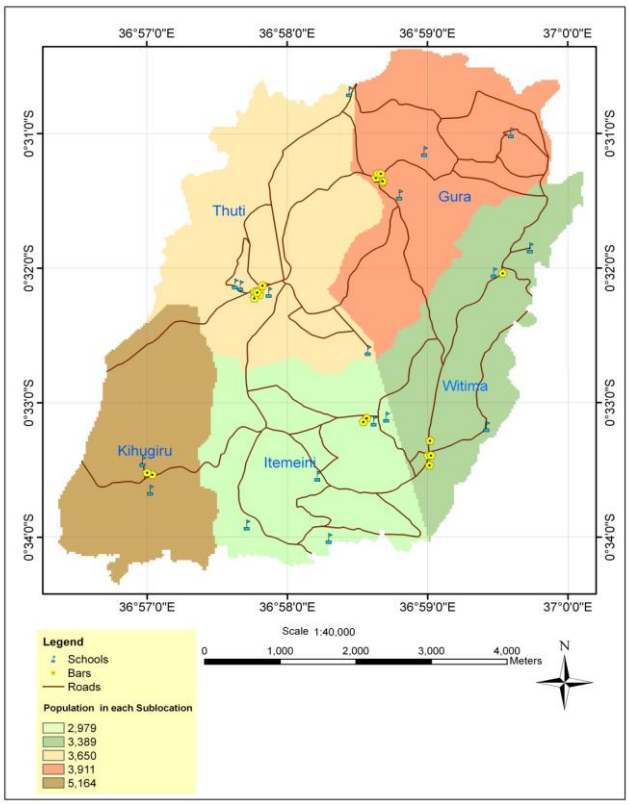


**Figure 4:** Relationship between bars and population

### 5.3 Bars affected by the Alcoholic Drinks Control Act

To determine bars within 300m from schools, buffers were generated using a proximity distance of 300m from schools. Selection by location query was performed which determined all those bars within the buffered regions and the result was presented as shown in figure 5 and figure 6.

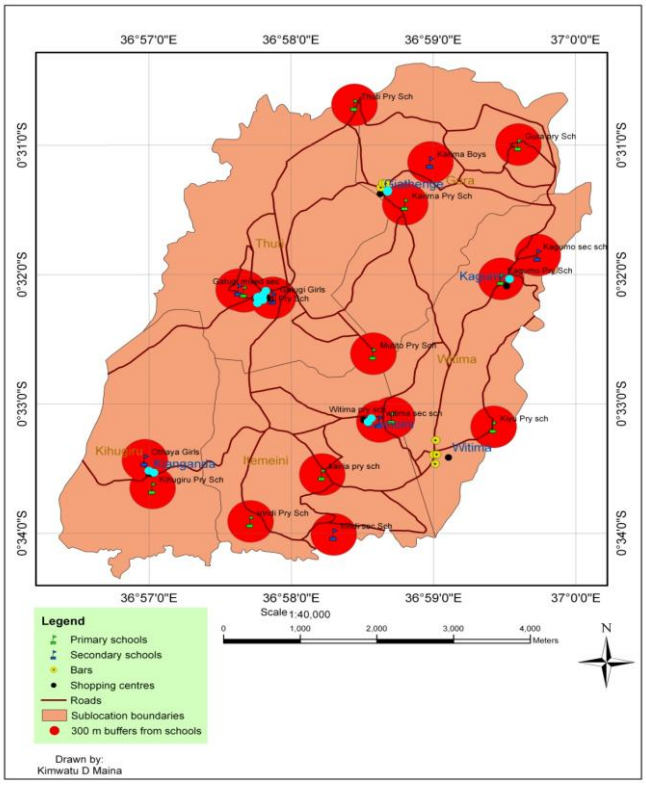


**Figure 5:** Bars affected are shown by light blue color

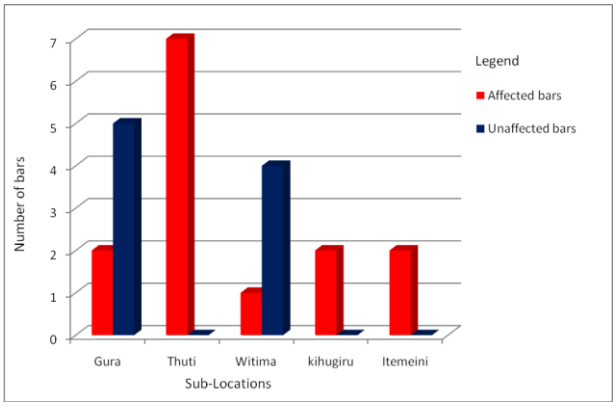


**Figure 6:** Numbers of bars affected in each sub-location

### 5.4 Optimal routes for patrol and inspections

For effective coordination between police officers from Gatugi and Witima police posts, in the process of administering and inspecting bars and pubs in Karima location, network analyses based on the closest police post was carried out. This was meant for assigning the routes which police officers from each police post would use when carrying out inspections on these bars. This was achieved by assigning the spatial location of police posts as the destination locations whereas, the shopping centers where bars were spatially located were considered as incidences locations. The result was presented as shown in figure 7. Based on closest police post, it was determined that police officers from Witima police post were supposed to carry out bars' inspections in Witima, Kagumo and Kamoini shopping centres. Police officers from Gatugi police post were supposed to inspect bars in Gatugi, Giathenge and Kianganda shopping centres.

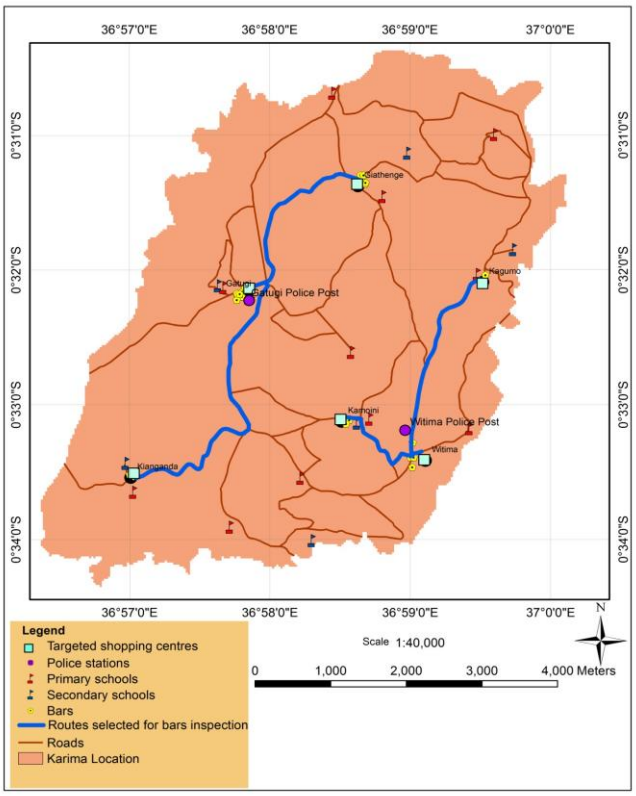


**Figure 7:** Optimal routes from nearest police post to specific shopping centres

### 5.5 Suitable and unsuitable sites for bars businesses

Using spatial modeller tool, the model shown in figure 8 was used to determine the suitable and unsuitable sites for bars operations based on distances from schools and shopping centres. The schools Euclidian surface generated was reclassified into two classes, where the suitable sites were set to take values in the range, 0-300m and the unsuitable region took values greater than 300m. In the case of shopping centres, Euclidian surface was reclassified into two classes where the suitable region was set to be within 0-400m and the unsuitable region took values greater than 400m from shopping centres. This was carried out using the model in figure 8.

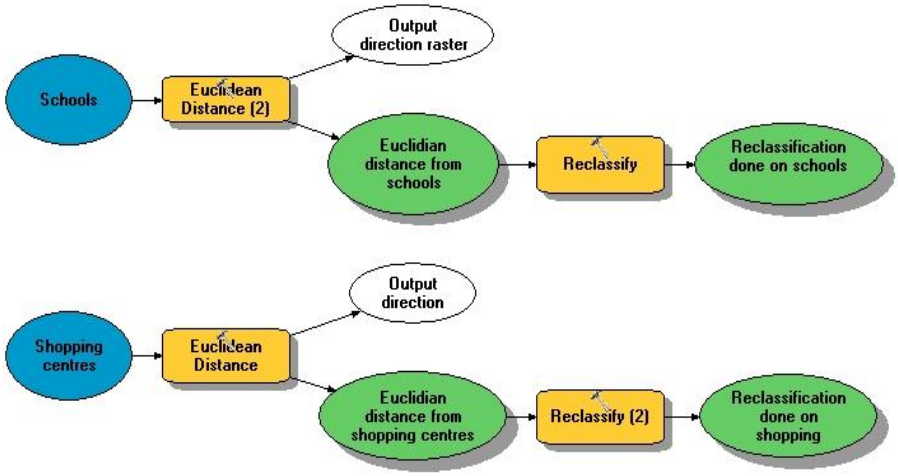


**Figure 8:** Reclassification of Euclidian distance

The results after running the model in the figure 8 were as shown in figure 9 and figure 10.

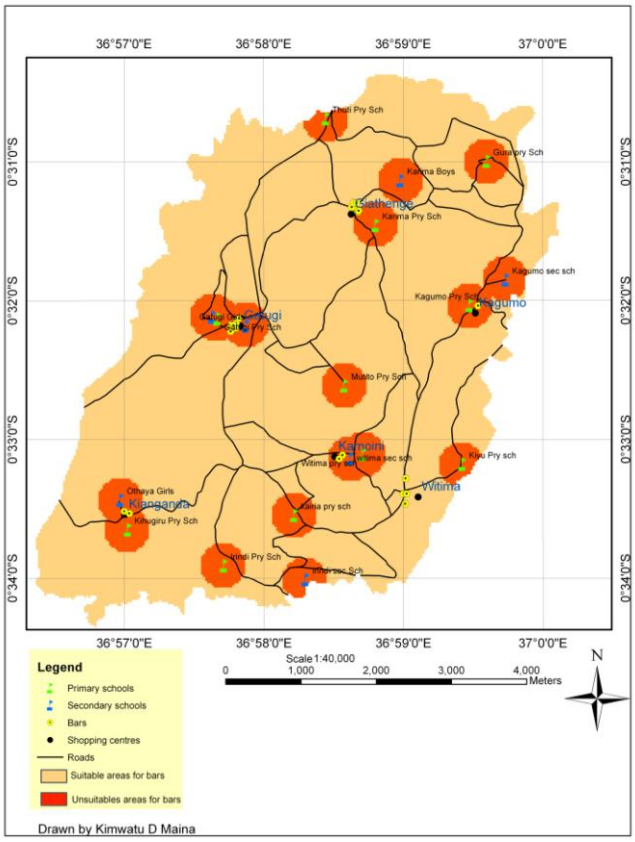


**Figure 9:** Reclassification results from school Euclidian surface

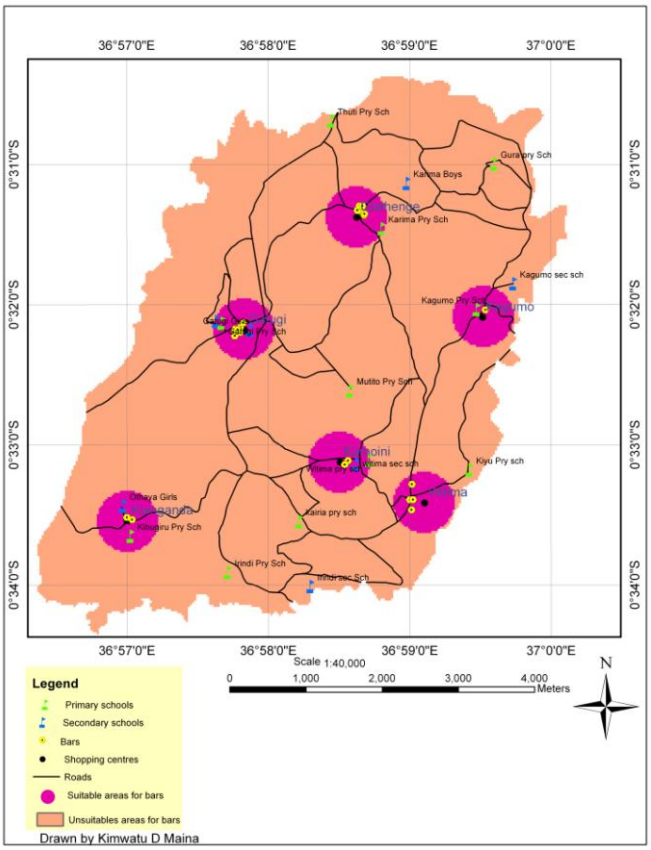


**Figure 10:** Reclassification results from shopping centres Euclidian surface

Results in figure 9, showed the suitable regions and unsuitable regions for bars operations based on the proximity distance of 300m from schools. Those regions that were within 300m were considered to be unsuitable region whereas those regions beyond 300m were considered to be suitable for bars operation as stipulated in the Alcoholic Drinks Control Act. The results in the figure10 show the region within 400m from shopping centres as suitable region for bars, while the region beyond 400m from shopping centres was considered to be unsuitable. There was a need to combine the two results to generate a more superior result. This called for applying weight which was facilitated by use of weight overlay tool. This tool enabled the reclassified shopping raster layer to be overlaid with the schools raster layer using the weight model shown in the figure 11 to generate the suitable sites for bars businesses.

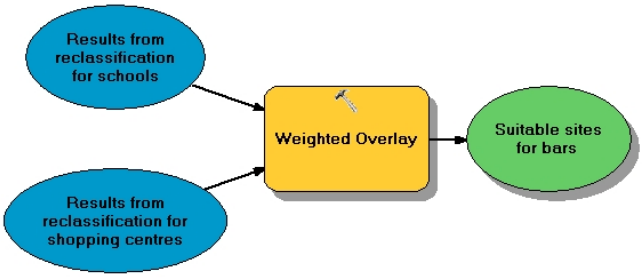


**Figure 11:** Weight model

The result of this model in figure 11 was a raster map showing suitable locations for bars operations as well as unsuitable sites as shown in figure 12.

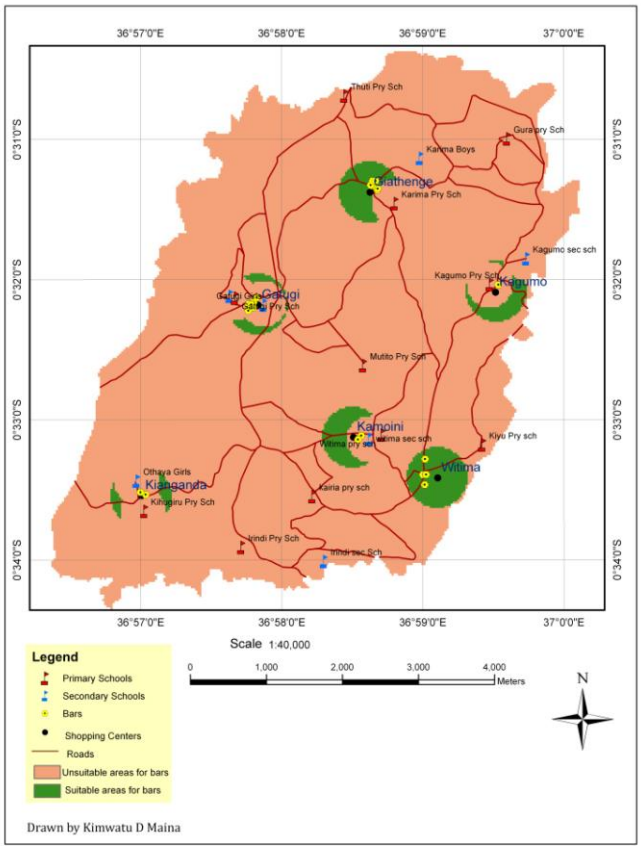


**Figure 12:** Suitable and unsuitable locations for bars businesses

From figure 12, it was noted that the area around Witima shopping centre seemed to be the most suitable area for starting or relocating a bar businesses. This was based on consideration of the requirement that no bar should be operating within 300m from schools and also the consideration of the location of the bar to shopping centres. The suitable areas for bars operation in Kianganda and Gatugi shopping centres were determined to be small compared to other shopping centres such as Witima. The reason for this was that in Kianganda shopping centre, it was neighboured by two school i.e. Othaya Girls and Kihugiru primary schools. In the case of Gatugi shopping centre, it was noted that there were three schools neighbouring this shopping centre and thus made the suitable region for bars operation to be small. This would help the businessmen interested in starting bar businesses in the region, to be aware of suitable and unsuitable locations.

## 6. Conclusion

A map showing the distributions and locations of bars and pubs as well as schools was generated. This map would assist the law enforcers' who are authorized to carry out investigation and patrol on bars and pubs more effectively. Moreover, a map showing bars and pubs within a distance of 300m from schools was also generated. In addition, the optimal routes analyses done also assisted in determination of the shopping centres which are supposed to be inspected by police officers from each police post in the region. This would assist in ensuring that effective patrol is carried out in Karima location as a result of proper coordination between police officers in the two police posts. Last but not the least, the suitable sites for bars operations was determined based on consideration of distances to schools as well as distances to shopping centres.

## 7. Recommendations

NACADA and other enforcers' of the Alcoholic Drinks Control Act are recommended to employ GIS technology and its products such as maps and its querying capabilities to assist them in the implementation of the Alcoholic Drinks Control Act. This is because, GIS can handle large amount of spatial data that would significantly aids in determination of bars within 300m from schools. It is also recommended that people given the responsibility of licensing should utilize this technology when making decision on whether to issue or revoke retail licenses for bars. This should be done after taking into consideration the restriction provided by the Alcoholic Drinks Control Act i.e. no bar should be licensed when being operated within 300m from schools.

In addition, is further recommended that for a more superior result, is better to incorporate cadastral data so as to be in position to properly demarcate the boundaries of schools rather than using GPS points to represent school's compound.

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